

# New-Tech

---

## Magazine

---

### Europe

August  
2017

**18**

**IoT Testing  
- The Big  
Challenge Why,  
What & How**

**22**

**Fast track  
to improved  
power supply  
reliability**

**26**

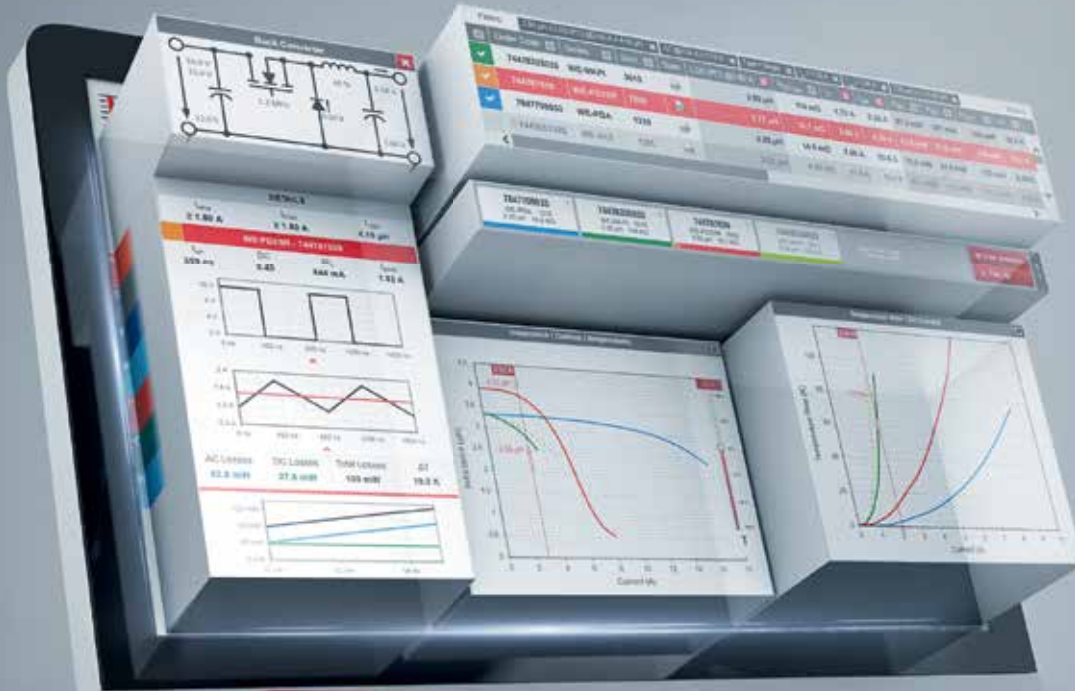
**Choose the Right  
Battery Fuel  
Gauge for Fast  
Time-to-Market  
and Maximum  
Run-Time**

**28**

**Smart Cities:  
How smart  
are our cities  
anyway?**



# REDEXPERT



# THE WORLD'S MOST ACCURATE AC LOSS MODEL

**REDEXPERT.** Würth Elektronik's online platform for simple component selection and performance simulation.

- The world's most accurate AC loss model
- Filter settings for over 20 electrical and mechanical parameters
- Inductor simulation and selection for DC/DC converters
- Ability to compare inductance/current and temperature rise/DC current using interactive measurement curves
- Available in seven languages
- Online platform based on measured values
- No login required
- Order free samples directly
- Direct access to product datasheets

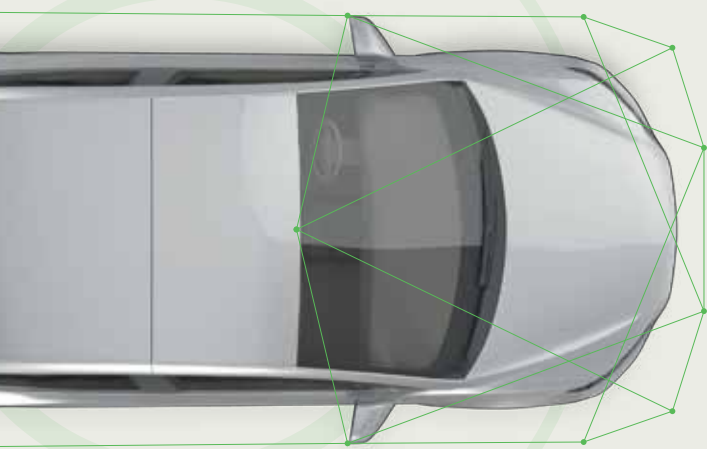
**#REDEXPERT**

*WE speed up  
the future*

[www.we-online.com/redexpert](http://www.we-online.com/redexpert)

WHEN SAFETY IS EVERYTHING,

THINK



ON.

**The world's #1 supplier of image sensors for active safety**

At ON Semiconductor, innovating is what we do. It's what we've always done. That's why more automotive engineers trust us for active safety and ADAS solutions than any other semiconductor company in the world. That's why we have more firsts in image sensing than any other company. We've built a proven reputation of reliability and credibility, so you know that our forward-thinking products are the safest in the industry. And we're just getting started. So when your customers' safety is riding on active-safety and ADAS innovations, Think ON.

For cutting-edge solutions, design tools, and resources, visit [onsemi.com/activesafety](http://onsemi.com/activesafety).

**ON Semiconductor®**





**HAND FLEX™**  
**CABLES**

Hand Flex Cables conform to any shape required.

**\$12<sup>95</sup>**  
 from ea. (qty.1-9) **DC to 18 GHz**

**Get the performance of semi-rigid cable, and the versatility of a flexible assembly.** Mini-Circuits Hand Flex cables offer the mechanical and electrical stability of semi-rigid cables, but they're easily shaped by hand to quickly form any configuration needed for your assembly, system, or test rack. Wherever they're used, the savings in time and materials really adds up!

**Excellent return loss, low insertion loss, DC-18 GHz.** Hand Flex cables deliver excellent return loss (33 dB typ. at 9 GHz for a 3-inch cable) and low insertion loss (0.2 dB typ. at 9 GHz for a 3-inch cable). Why waste time measuring and bending semi-rigid cables when you can easily install a Hand Flex interconnect?

**Two popular diameters to fit your needs.** Hand Flex cables are available in 0.086" and 0.141" diameters, with a tight turn radius of 6 or 8 mm, respectively. Choose from SMA, SMA Right-Angle, SMA Bulkhead, SMP Right-Angle Snap-On and N-Type connectors to support a wide variety of system configurations.

**Standard lengths in stock, custom models available.** Standard lengths from 3 to 50" are in stock for same-day shipping. You can even get a Designer's Kit, so you always have a few on hand. Custom lengths and right-angle models are also available by preorder. Check out our website for details, and simplify your high-frequency connections with Hand Flex!  RoHS compliant





AHEAD OF WHAT'S POSSIBLE™

**AHEAD OF WHAT'S  
POSSIBLE JUST GOT  
MORE POWERFUL.**

Analog Devices and Linear Technology have joined together to create an unparalleled innovation engine and strategic partner for our customers. Together, we will continue to challenge and extend the boundaries of what's possible – and enable your most impactful designs.

# ANALOG DEVICES + LINEAR TECHNOLOGY



MORE EXPERTISE, SOLUTIONS  
AND OPPORTUNITIES START HERE:  
[analog.com/linear](http://analog.com/linear)



#ADlahead

# Industrial Wireless Sensor Networking

## SmartMesh<sup>®</sup>



In a commercial building, factory, smart grid, industrial plant or for transportation, you need a wireless sensor network that performs in tough RF environments, in extreme environmental conditions, and operates reliably for many years. With over 50,000 customer networks in over 120 countries, SmartMesh is field-proven to deliver >99.999% data reliability and >10 year battery life. Customers trust SmartMesh to deliver their business-critical data and enable their Industrial IoT businesses.

### ▼ Features

- The Only Network Built for Industrial IoT
- Complete Networking Software Speeds Development
- Engineered for Years of Trouble-Free Operation

### Reliable Wireless Sensor Network Streamlines Manufacturing Operations



[video.linear.com/7254](http://video.linear.com/7254)

### ▼ Learn More

[www.linear.com/SmartMesh](http://www.linear.com/SmartMesh)

1-800-4-LINEAR

LT, LT, LTC, LTM, Linear Technology, the Linear logo, and  $\mu$ Module are registered trademarks of Analog Devices, Inc. All other trademarks are the property of their respective owners.



NOW PART OF



Find your local sales office: [www.linear.com/contact](http://www.linear.com/contact)

---

NI AWR DESIGN ENVIRONMENT

# SIMPLY SMARTER

FILTER DESIGN

---

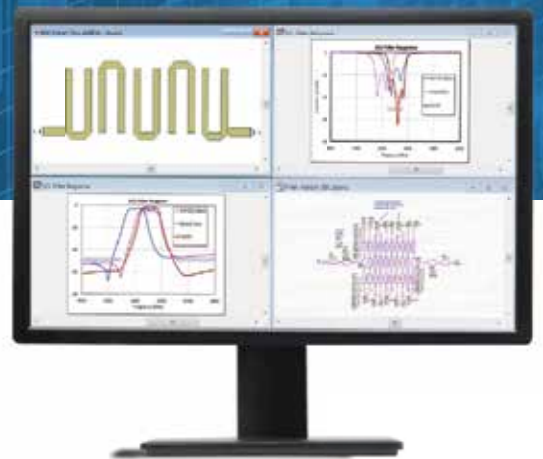
NI AWR Design Environment is one platform integrating system, circuit, and electromagnetic analysis that addresses all stages and types of filter development. From lumped-element or distributed filters to more complex multiplexed, high-power, and high-Q cavity filters, the software supports the latest materials and topologies, enabling filter designers to meet challenging performance metrics and size, cost, and time-to-market goals.

Simply smarter filter design.

---



Learn more at [awrcorp.com/il](http://awrcorp.com/il)



# New-Tech Europe

Read  
To  
Lead

August  
2017

**Editor:** Tomer Gur-Arie  
**COO & CFO:** Liat Gur-Arie  
**Journalist:**  
Amir Bar-Shalom  
**Technical journalist:**  
Arik Weinstein  
**U.S journalist:** Sigal Shahr  
**Graphic Design:** Hadas Vidmayer  
**Concept design:** Maya Cohen  
mayaco@gmail.com  
**Technical counselor:**  
Arik Weinstein  
**Sales and advertising:**  
sales@new-techmagazine.com  
**Account Manager:** Yael Koffer Rokban  
**Account Manager:** Rinat Zolty Meroz  
**Account Manager:** Irit Shilo  
**Account Manager:** Tatiana Yamin  
**Exhibition Department:**  
Yael Koffer Rokban  
**Data system:** Liat Tsarfati  
**Administrator & Exhibition  
Department:** Lihi Levi  
**Internal Sales Administrator:** Shirley  
Mayzlish  
**Editorial coordinator:** Chagit Hefetz  
**Editorial coordinator:**  
Shirley Mayzlish  
**Mail: Office:**  
info@new-techmagazine.com  
**Publisher:**  
NEW-TECH MAGAZINE GROUP LTD

## About New-Tech Magazines Group

'New-Tech Magazines' A world leader in publishing high-tech and electronics, producing top quality publications read by tens of thousands professionals from all over the world especially from Europe, innovative electronics, IoT, microwave, homeland security, aerospace, automotive and technological industries.

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.

[www.new-techeurope.com](http://www.new-techeurope.com)



# Contents

<b>10</b>	<b>LATEST NEWS</b>
<b>18</b>	IoT Testing - The Big Challenge Why, What & How
<b>22</b>	Fast track to improved power supply reliability
<b>26</b>	Choose the Right Battery Fuel Gauge for Fast Time-to-Market and Maximum Run-Time
<b>28</b>	Smart Cities: How smart are our cities anyway?
<b>32</b>	Testing MIPI interfaces with an oscilloscope
<b>38</b>	Crystal clear choice for displays
<b>42</b>	High Directivity Couplers Isolate Upstream/ Downstream Paths in Full Duplex DOCSIS® 3.1 Systems
<b>44</b>	RF transceivers provide breakthrough SWaP solutions for defense and aerospace applications
<b>48</b>	reVISION Stack: Accelerating your Embedded Vision development
<b>52</b>	Hints and tips on the use of cooling fans for power supplies
<b>56</b>	Considering EMC Emissions Early in the Design Process
<b>60</b>	Interline Transfer EMCCD Technology Enables a New Regime of Very Low Light Imaging
	<b>AEROSPACE Special Edition</b>
<b>62</b>	VxWorks 653 Multi-core Edition Update: Why COTS Certification Evidence Matters
	<b>INNOVATION &amp; START-UP Special Edition</b>
<b>64</b>	The Cloud Comes to You: AT&T to Power Self-Driving Cars, AR/VR and other Future 5G Applications Through Edge Computing
<b>66</b>	<b>OUT OF THE BOX</b>
<b>68</b>	<b>New Products</b>
<b>82</b>	<b>Advertisers index</b>





# Latest News

## Trillium Announces Acquisition of CanBusHack, Inc.

Trillium Inc, a leading automotive cybersecurity solutions provider, today announced its acquisition of the assets of cybersecurity consulting firm CanBusHack, Inc. Established in 2010, CanBusHack is the oldest automotive cybersecurity consulting and penetration testing company in the world. It is widely recognized as an industry leader thanks to its broad portfolio of successful projects with major OEM and Tier1 customers

around the world. Trillium made the announcement during the annual DEF CON hacker convention, being held at Caesars Palace in Las Vegas, Nevada, from July 27 – 30. Trillium’s automotive cybersecurity technology is under attack in the Car Hacking Village by the hacker community, who were offered the challenge of compromising Trillium’s BrainBOX and SecureCAR Server platform — as part of the Car Hacking Village’s “Capture the Flag” competition. (<https://dc25.chvctf.com>)

“The addition of CanBusHack’s Red Team and penetration testing expertise is a perfect fit for Trillium, and adds to our already robust range of cybersecurity products, services and training capabilities,” says Trillium President and CEO, David M. Uze. “Now, in addition to providing customers with tools and systems to ward off cyber-attacks, we can also help identify weaknesses early to reduce network vulnerabilities prior to commercial system deployment.”

The combination of CanBusHack’s sophisticated “Red Team”



and Trillium’s advanced “Blue Team” expertise is expected to deliver a 100% IP accretive environment for developing advanced vehicular cybersecurity systems.

As a result of the acquisition, CanBusHack President and Founder Robert Leale will join Trillium as its Global Consulting Practice Director, and be deeply involved with Trillium’s cybersecurity product development

roadmap. He will also assume responsibility for building Trillium’s worldwide capabilities in cybersecurity consulting and penetration testing.

Mr. Leale and his team will proactively work with Trillium’s IoT and automotive customers on an on-going basis to identify and prevent “Zero-Day” exploits, ensuring that Trillium’s customers remain among the safest on the planet. “I’m thrilled about this opportunity to join Trillium’s world-class team and contribute to making it the global leader in automotive IoT penetration testing and vehicular cybersecurity consulting,” said Mr. Leale.

Trillium at DEF CON

Meet Trillium at DEF CON in the Car Hacking Village, where professional and hobbyist car hackers will work together to provide hands-on, interactive car hacking learning, talks and interactive contests. Trillium will be offering private demonstrations by appointment in its suite at Caesars Palace.

## Aalto-1 satellite sends first image the camera developed by VTT

Launched on the morning of 23 June from India, the Aalto-1 satellite’s first month in space has gone according to plan.


‘We have run checks on the majority of the satellite’s systems and found that the devices are fully functional,’ Aalto University’s Professor Jaan Praks, who is heading the satellite project, explains.

‘We have also downloaded the first image sent by Aalto-1, which is also the first ever image taken from a Finnish satellite. It was



taken while on orbit over Norway at an altitude of about 500 kilometres. The image shows the Danish coast as well as a portion of the Norwegian coastline.

The photograph was taken by the secondary camera for the VTT-developed hyperspectral camera. The secondary camera faces the same direction as the main hyperspectral

camera, but it has a slightly broader view angle to support, the analysis of the hyperspectral camera’s images. 



# Latest News

→ 'On the basis of this first image, the system works as planned. The main hyperspectral camera will be tested later this week,' Research Scientist Antti Näsilä from VTT says. Unlike traditional cameras, which measure three colours, the hyperspectral camera is able to measure dozens of freely selected narrow color channels. For this reason, it can be utilised for example in surveying forest types, algae and vegetation and as a tool in geological research.

The Aalto-1 satellite is also carrying a radiation monitor jointly constructed by the Universities of Helsinki and Turku and a Plasma Brake built by the Finnish Meteorological Institute. When the time comes, the brake will allow the satellite to slow down and fall into the Earth's atmosphere where it will burn to dust, ensuring that it will not be left behind as space debris.

'The plasma brake has naturally not been tested yet. However, we have used the radiation monitor to measure an area of high radiation called the South Atlantic Anomaly,' Petri Niemelä Manager of the Otaniemi base station, which is overseeing the operations of the satellite, explains.

## A year of measurements

Jaan Praks emphasises that although the functionality of the technology has been demonstrated, the satellite mission itself is only in its early stages. The plan is to collect data and images over the course of several months or even an entire year. The mission schedule also includes stabilising of the satellite's attitude.

'Until now, we have allowed the satellite to slowly tumble as this is ideal with regard to spacecraft temperature management. So far, the satellite's internal temperature has remained wonderfully between zero and 25 Celsius for the duration of its mission, alternating according to whether the satellite has been in shade or light.'

From Aalto University's and Finland's perspectives space research prospects are bright. Nanosatellites developed by numerous start-ups as well as a third Aalto satellite, i.e. the Suomi 100, are to be launched into space this year.

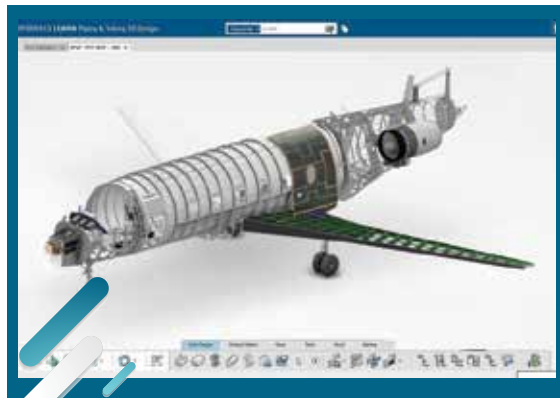
'Finland now has the opportunity to register its first space device in the UN's international Register of Objects Launched into Outer Space,' Mr Praks notes.

## Boeing and Dassault Systèmes Announce Extended Partnership

Dassault Systèmes (Euronext Paris: #13065, DSY.PA) and Boeing have extended their partnership. Boeing will expand its deployment of Dassault Systèmes' products across its commercial aviation, space and defense programs to include the Dassault Systèmes 3DEXPERIENCE platform.

This decision follows a competitive process that included the rigorous analysis of technical and functional capabilities, cost and business benefits across the value chain. Boeing will deploy the 3DEXPERIENCE platform in phases and rely on Winning Program, Co-Design to Target, Ready for Rate, Build to Operate and License to Fly industry solution experiences for aerospace and defense to deepen its end to end digital collaboration, design, engineering, analysis, manufacturing planning and shop floor execution capabilities throughout the enterprise.

'Dassault Systèmes is proud to collaborate with Boeing as it embarks on another century of innovation with a partner it trusts. Boeing not only leads the way in its own industry,



but influences the progress of all industries across modern society," said Bernard Charlès, Vice Chairman and CEO, Dassault Systèmes. "We are at the turning point of the industrial era, where we are shattering another industry paradigm. The parallel exchange of data between virtual and real operations will transform the value-adding chain into a value creation chain. The entire 'extended'

enterprise can continuously measure and control business processes for maximum efficiency and potential top line growth. This is 'Business in the Age of Experience.'"

The 3DEXPERIENCE platform can reduce integration and support costs, improve productivity, foster new innovation, and aid in the introduction of best practice processes to deliver standard work across the value chain. The 3DEXPERIENCE platform can not only simulate products and processes, but also find and eliminate potential risks and quality issues before production. The platform's single source of data across all applications will provide →



# Latest News

→ reliable and actionable real-time information and seamless communication throughout the entire enterprise and supply chain as well as across product generations. This digital continuity will improve data and analytics capabilities.

"The decision to adopt Dassault Systèmes' 3DEXPERIENCE platform is a key milestone in our digital transformation. This

digital enabler provides global design and manufacturing capabilities that will fuel our second century," said Ted Colbert, Chief Information Officer and Senior Vice President of Information Technology & Data Analytics, Boeing. "The value of this extended strategic partnership is a mutual desire to transform how Boeing connects, protects, explores and inspires the world."

## ABB wins 30 million USD order to support integration of offshore wind energy in the UK

ABB's Static Compensation SVC Light® technology to enable voltage stabilization and enhanced power quality for East Anglia ONE windfarm.

ABB has won a \$30 million order from ScottishPower Renewables to supply two SVC Light® Static Compensators (STATCOMs) that will smooth out the voltage fluctuations that are an inherent feature of intermittent wind energy. They will

increase power transfer capability, improve power quality and enhance grid stability, enabling more energy efficient and reliable power supplies for millions of consumers. The order was booked in the second quarter of 2017.

The UK government has set a target to meet 15 percent of its energy needs from renewable sources by 2020. Contributing to this goal, the East Anglia ONE project is expected to provide in total, 714 megawatts (MW) of renewable wind energy from 102 wind turbines to meet the needs of over 500,000 homes. The offshore wind farm is located approximately 43 kilometres (km) off the Suffolk Coast in the southern North Sea.

STATCOM is part of ABB's family of FACTS (Flexible Alternating Current Transmission Systems) technologies that help reduce losses, enhance the capacity and flexibility of power transmission systems and contribute to more efficient and reliable grids. As the technology pioneer and market leader, ABB has delivered more than 800 FACTS installations around the world. Acting as the brain of the STATCOM, is the ABB Ability™ MACH system which monitors, controls and protects the sophisticated technology in the station,



managing thousands of operations to ensure power reliability and efficiency.

Two advanced ABB TrafoStar™ Autotransformers will be incorporated in the STATCOM system. These compact and low weight transformers are ideal for this type of application as they combine the functionality of two transformers in one, while boosting

energy efficiency by significantly reducing the total losses. "ABB's advanced STATCOM and transformer technologies will not only help stabilize voltage fluctuations and enhance power capacity but also improve the quality and reliability of renewable wind energy supplies to millions of people," said Patrick Fragman, head of ABB's Grid Integration business, a part of the company's Power Grids division. "Renewables and power quality are both key focus areas of our next level strategy and such technology solutions reinforce our position as a partner of choice for enabling a stronger, smarter and greener grid."

ABB (ABBN: SIX Swiss Ex) is a pioneering technology leader in electrification products, robotics and motion, industrial automation and power grids, serving customers in utilities, industry and transport & infrastructure globally. Continuing more than a 125-year history of innovation, ABB today is writing the future of industrial digitalization and driving the Energy and Fourth Industrial Revolutions. ABB operates in more than 100 countries with about 132,000 employees.



## Nexperia supports Engineers of the Future with sponsorship of University Robotics & AI team

Nexperia, the former Standard Products division of NXP, today announced that it is proud to be the main industry sponsor for the University of Twente's RoboTeam, a multidisciplinary student group that aspires to innovate in both robotics and artificial intelligence. One channel that the team is using to achieve this ambition is by competing in RoboCup 2017, the world championship of robot soccer in Japan (July 25-31). <http://www.robocup.org/>. RoboTeam Twente will participate in the Small Size League, which focuses mainly on artificial intelligence.

Nexperia supports the team both financially and with products and technical support. "It is important for Nexperia to sponsor RoboTeam Twente as we believe we



must facilitate the engineers of the future and at the same time be inspired and triggered by their innovations and ideas", said Gerton Jansen, SVP Marketing and Sales Nexperia. "It is a win-win situation: RoboTeam Twente will take part in the Small Size League – you could say we fulfill a similar role as the industry leader miniature packaging."

Added Jim Hoekstra, Software & External Relations: "We are very grateful to be sponsored by Nexperia, especially since we share common philosophies concerning efficiency, miniaturization, quality and innovation. We are looking forward to a highly-fruitful cooperation with Nexperia, which has begun very well with the immediate delivery of products straight after our agreement was signed."

## BAE Systems expands teaming in Italy for highly mobile armored vehicle


BAE Systems has signed an agreement with the Goriziane Group SpA, an Italian company that specializes in the engineering and maintenance of vehicles and other heavy equipment, to support the BvS10, the latest generation of highly mobile and widely used armored vehicles.

The agreement significantly builds on BAE Systems' current relationship with Goriziane Group in support of the BV206, and calls for joint marketing and sales of the BvS10. The BvS10 is combat proven and designed to operate in difficult terrain while offering fully amphibious capability for littoral operations, making it capable of accessing some of the world's most remote regions. The BvS10 is in service with an ever increasing number of European Union and NATO countries.



"Our new, extended agreement with Goriziane Group further demonstrates BAE Systems' commitment to work closely with industries in the countries we do business in to support government programs and local economies," said Tommy Gustafsson-Rask, general manager of BAE Systems Hagglunds, which produces

the BvS10, as well the CV90 Infantry Fighting Vehicle, in Ornskoldsvik, Sweden. "Goriziane Group's excellent record of producing high quality work has made it a trusted partner for years."

The BvS10 is the successor to the legacy BV206 all-terrain vehicle. More than 11,000 BV206s have operated in more than 40 countries over the last few decades. The Italian military is one of the largest users of the BV206 and 



# Latest News

➔ BV206S vehicles. Leveraging the BV206's venerable design, the BvS10 offers improved mobility, better soldier protection, and lower life-cycle costs, leaving it well suited for the Italian Armed Forces' mission profile. "We are pleased with the latest agreement with BAE Systems and see tremendous potential for the BvS10 in

Italy, and we will continue to perform the services we provide at the highest possible level," said Massimo Zanin, president of Goriziane Group.

Countries under contract to receive or are already operating the BvS10 include Austria, France, the Netherlands, Sweden, and the United Kingdom.

## 3D imaging of surface chemistry in confinement

EPFL researchers have developed an optical imaging tool to visualize surface chemistry in real time. They imaged the interfacial chemistry in the microscopically confined geometry of a simple glass micro-capillary. The glass is covered with hydroxyl (-OH) groups that can lose a proton – a much-studied chemical reaction that is important in geology, chemistry and technology. A 100-micron long capillary displayed a remarkable spread in surface OH bond dissociation constant of a factor of a billion. The research has been published in *Science*.

Geological, catalytic, biological and chemical processes are driven by surface chemical heterogeneities, electrostatic fields and flow. To understand these processes and to enable the further development of new materials and microtechnology, researchers at EPFL's Laboratory for Fundamental BioPhotonics (LBP) have designed a microscope that can track, in real time, three-dimensional spatial changes in the molecular structure and chemistry of confined systems, such as curved surfaces and pores. The microscope was used to image the surface chemical structure of the inside of a glass microcapillary. Surface potential maps were constructed from the millisecond images, and the chemical reaction constant of each 188nm-wide pixel was determined. Surprisingly, this very simple system – which is used in many devices – displayed a remarkable spread in surface heterogeneity. The researchers' findings have been published in *Science*. Their method will be a boon for understanding fundamental (electro)chemical, geological and catalytic processes and for building new devices.

### Second-harmonic imaging

Sylvie Roke, director of the Julia Jacobi Chair of Photomedicine at EPFL, has developed a unique set of optical tools to study water and aqueous interfaces on the nanoscale. She uses



second-harmonic and sum-frequency generation, which are optical processes in which two photons of a certain color are converted into a new color. "The second-harmonic process involves 1000 nm femtosecond photons – that is, 0.0000000000001-second bursts of light – being converted into 500 nm

photons, and this occurs only at interfaces," says Roke. "It is therefore ideal for interfacial microscopy. Unfortunately, the process is very inefficient. But by using a number of optical tricks, such as wide field imaging and light shaping, we were able to enhance both the imaging throughput and the resolution, bringing the time to record an image down from minutes to 250 milliseconds."

### Surprising surface chemistry

The researchers then imaged the deprotonation reaction of the inner silica capillary/water interface in real time. Silica is one of the most abundant minerals on earth, and its interaction with water shapes our climate and environment. Although many researchers have characterized the properties of the silica/water interface, there is no consensus on its chemical reactivity. Roke continues: "Our data shows why there is a remarkable spread in surface reactivity, even on a very small portion of a capillary. Our data will help in the development of theoretical models that are more effective at capturing this surprising complexity. In addition, our imaging method can be used for a wide variety of processes, such as for analyzing the real-time functioning of a fuel cell, or for seeing which structural facet of a mineral is most chemically active. We could also gain more insight into nanochannels and both artificial and natural pores.



# Latest News

## TTI achieves top marks in TDK's European Distribution Awards

TTI, Inc., a world leading specialist distributor of electronic components, has been honoured with a 'Senten Manten' European Distribution Award in gold from TDK Europe. This is the second consecutive year that TTI has received the top award in the International Volume Distributor category.

Senten Manten is a Japanese term that translates as 'perfect result' that is achieved with a score of 1000. TDK's annual assessment of distribution partners is scored rigorously on distributors' performance and collaboration with TDK in four categories: business performance, inventory management, contractual terms and operational excellence. To achieve an award, distributors must score at least 600/1000.

Commented Felix Corbett, Director, Supplier Marketing, TTI, Inc. in Europe: "We can only deliver the levels of service and support that our customers demand if we work in partnership



with our franchise suppliers. Therefore, we welcome any efforts to measure and improve our relationships. The TDK Senten Manten awards are achieved by stringent analysis of performance according to a strict framework of criteria. These results are very useful in building, maintaining and strengthening the fantastic co-operation we have with TDK. We are honoured to receive this award and thank TDK very much."

Added Dietmar Jaeger, head of the TDK's distribution business in Europe and Vice President of the Global Sales Distribution: "TTI has always been an outstanding performer in our distribution network. We share the same goal – to deliver the best possible value to our customers – which is an excellent basis for our partnership. We are delighted that TTI continues to achieve such high results in our awards program and thank every member of their team for their commitment, energy and expertise. "

## Intel Democratizes Deep Learning Application Development with Launch of Movidius Neural Compute Stick


Today, Intel launched the Movidius™ Neural Compute Stick, the world's first USB-based deep learning inference kit and self-contained artificial intelligence (AI) accelerator that delivers dedicated deep neural network processing capabilities to a wide range of host devices at the edge. Designed for product developers, researchers and makers, the Movidius Neural Compute Stick aims to reduce barriers to developing, tuning and deploying AI applications by delivering dedicated high-performance deep-neural network processing in a small form factor.

As more developers adopt advanced machine learning approaches to build innovative applications and solutions, Intel is committed to providing the most comprehensive set of development tools and resources to ensure developers are retooling for an AI-centric digital economy. Whether it is



training artificial neural networks on the Intel® Nervana™ cloud, optimizing for emerging workloads such as artificial intelligence, virtual and augmented reality, and automated driving with Intel® Xeon® Scalable processors, or taking AI to the edge with Movidius vision processing unit (VPU) technology, Intel offers a comprehensive AI

portfolio of tools, training and deployment options for the next generation of AI-powered products and services.

"The Myriad 2 VPU housed inside the Movidius Neural Compute Stick provides powerful, yet efficient performance – more than 100 gigaflops of performance within a 1W power envelope – to run real-time deep neural networks directly from the device," said Remi El-Ouazzane, vice president and general manager of Movidius, an Intel company. "This enables a wide range of AI applications to be deployed offline." 



# Latest News

➔ Machine intelligence development is fundamentally composed of two stages: (1) training an algorithm on large sets of sample data via modern machine learning techniques and (2) running the algorithm in an end-application that needs to interpret real-world data. This second stage is referred to as “inference,” and performing inference at the edge – or natively inside the device – brings numerous benefits in terms of latency, power consumption and privacy:

**Compile:** Automatically convert a trained Caffe-based convolutional neural network (CNN) into an embedded neural network optimized to run on the onboard Movidius Myriad 2 VPU.

**Tune:** Layer-by-layer performance metrics for both industry-standard and custom-designed neural networks enable

effective tuning for optimal real-world performance at ultra-low power. Validation scripts allow developers to compare the accuracy of the optimized model on the device to the original PC-based model.

**Accelerate:** Unique to Movidius Neural Compute Stick, the device can behave as a discrete neural network accelerator by adding dedicated deep learning inference capabilities to existing computing platforms for improved performance and power efficiency.

Movidius Neural Compute Stick is now available for purchase through select distributors for MSRP \$79 and at the conference on Computer Vision and Pattern Recognition (CVPR) in Honolulu, Hawaii, from July 22-25.

## NAO sets out to conquer new markets with the Zora solution

PARIS, JULY 20 2017 SoftBank Robotics and Zora Bots have just signed a major partnership aimed at reaching a wider audience for the humanoid robot NAO. Zora Bots, which has already deployed its software designed for robots in the health sector, is now the world's leading distributor of NAO and is poised to expand its solution in many areas including retail, hospitality, education (STEM skills) and personal services.

This strategic rapprochement in the international arena will bring humanoid robotics into a new dimension and make NAO available to a wider audience. Every day, the humanoid robot created by SoftBank Robotics and equipped with the Zora® solution is already working alongside healthcare teams, performing various feats and providing new kinds of support throughout the world. In hospitals, treatment centres, nursing homes and care centres, this small robot just under 58 cm tall has been adopted as a working tool that makes it possible to improve patient care significantly.

Today, SoftBank Robotics and Zora Bots have reached an agreement to expand their partnership. Designed and developed to universalise the use of humanoid robots, the Zora® solution will now be available worldwide, facilitating the use of NAO in a considerable number of domains.

“Humanoid robotics is entering a new dimension,” explain



Fabrice Goffin and Tommy Deblieck, joint managing directors of Zora Bots. “Our first years of operation have allowed us to continually test and improve the way NAO is used on a day to day basis. Today, with the Zora® solution, NAO is set to conquer new areas.”

Over 10,000 NAO have already been sold in almost 70 countries. This strategic rapprochement between the two companies should

make it possible for NAO to attract an even wider audience. In retail, hospitality, education and other sectors, NAO equipped with the Zora® solution is the ideal companion for carrying out repetitive tasks such as reception services, providing information (product/services catalogues, school exercises, events agendas) and leading activities. It is also perfect for offering opportunities for interaction unique to all individual user groups such as clients, students and colleagues.

“Our vision has always been to create a solution that would allow everyone, regardless of whether they are adept at using new technologies, to imagine their profession and their everyday life differently through the intuitive use of an undeniably versatile and likeable robot,” add Zora Bots’ directors.” With SoftBank Robotics, we share this vision that every day, robots can assist man rather than replace him”.





# Latest News

## Rohde & Schwarz and MediaTek present world's first test solution for A-BeiDou location based services (LBS)

**Rohde & Schwarz and MediaTek have successfully completed the verification of location based services (LBS) in the U-plane and C-plane for A BeiDou, the new GNSS satellite positioning system from China. The R&S TS-LBS test solution allows mobile manufacturers, chipset manufacturers, test houses and network operators to verify chipsets and mobile devices in order to obtain permission to operate them in a particular network.**



The successful A-BeiDou verification of the MediaTek device under test (DUT) using the Rohde & Schwarz test system marks an important milestone in the GNSS evolution of positioning and navigation. It was the first time that the setup could be used to validate and verify a device for A-BeiDou location based services.

The R&S TS-LBS from Rohde & Schwarz is a test system for testing GNSS and network-based LBS. It consists of an R&S CMW500 as the base station simulator and an R&S SMBV100A GNSS simulator. The R&S CMW500 provides assistance data to the DUT and the R&S SMBV100A simulates the BeiDou satellites. The R&S TS-LBS test system can be used to obtain GCF and PTCRB certification as well as network operator specific

certification for chip sets and mobile devices. Alexander Pabst, Vice President Systems and Projects within the Rohde & Schwarz Test & Measurement Division, says: "We are delighted to collaborate with MediaTek and to contribute our test and measurement expertise to the development of A-BeiDou location based services. Rohde & Schwarz already has a strong global footprint with testing solutions for A-GNSS, such as A-GPS or A-Glonass, and for OTDOA/eCID. Thanks to

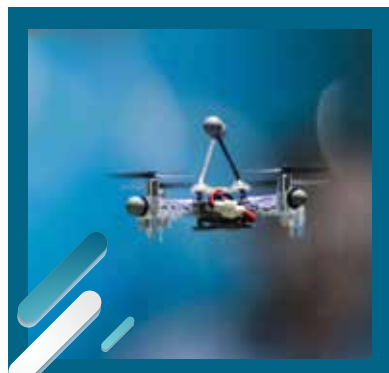
our close cooperation with our partners, Rohde & Schwarz is committed to accompanying the evolution from existing to new satellite systems such as A-BeiDou with our innovative test and measurement solutions."

TL Lee, General Manager of the Wireless Communications Business Unit at MediaTek, says: "MediaTek is committed to developing and testing the latest mobile technologies and standards to drive the industry forward. We have worked closely with Rohde & Schwarz to develop and validate the test solution for A-BeiDou LBS, verifying the A-BeiDou proof-of-concept trial system based on the R&S TS-LBS and MediaTek DUT. This represents an exciting step forward in the evolution of LBS technology, enabling the mobile ecosystem to verify chipsets and mobile devices on the new LBS technology."

## Ericsson Garage launches Startup Challenge 2017

As part of the STHLM Tech Fest taking place September 4-5, Ericsson is offering entrepreneurs an opportunity to be considered for a venture capital investment and technology incubation through the Ericsson Garage global network. Submit your application before August 23.

Ericsson Garage is an in-house incubator that explores opportunities to develop tangible prototypes in new areas together with partners. Now, Ericsson Garage is collaborating with Capital A Partners (CAP A), and their Nordic partner seed fund, Butterfly Ventures, to launch the



Startup Challenge 2017. The competition is a chance for entrepreneurs to win technology incubation with the global network of Ericsson Garages, unlimited access to a smart city testbed and an express pass to a final decision investment meeting.

Applications will be accepted from July 24 until August 23 and finalists will face a 'Dragon's Den' of Tanya Marvin Horowitz, co-founder and managing partner, CAP A Partner, Butterfly Ventures, Börje Ekholm, President and CEO of Ericsson and Ville Heikkinen, Partner, Butterfly Ventures.



# IoT Testing - The Big Challenge Why, What & How

› Benny Sand, VP Knowledge & Innovation, QualiTest Group

Abstract. “Internet of Things” (IoT) is the network or associations between those Internets connected objects (smart Devices) that are able to exchange information by using an agreed method and data schema. The enormous amount of things, the communication protocols the combination between hardware and software ,the Big Data impact, a verity of protocols, lack of standards and the high level of the required SLA by the end users set up new and challenging bars regarding QA in general and testing in particular in the IoT scene. This article will highlight the challenges as well as address potential strategies and solutions.

Keywords: IoT Testing, Testing Assurance, DevOps Interoperability, Security, Validation, Protocols

## 1. Introduction

The Internet of Things (IoT) is a key enabling technology for digital and virtual technologies Apparently 3.5 Billion things were connected in 2014, and the figure is expected to rise to 25

Billion things by 2020.

The recent progress on Internet of Things deployments with the rise of Mobile culture have given a strong push to the IoT to be today’s considered as one of the most promising emerging technologies.

However the conceptual realization of Internet of Things is far from achieving a full deployment of converged IoT services and technology.

One of the key elements in the IoT go to market path is Interoperability. Interoperability can be generalized as the feature for providing seamless exchange of information to, for example, personalize services automatically, or simply exchanging information in a way that other systems can use it for improving performance, enable and create services, control operations and information processing.

## 2. IoT Challenges

Internet of Things enables the things/ objects in our environment to be active participants, i.e., they share information

with other objects and/or communicate over the networks (wired/wireless) often using the Internet Protocol (IP). Processing the IoT data enables to recognize events and changes in the surrounding environments and “things” can act and react autonomously. However, all these require heterogeneous objects to exchange information in an interoperable way to make their data and services accessible and interpretable by other objects and services.

The IoT is an emerging area that not only requires development of infrastructure and technologies but also deployment of new services capable of supporting multiple, scalable (cloud-based) and interoperable (multi-domain) applications in a verity of telecommunication protocols. The significant IoT problem to be challenged is the interoperability of the information and services.

IoT refers to objects (“things”) and the virtual representations of these objects on the Internet. It defines

how the things will be connected through the Internet and how those things “talk” amongst other things and communicate with other systems in order to expose their capabilities and functionalities “services”.

IoT is not only linking connected devices by using the Internet; it is also web-enabled data exchange in order to enable systems with more capacities to become “smart”. In other words, IoT aims to integrate the physical world with the virtual world by using the Internet as the medium to communicate and exchange information.

IoT is mainly supported by continuous progress in wireless sensors and actuator diversified networks and by manufacturing low cost and energy efficient hardware for sensor and device communications.

However, heterogeneity of underlying devices and communication technologies and interoperability in different layers, from communication and seamless integration of devices to interoperability of data generated by the IoT resources, is a challenge for expanding generic IoT solutions to a global scale.

Networking everyday objects to send and receive data has been received with as much hope and promise as it has worry and concern. Certainly, the day may come when your refrigerator automatically orders milk when you are running low, but a connected supply chain might just as likely be shut down by a security breach by malicious hackers.

### 3. IoT Testing challenges and Vision

Software testing helps in finalizing the software application or service against business and user requirements. It is very important to have good test coverage in order to test the software application completely and make it sure that it's performing well and as per the specifications. While determining the coverage the test cases should be designed well with maximum possibilities of finding the errors or bugs.

Today's connected world unifies

multiple company aspects, namely customer engagement channels, supply chains, interfacing devices and application touch points. Therefore Quality Assurance organizations need to assess their customer experience capabilities, as well as ensure the functionality of each individual application; introducing remarkable developments in quality, cost and agility.

Companies need to focus on the disruptive nature of digital technologies by paying close attention to customer experience-based testing. The key to successfully executing this new approach is to look for service offerings that feature an integrated test delivery platform, encompass omni-channel test automation frameworks, mobile testing strategies and crowd testing.

With the brilliance of a connected world, comes the necessary capability to provide more niche expertise closer to the customer and the realization that testing is a combination crowd testing in order to reflect real life conditions to ensure a delivery of top notch IoT services.

In a connected world, global companies realize that they need to organize their Quality Assurance and testing functions with a combination of centralized and decentralized approaches. A testing team tightly integrated into the product development process is vital for complex integrations and transformations pr in other words Agile will become the governing model and will implemented via DevOps platform. Moreover, companies need to ensure they define their own formula for success as one size does not fit all. It is vital that they look for a testing partner with a multi-layered test target operating approach, continuous delivery integration and outcome and output-based pricing models; all governed by a 24/7 real-time dashboard.

Companies need to stop the one-way upstream integration and align it with a downstream approach to create a new TestOps concept. In order to stay ahead of the game, companies need to drive efficiency through risk-based

analysis techniques, risk-based testing, test-driven development, integrated test delivery, and service virtualization. Understanding that security and performance testing is a top priority area; companies need to include multichannel and behavior driven testing models and approaches as well as focused platform migration testing. It is crucial to have strong links with test automation framework, connected world test strategies, end user performance analysis, and competition benchmarking capabilities.

In a connected world, it is vital for applications to be tested on numerous operating systems and devices in different geographies; such ample testing cannot be done on premise, it must be done in the cloud. This is why it is important to ensure your testing partner has access to the best possible testing environments that leverage all necessary services.

In a connected world, competition is rapidly increasing, so companies need to closely examine thesetrends and ensure they are following the right steps to enrich their test methodologies. Implementing the right testing practices will allow companies to seamlessly manage the complexity and scale that IoT presents.

### 4. The Interoperability impact in IoT

**4.1** The Interoperability ExFactor Interoperability is a major theme in the IoT scene; hence it impacts the testing lifecycle of Internet of things strategic and operational wise. Interoperability in IoT is compound as well as influenced form several elements which impact in a direct and indirect way on the implementation process The Technical Interoperability is usually associated with hardware/software components, systems and platforms that enable machine-to-machine communication to take place. This kind of interoperability is often centered on verity of communication protocols.

The Organizational Interoperability, as the name implies, is the ability

of organizations to effectively communicate and transfer (meaningful) data (information) even though they may be using a variety of different information systems over widely different infrastructures, possibly across different geographic regions and cultures. Organizational interoperability depends on successful technical, syntactical and semantic interoperability.

Needless to say those two things cannot interoperate if they do not implement the same set of services.

Therefore when specifications are including a broad range of options, this aspect could lead to serious interoperability challenges.

Solutions to overcome these aspects consist of definition clearly in clear requirements the full list options with all conditions. In the latter case, defining profile would help to truly check interoperability between two products in the same family or from different family if the feature checked belongs to the two groups.

#### 4.2 Methodologies for Interoperability testing in IoT

Interoperability testing involves testing whether a given software program or technology is compatible

with others and promotes cross-use functionality. This kind of testing is now important as many different kinds of technology are being built into architectures made up of many diverse parts, where seamless operation is critical for developing a user base.

The factors in interoperability testing include syntax and data format compatibility, sufficient physical and logical connection methods, and ease of use features. Software programs need to be able to route data back and forth without causing operational issues, losing data, or otherwise losing functionality. In order to facilitate this, each software component needs to recognize incoming data from other programs, handle the stresses of its role in architecture, and provide accessible, useful results.

Interoperability testing can be addressed in two main approaches for

testing:

The empiric approach of testing regroups several ways to do testing. Since this kind of testing is informal, they are generally carried out while coding. There is no set procedure for informal testing, and this is entirely up to the coder to implement without the need to submit the test reports. The coder feels confident that his code works as required and contains no obvious bugs.

Empiric approach for testing encompasses tests that are done while developing the product to identify bugs, as well as those that is done on the fly. The main advantages of the empiric testing methodology are the following:

Tests can be done very earlier while developing the products, allowing detecting errors/bugs in the earlier stage of the development, moreover the tests can be setup very quickly, without huge constraints such as having reports to prepare etc.

Having said that the above advantages can be canceled by the following drawbacks:

No ideas regarding the test coverage since there is no real test plan, part of the properties to be tested cannot be measured. Thus, errors/bugs may not be detected. Since these tests have been done informally, end users will have difficulty to trust the final product so the marketing and business demerger can be rather significant.

The methodological approach for testing generally encompasses different steps leading to the execution step where test suites are generated against products. These products can be at different degree of their development.

Three main steps can be seen in this approach: Abstract Test Suite (ATS) specification, Derivation of executable test, and Test execution and results' analysis.

The advantages of the methodological approach are the following: Improved test coverage due to a real consist methodology that monitors the whole processes while

maintaining KPI's, properties to be tested can be measured. Thus, it may help in determining more precisely how to cover important parts of the system and subsystems under test. By this way, it may reduce non-interoperability of the product at the end.

Moreover the methodological approach provides real added value to the market. As these tests have been done formally, end users will trust more easily the final product. In addition tests can be done very earlier in parallel with products' development, allowing detecting errors/bugs in the earlier stage of the development.

### 5. DevOps, TestOps & IoT

IoT implementation in intelligent corporate and residential IT networks poses unique challenges for DevOps as requirements apply well beyond the software development lifecycle and encompasses the complex quality assurance and robust back-end support phase.

Although IoT is largely consumer-driven, the technology is equally pervasive in corporate markets. In this context, DevOps engineers must address traceability and audit ability for all IoT firmware OS developments to ensure compliance success. Collaboration with hardware product specialists and vendors throughout the development process also ensures software robustness to enable streamlined integration with existing IT networks while avoiding vendor lock-in. The world's networking infrastructure with its finite capacity is reaching its limit as the number of IoT endpoints explodes. This in turn, drives interoperability, networking and connectivity issues impacting the wider IT network, whereas IoT development with a focus on network environments, protocols and standards can help eradicate these concerns. Given the scale of IoT production and deployment across the globe, maintaining a robust back-end architecture to automate testing and upgrades requires full visibility into the

development cycle as well as a single repository to track changes that follow a device rollout.

Interoperability issues emerge naturally when billions of 'dumb' devices interact with each other.

Developing for IoT with the API evolution in mind to expose unique functionalities of the hardware ensures easy rollout of upgrades in addressing integration, connectivity and interoperability issues that may arise down the line.

The performance and behavioral attributes of IoT hardware pose unique challenges for DevOps engineers who must test IoT software in complex real-world environments and use cases. For instance, weather conditions and durability of the hardware can impact software performance especially when the technology is designed for responding to environmental conditions, such as Web-connected automated fire alarms.

Quality assurance is inherently complex and specialized with the burden of architecture almost entirely falling on the back-end. With this service model, DevOps engineers can push updates frequently as the slow approval process of app stores doesn't hold for IoT software. The IoT ecosystem's vastness has also led to the unpredictability of application requirements for these devices. The understanding of IoT applications is therefore altered even after the launch, prompting significant updates regularly to incorporate the required changes. With the DevOps approach, these updates are directly pushed from the back-end with a continuous delivery service model.

## 6. Summary & Conclusions

The Internet of Things offers great potential for organizations and societies. A connected world where billions, or even trillions, of devices are connected to the Internet and as such can communicate with each other. If we manage to successfully develop the Internet of Things it will unlock a lot of value and the benefits of the

Internet of Things are enormous for organizations and societies. However, there are still some major challenges for the Internet of Things.

Organizations will be able to track their assets in real time, improve utilization of the assets to meet demand. They will be able to predict required maintenance without visiting remote. Monetization of expensive assets becomes easier for organization as the Internet of Things will enable operating expenditure instead of capital expenditure; meaning that users of certain assets are billed based on their actual usage, engine hours, and fuel load etc. instead of having to purchase expensive assets. In addition, devices that are connected to the Internet can receive software updates regularly, instead of replacing the asset thereby prolonging the life of the asset.

The overall challenges in interoperability is first to stabilize the foundation of the real world data services, ensuring technical interoperability from technologies to deliver mass of information and then complementary challenges are for the information to be understood and processed.

The complexity and the diversification embedded in the IoT processes raises many challenges to the Testing organizations in many aspects such as: planning, monitoring, controlling and execution.

The huge amount of things, processes, the big data and complex processes requires a comprehensive testing strategy which will oversee the "Big Picture".

Interoperability testing is a key motive in IoT testing since it addresses the endless amounts of sub systems and its related interactions.

A crucial step for successful integration in a digital world is to reduce test cycle time through the adoption of swift practices and a dynamic test engineering platform. This means fast, responsive QA and testing solutions integrated with agile development.

Choosing the right testing partner can mean the difference between success

and failure. Identifying the best practices ensures that products and applications are ready by deadlines and meet customer expectations; ensuring companies deliver defect-free products and services for a quantifiable return on investment.

Companies need to place a strong emphasis on specific cloud and virtualization solutions to create a solid test environment and to manage their cloud and virtualization strategies.

The DevOps approach should also address the disconnect between IT realities and management desires leading to interoperability and productivity concerns for enterprise customers.

The enormous amount of details demonstrated via the endless number of things, processes, sw, hw and SLA may lead to a comprehensive testing strategy which oversees and controls a unified testing life cycle.

Testing is a change agent in the IoT, it provides the natural link between Development and operation from the technological and cultural aspects.

## References

1. Vermisan, Ovidiu, Friess: Building the Hyperconnected Society, IoT Research and Innovation, Value chains, EcoSystems and Markets, RiverSide Publisher (2015)
2. Martín Serrano, Payam Barnaghi, Francois, Carrez Philippe Cousin, Ovidiu Vermesan: Peter Friess  
Internet of Things IoT Semantic Interoperability Research challenges best practices, Recommendation and next steps, European Research cluster on Internet of Things (2015)
3. Security call in Action, Preparing to the Internet of Things Accenture (2015)
4. D4.1 - Framework for studying existing IoT testing solutions (2013)
5. Internet of Things a Developer's mandate (2014)
6. TESDT Maturity Model Integration, TMMI Foundation (2012)
7. Certified Tester Foundation Level Extension Syllabus Agile Tester ISTQB (2014)
8. Tester Foundation Level Extension Syllabus Agile Tester ISTQB (2011)



## Fast track to improved power supply reliability

› **Janne Paananen, Technology Manager, Eaton**

**Martijn Imming, Business Development Manager Data Centers, Eaton**

### **Executive summary**

Businesses, hospitals and other mission-critical applications rely completely on the uninterrupted accessibility of their data center resource – and this, equally, depends crucially on the continuous availability of clean power, under all conditions, to every IT and communications device distributed around the data center site. Meeting this power reliability and resilience challenge calls for a power infrastructure as well-thought out and implemented as the data environment that it protects. While each subsystem, component and connection from the utility supply, Uninterruptible Power Supply (UPS) or generator to the load should be best in class and correctly specified

for its role, this alone is not sufficient. When choosing these key power components, designers must cater for their many aspects of mutual interdependence. For example, selectivity must be set up correctly, to ensure that a local equipment problem only shuts down a minimal part of the power network. Another example involves protection of inter-UPS communications, to prevent loss of multiple UPS synchronization. Additionally, systems must be designed for and resilient to unplanned events such as ageing hardware failures, overloads, short circuits, arcing and mistakes made during maintenance to avoid loss of availability, equipment damage or threat to personnel safety. This

White Paper discusses how to solve these issues. It looks at ways to design a UPS and power distribution system sufficiently reliable and resilient to support a mission critical data center load, yet proof against interdependence challenges and unscheduled events. While reviewing recommended solutions, it also shows the importance of this inclusive approach by outlining the consequences of failing to make these provisions. Overviews of relevant norms and standards are also given, providing an insight into current expectations of system performance and safety as well as common reference points for suppliers and users. This Paper does not provide in-depth design solutions. Rather, its intention is

to make readers aware of all the issues that must be considered and discussed with every party involved when planning a data center power system. The Paper also offers unique, practical hints and tips gained from Eaton's extensive experience in the field. When planning moves to a more detailed design stage, Eaton offers full support in the form of more in-depth documentation on every relevant topic, and industry experts who can advise on designing for all product, system and operation-related issues.

## Introduction

A data center's critical load is fed from a power distribution network comprising switchgear, overload and short-circuit protection devices, and cables from up to three sources: The incoming utility mains transformer, a standby generator and a UPS in either normal or battery mode. Not considering the different behavior of these power sources can cause unexpected load losses due to slow-acting protection mechanisms. Problem examples include voltage dips too long for a load to ride through, or voltage dips caused by short circuits. Accordingly, we start by examining the impact of the major power network and UPS components, interactions and relevant norms, and then look at fault conditions, operation and maintenance issues.

## 3- and 4-pole switching

A choice between 3- and 4-pole switching is necessary for each breaker. 4-pole switching is often necessary to prevent back feed and undesired ground links, yet neutral switching is not always appropriate. The choice has cost and space implications, but selecting the wrong pole number can create undesired ground links, causing

conductor overheating, dangerous voltage levels or a floating neutral – which could cause harmful over voltages or over currents that are detected.

## Use of 4-pole transfer switches and breakers

IEC60364 principles apply to installations in Europe. In earth referenced systems (TN-C, TN-S), system neutral must always remain earth referenced if multiple sources are used. This ensures proper operation and safe voltage levels in electrical installations, in combination with correct protective device functionality if earth faults occur.

4-pole transfer switches may be commonly accepted in systems without UPSs, though not recommended by IEC 60364.

In most European power distribution systems, the neutral has an earth reference at the power source. The requirement to follow IEC 60364 principles becomes crucial when UPS systems are used, due to the installation rather than the UPS. If the upstream neutral is separated from earth reference the electrical system behaves as a floating IT system without a return path for the earth fault. This results in a non-referenced, floating and unsafe distribution system.

## Breaker sizing

The actual critical load may be less than UPS nominal rating. The supplier can advise the maximum input current required to charge the batteries and support the maximum (design) critical load. Installations can also benefit from modern digital UPSs with many adjustable parameters and near-unity power factors. This considerably reduces maximum input current for a given UPS kVA rating and often renders traditional feeder selection criteria

as outdated.

This fit for purpose rating provides cost benefits for input switchgear, transformer and back-up generator sizing. Adjusting sizes and fault current levels yields some easy cost savings, yet this attractive approach is currently rarely used.

## Impact of a UPS in a power distribution system

Using a UPS in a power distribution system adds two power sources to the transformer and generator power which is usually considered; UPSs supply via the inverter or static bypass during normal operation, and battery operation via the inverter only. Each mode has distinct behavior.

Allowing correctly for these UPS behaviors is essential within mission-critical power systems. Possible consequences of not doing so include load loss during a short circuit, and extended repair time and a long period without power availability. Also, neglecting the UPS in a selectivity study could convert a branch fault into a SPoF (Single Point of Failure).

## Selectivity

To achieve proper selectivity in a critical power supply system including a UPS installation, the UPS system must be able to sustain fault current until the downstream load branch circuit protection devices can trip, otherwise a branch fault can kill the power to all the loads. This can be a challenge where scalability is wanted, as the initial configuration's static switch capacity may be insufficient. The required amount and duration of fault current depends on short circuit capacity, impedances and protection settings of the installation and should be studied as a whole.

Eaton UPSs' unique capability to mix and match power module (inverter) and static bypass capacity allows tailoring the UPS system to meet both the load rating and fault clearing requirements, with optimization for functionality and cost.

### **Backfeed protection**

Backfeed protection is required by UPS Safety Standard IEC 62040-1 – a legally enforceable European Normative - in UPS installations to ensure service personnel safety. The standard allows this protection to be internal to the UPS, or external, in the UPS supply panel. If relying on an external device, the responsibility for fulfilling the minimum legislative requirements lies with the electrical contractor, or owner of the installation, who may lack adequate knowledge of UPS equipment and installation requirements.

Eaton UPSs include factory-installed and tested internal backfeed protection devices; these ensure that safety requirements are fulfilled without needing action from the electrical contractor.

### **UPS withstand current rating (IEC 62040-1:2008 Amendment1:2013)**

Every switchgear and device used in the installation must be capable of safely managing its fault current levels. The product requirements are given in applicable standards, must be followed, and are typically enforced by legislation.

Since February 2016 it has been mandatory, by law, to follow the Amendment1:2013 for UPS Safety Standard requiring UPS manufacturers to declare either Rated short-time withstand current

(ICW) or Rated conditional short-circuit current (ICC) and to state the maximum allowed fault current level at the UPS input terminals. The equipment selected must have equal or higher rating than fault current levels in the installation and these values must not be exceeded under any conditions.

Present and possible future fault currents depend on site conditions, affect where the product can be sited, and are key factors in equipment choice – yet few people are aware of this significance.

When conditional ICC rating is used, the fault current is reduced by overload and short-circuit protection devices to a safe level for UPS internal circuits and components. In any case the standard allows this protection to be internal, or externally sited in the UPS supply panel.

If the UPS supplier relies on external protection, this requirement for UPS system safety lies with the installation and becomes the responsibility of the designer, electrical contractor and installation owner. These may lack the knowledge of product specific standards and requirements essential to ensure the protective devices stated by UPS supplier are used and never replaced with a device giving less protection and having higher let-thru energy.

Eaton UPSs have internal overload and short-circuit protection devices (SCPDs) and have been laboratory-tested at up to 100 kA fault current levels. These greatly exceed the standard's minimum requirements, suiting them for practically any installation without special requirements for the supply panel feeders used. This means less responsibility for designers and contractors, since Eaton manages product safety, and possible future

installation changes are less likely to be in the critical path.

### **Distributed controls**

Centralized controllers are considered as Single Points of Failure, as a problem within them can paralyze the whole system. They can also impact the reliability of, or limit, the concurrent maintenance strategy, impacting overall system availability and resiliency.

Eaton uses distributed control architecture where the parallel system single points of failure have been eliminated and load sharing is inherent, operating without communication or signals between units. With thousands of installations worldwide since 1998, this avoids master-slave arrangements and gives unique resilient paralleling of static inverters.

### **Fault conditions, operation and maintenance issues**

So far, this paper has examined the major power system components' specifications, and how they interact together. However, it is also important to consider the power network problems that can arise during the use of these components, their possible consequences and the options available to resolve and prevent them.

**Arc flashes**, which mostly occur during maintenance activities, can inflict considerable damage on both personnel and equipment. However, end-users and maintenance providers are not usually aware of arcs and their consequences, so do not specify arc reduction measures. Personal safety and reliability can be improved if the system builder sacrifices redundancies



during maintenance and otherwise minimizes arc flash possibilities. There are some norms to follow: Switchgear must be built to IEC 61439, and we are proud that all Eaton switchgear is verified by testing – the IEC’s most rigid verification method. However potential danger still exists, because the standard does not impose rules for switchgear open arc behavior. IEC/TR 61641 provides guidelines, but most end customers lack detailed awareness of this standard, and do not specify it.

Eaton’s switchgear uses arc-free design, as we believe that ‘prevention is better than cure’. We support this with further mitigation products and strategies:

**Arc Flash Reduction Maintenance System (ARMS)**, available with Eaton Magnum and NRX air circuit breakers (ACBs), is a tighter protection setting that reduces arc energy through accelerated tripping when people are working close to the switchgear.

**Arc detection systems** operate by ‘seeing’ the arc flash, preferably in combination with detecting a current surge. Current can be switched off within 100 ms of detection. **Arc killer Arcon** reduces equipment damage by reducing arc duration and energy – reducing arc times from 100-50 ms typically with protection settings only, to below 3 ms with Arcon.

**Internal separation in Low Voltage (LV) switchgear** LV switchgear has multiple functional units. The form of internal separation, as defined by IEC 61439-2, indicates how these functions are separated from one another.

No internal separation means that an entire switchgear unit must be disconnected before connecting a cable or performing any other modification. Increasing levels or forms of separation can reduce the

proportion of the board that must be de-energized for maintenance on a unit, but make the switchgear more complicated and expensive to build.

## Operational life and maintenance issues and solutions

LV switchgear is typically expected to operate for 20 years or more, with periods between inspections often extending to several months. If switchgear is neglected for long periods, a small problem like a bad connection can develop into a major failure.

**Monitoring** Eaton provides continuous predictive monitoring of switchgear and UPSs used in mission critical applications. This identifies and recognizes hotspot issues and problems before they become major failures, while providing insight into the state and availability of the switchgear. It also provides supervisory control and data acquisition systems log data.

**Maintenance induced errors** Total load loss maintenance errors can arise from incorrectly following predetermined sequences in operating breaker switches. The incidence of such errors can be significantly reduced, and power availability improved, with a well-designed key interlock system and a hardware handshake between UPSs and switchgear.

## Norms

It is important to be aware of and understand applicable IEC industry standards, as they define safe products and provide common points of reference. To avoid receiving equipment that is IEC-compliant and attractively priced, yet not fit for purpose, users should ensure that their suppliers not only build to relevant IEC standards,

but also work to mutually-agreed interpretations of those standards. UPS equipment suppliers are often the best source of knowledge about product related standards and norms, as well as upcoming changes or new requirements.

The new IEC 61439 series of international standards defines clear regulations for low-voltage switchgear and control gear assemblies. Annex BB.1 of IEC61439-2 provides a good overview of the agreement to be established between the assembly manufacturer and user for power switchgear and control gear assemblies.

## Conclusions

In this paper we have seen how the design, installation, use and maintenance of UPS and switchgear components impact power distribution system safety, performance and availability. The consequences of failing to follow good design guidelines and legislative requirements have been discussed.

The discussion makes it clear that consultation with an experienced, established supplier such as Eaton is essential in overcoming complex challenges and achieving guaranteed safety and reliability. Eaton’s expertise translates into equipment with built-in protection features that address key installation and legislative issues, relieving installers of many design responsibilities - including some that they may not even be aware of.

.....  
Visit our website [www.eaton.eu/datacenters](http://www.eaton.eu/datacenters) or contact us to access more detailed documentation on these topics, or to discuss your project requirements with one of our industry experts.



## Choose the Right Battery Fuel Gauge for Fast Time-to-Market and Maximum Run-Time

› **Nazzareno (Reno) Rossetti**, seasoned Analog and Power Management professional  
And **Bakul Damle**, Mobile Power Business Management Director at Maxim Integrated.

### Introduction

Wearable devices are driving an attractive and growing market, in which smart watches continue to hold a dominant position. Every manufacturer strives to be first-to-market in this very crowded and competitive environment, while consumers demand the most accurate and longest possible battery run-time for their devices (Figure 1). This article discusses these requirements as they relate to the critical function of managing battery capacity and presents a disruptive technology that overcomes the challenges.

### Time-to-Market Challenge

Optimal battery performance relies on a high-quality battery model that drives the fuel gauging algorithm. Taking the time to do this customized characterization work yields more accurate battery performance, minimizing state of charge (SOC) errors and correctly predicting when the battery is nearly empty.

The energy stored in the battery (capacity in mAh) is dependent upon several

parameters such as load and temperature. As a result, developers must characterize the battery under a variety of conditions. Once a model tuned to the battery behavior has been extracted, it is loaded into the fuel gauge chip. This closely supervised process results in safer battery charging and discharging.

Fuel gauge characterization presents both a time-to-market issue and a barrier to growth for manufacturers, due to the difficulty in serving any but the highest volume customers. IC vendors have traditionally focused on high-volume applications since extensive lab work is often required for model extraction and only a few IC manufacturers have the required resources.

### The Battery Run-Time Challenge

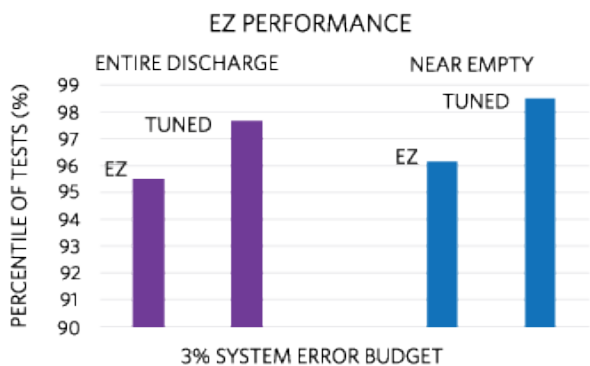
One important consequence of a poorly modeled battery is an inaccurate run-time estimate. A typical smart watch usage model includes 5 hours in an active state (including activities such

as time checks, notifications, app use, music playback, talk, and workout) and 19 hours in a passive state (time check only) over the course of a single day. If the device consumes 40mA in active mode and 4mA in passive mode over the course of a day, it will consume a total of 276mAh, which is just about the capacity of a typical smart watch battery. Accurate prediction of the battery run-time is necessary to avoid unexpected or premature interruptions of the device operation.

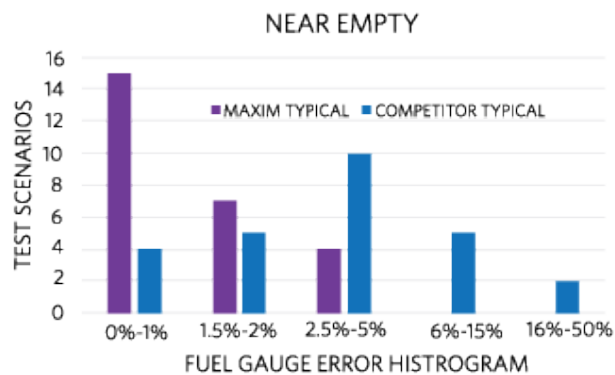
The run-time duration is equally important. In passive mode, the same battery can sustain up to 69 hours of operation (276mAh/4mA). A typical fuel gauge that consumes 50µA will shorten the battery passive run-time by about 52 minutes, which is not a negligible amount of time.

### The EZ Solution

Maxim Integrated has developed an algorithm to accurately estimate the battery state of charge and safely handle most



**Figure 2. EZ System Error Performance**



**Figure 3. System Error Competitive Analysis**

batteries. The algorithm was developed after studying the characteristics of common lithium batteries.

The ModelGauge™ m5 EZ algorithm (EZ, for short) uses a battery model tuned to a specific application and is embedded into the fuel gauge IC. Designers can generate battery models using a simple configuration wizard included in the evaluation kit software. The system designer needs to only provide three pieces of information:

- 1) Capacity (often found on the label or data sheet of the battery)
  - 2) Voltage per cell, considered the empty point for the battery (application dependent)
  - 3) Battery charge voltage (if it is above 4.275V)
- With EZ, the system designer no longer needs to perform characterization work, as it has essentially been done by the fuel gauge vendor.

Several adaptive mechanisms included in the EZ algorithm increase the fuel gauge accuracy even more by helping it learn about the battery characteristics. One such mechanism guarantees that the fuel gauge output converges to 0% as the cell voltage approaches empty. Thus, the fuel gauge reports 0% SOC at the exact time that the cell voltage reaches empty.

If we assume a system error budget of 3% in the SOC prediction, the EZ model passes 95.5% of the entire discharge test cases—very close to the performance of labor-intensive custom models that pass 97.7% of test cases. As shown in Figure 2, the EZ mechanism performs at about the same level of accuracy when the battery is near empty, which is where it matters most.

For many users, simply knowing the SOC or the remaining capacity is not enough. What they really want to know is how much run-time is left from the residual charge. Simplistic methods, such as dividing the remaining capacity by the present or future load, can lead to overly optimistic estimates. The EZ algorithm is able to provide a much more accurate time-to-empty prediction based on battery parameters, temperature, load effects, and the empty voltage of the application. With the EZ algorithm, high-volume manufacturers can use EZ as a starting point for quick development. Once they have a working prototype, a finely tuned battery model can be selected. The small-volume manufacturer can use EZ to model the best available battery, with the confidence that most batteries will be compatible.

#### 1-Cell Fuel Gauge with ModelGauge m5 EZ

The EZ algorithm is built into the MAX17055 stand-alone single cell pack, fuel gauge IC. With 0.7μA shutdown current, 7μA hibernate current and 18μA active supply current, the device is ideal for battery-operated wearable devices. The I2C interface provides access to data and control registers.

**System Error Competitive Analysis**  
Figure 3 shows a system error competitive analysis. This histogram illustrates that near empty, the MAX17055 delivers no more than 1% error in most test cases (15 out of 26), while the competitive device exhibits much higher error for the same set of tests.

### Run-time Accuracy Competitive Advantage

Low error near empty assures optimum utilization of the battery charge, maximizing run-time and minimizing unexpected or premature interruption of the device operation.

### Run-time Extension Competitive Advantage

Using a fuel gauge IC with a low quiescent current extends run-time. The MAX17055's 18μA quiescent current is 64% lower than that of the nearest competitive device. Further, in low power hibernate mode the device absorbs only 7μA. Applying it to the scenario discussed earlier, the run-time is reduced from 52 minutes down to 7 minutes—a substantial gain in performance.

### Conclusion

We have highlighted the critical importance of battery modeling in an effective fuel gauge system to maximize battery run-time accuracy and duration. We discussed the barriers to obtaining accurate battery models, which lengthen time-to-market and impede the proliferation of lower volume battery applications. A disruptive approach, based on the ModelGauge m5 EZ algorithm, embedded in MAX17055, makes battery system development faster, easier, more cost effective, and delivers better battery performance for a broad range of applications.



## Smart Cities: How smart are our cities anyway?

> Dan Chupek

**Every city wants to present itself as a smart city. Understandable because the word is reminiscent of innovative technology, progress and sustainability. Yet some realism is in place. Our cities are in fact not nearly as smart as we want.**

**The concept of smart cities is very promising. New technology, digital applications and Internet-connected devices transform the way we live and travel. Billions of sensors continuously collect data about our homes, roads and hospitals. With this information we can prevent all kinds of urban problems. Traffic congestion, pollution and waste of energy, therefore belong in the city of the future to the past. This all sounds wonderful, but how feasible is this utopia?**

### Definition of Smart City

We put this question to John Stokoe, smart city expert at Dassault Systèmes. Stokoe shares the enthusiasm, but also thinks we should be realistic about smart cities. According to him, the term is often incorrectly used.

"There are misunderstandings about the definition of a smart city," he begins. "The cities in the Netherlands, the United Kingdom and the Scandinavian countries I have studied, all are going more or less into the same direction. They choose a small part of the city and create a smart hub out of that.

"With smart they mean usually that they put sensors to measure activity," the expert explains. "For example at traffic lights and along roads to prevent traffic jams and other traffic suffering. Or in buildings, so no energy is wasted if no one is in a room. Also installing many cities security cameras to observe and monitor problem areas e.g. for crime or fires at an early stage. That's all very clever. But this makes a city in my eyes not really smart."



**Figure 1: Singapore: smart city project does not depend on a national government that divides the budget**



**Figure 2: Port of Rotterdam: Hardly any human work involved**

### Much more than sensors

"That's only true if the data from all the sensors are consolidated on a mutual platform that lets you see at a glance what is happening in the city and only on this basis decisions can be made," and Stokoe continues "Currently, we have isolated pieces of smart activities so-to-say and so it will remain for at least for the next 10 to 15 years. It takes a lot of time and money to lay the foundation and you must have a good plan. It makes no sense to connect indiscriminately sensors via a platform without knowing exactly what you want to do with that data." According to Stokoe an ideal smart city fulfill a number of basic conditions. "It must have a clear city boundaries. Where does the city cease? Are suburbs counting too? Secondly, there are measurable activities; otherwise you cannot organize them smarter. A third condition is structural funding by both the government and the private sector. A smart city is a long-term project, but cities do not usually decide how much budget is there. And industries only invest in profitable projects."



**Figure 3: Really Smart City: Data from all the sensors are consolidated on a platform that lets you see at a glance what is happening**

### Singapore as a blueprint

Actually, there is only one city that fits in this picture perfect: Singapore. "The borders are clear, because the city is bordered by the sea," said Stokoe. "Singapore has collected 15 years all sorts of data. And sufficient budget is available. Namely Singapore is a city state. So if the government of Singapore sets itself the goal to be a smart city in ten years from now, that is actually

feasible. To finance the smart city, the city does not depend on a national government that divides the budget."

Most European cities do not meet these conditions. It also does not help that they exist for centuries. There are historical buildings and the infrastructure is sometimes outdated. The city is only equipped with a modern layer and in the periphery are industrial estates and shopping malls. These features



**Figure 4: Billions of sensors continuously collect data about our homes, roads and hospitals**

make the realization of a European smart city complex and costly. Stokoe does not expect that our cities in every respect will be completely "in pain". "Unless you build a new urban area".

### Rotterdam Harbour

Stokoe finds the port of Rotterdam a fine example of an environment that is indeed quite smart. "That's really a smart port. In recent decades, the Port of Rotterdam has grown tremendously. I am impressed by the efficient way in which instance the container is managed today. Everything is going smoothly and there is hardly any human work involved. Those aspect towns also have. But the port of Rotterdam had also about 25 years to get at this current level."

The expert sees some towns with a lot of smart city-potential. He calls Amsterdam and Utrecht, Manchester and Bristol in England, the Australian Adelaide and Chinese cities like Shanghai and Beijing. "These cities are beginning to

recognize the value of data. How can we use data to improve our environment? Sustainability is always an important element: the use of green energy, recyclable materials and reducing greenhouse gas emissions. The Netherlands plays a pioneering role."

### Virtual twin city

But none of these cities have it as Singapore. Not for nothing Dassault Systèmes chose Singapore just for the ambitious 3DEXPERIENCE project. The company created in collaboration with the Singaporean government a hyper-realistic model of the city that is constantly fed with real-time data on population density, traffic, weather, energy consumption and recycling. Analyzing this dynamic digital 'twin city replica' helps policy makers to improve the quality of life. Now and in the future.

This model, moreover, goes much further than simply raw data about the city, designed in a visually appealing way. "You will not only

see how those individual issues look like, but also how they influence each other," said Stokoe. "Then it really delivers actionable insights. What happens in my town, what goes wrong and what can I do? The beauty is that this platform is evolving along with Singapore. When the project is completed, we have a simulation platform that is applicable to other cities or parts of it."

### Endless possibilities

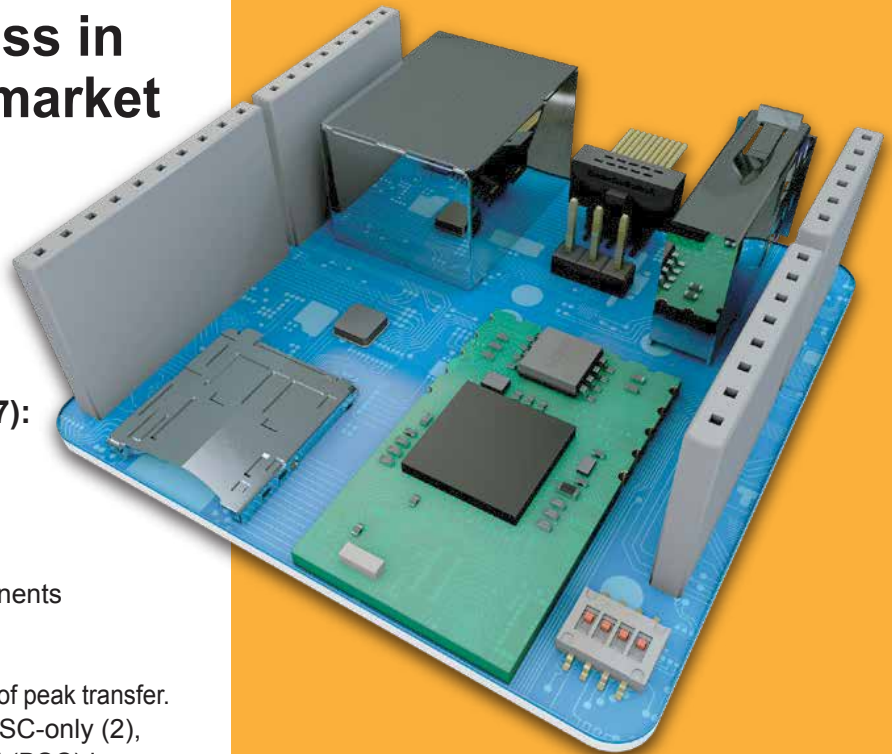
Apart from Singapore, we are still far from smart cities. But Stokoe radiates optimism. He points out that many applications are already within reach. "You can monitor traffic and manage, so people can quickly move from A to B. Patients and the elderly do not need to go to the hospital because you can monitor their health from home. Education is more accessible, because students can study at home. And also in the retail industry and energy sector much is already possible."

At the same time, the expert recognizes that there are new dangers lurking by collecting all that data. "The smarter our cities are the more important cyber security becomes. These two things go hand in hand. Ultimately, our security is still no. 1 priority. Let us therefore remain particularly rational about smart cities. The point is that smart technology makes our world truly better, more efficient and more sustainable. But without any targeted usage and only promoting how great and wonderful the smart city is, it will be nothing more than a phenomenon or a buzzword."



# THE ARROW QUADRO IoT Wi-Fi Kit

A faster route to success in  
the Internet of Things market



## Features (Based on Cypress CY43907):

### Application Processor Features

- ARM Cortex-R4 32-bit RISC processor.
- 1 MB of on-chip SRAM for code and data.
- An on-chip cryptography core
- 640 KB of ROM containing WICED SDK components such as RTOS and TCP/IP stack.
- 17 GPIOs supported.
- Q-SPI serial flash interface to support up to 40 Mbps of peak transfer.
- Support for UART (3), SPI or BSC master (2), BSC-only (2), and I2S (2) interfaces. (Broadcom Serial Control (BSC) is an I2C-compatible interface.)
- Dedicated fractional PLL for audio clock (MCLK) generation.
- USB 2.0 host and device modes.
- SDIO 3.0 host and device modes.

Powered by



[www.arrow.com/quadro](http://www.arrow.com/quadro)



## Testing MIPI interfaces with an oscilloscope

› Dr. Philipp Weigell is Product Manager for oscilloscopes at Rohde & Schwarz in Munich.

**Many components in modern smartphones communicate with each other via interfaces standardized by the MIPI Alliance. Developers can analyze signal integrity and data content on these interfaces with an oscilloscope. But you need a low-noise oscilloscope with a very high dynamic range and some relevant software tools.**

Each new generation of modern mobile phones enters the market with new features such as additional sensors, higher display resolutions and an extended range of equipment. The numerous components inside these devices communicate quickly and efficiently via common interfaces to offer smooth functionality. The most widely used standards for hardware and software interfaces in mobile phones are from the non-profit MIPI Alliance, which consists of more than 280 member companies. According to the MIPI Alliance, at least one of their standards is implemented in every modern smartphone and in about 90 % of all classic mobile phones. The MIPI standards, which are constantly evolving, are also used in tablets and digital cameras as well as products for the automotive and health care sector. Fig. 2 shows the current status.

The standard framework defines three physical layers: D-PHY, C-PHY and M-PHY (Fig. 3). These physical layers are optimized for high-speed (HS)

data transmission while maintaining low power (LP) consumption. This optimization places special demands on test equipment during development.

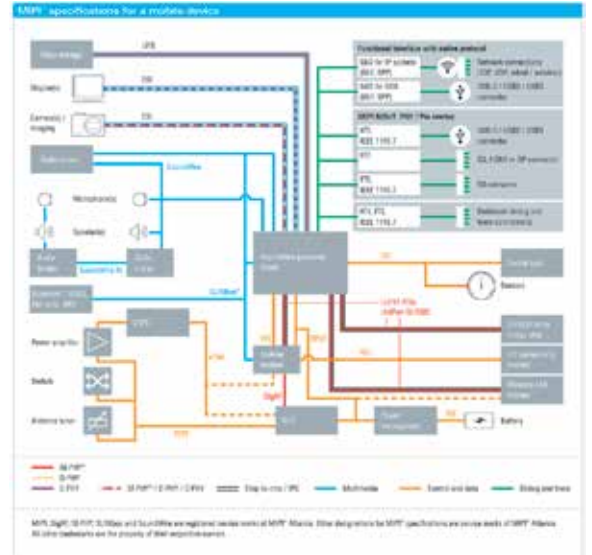
### **The physical layers – specifications and use**

D-PHY, the most commonly used specification, supports camera and display applications. The recently published specification for C-PHY describes an efficient unidirectional streaming interface with low-speed, in-band reverse channel, which should replace D-PHY for higher speed requirements in the future. The third specification, M-PHY, supports a broader range of applications, including interfaces





**Fig. 1: The R&S RTO oscilloscopes' outstanding RF characteristics and their numerous debugging functions for MIPI interfaces save time during development (source: Rohde & Schwarz).**



**Fig. 2: Overview of the MIPI specifications' ecosystem (source: MIPI Alliance).**

for display, camera, audio, video, memory, power management and interchip communications, for example, between baseband chips and those for RF. In addition, it was adopted as a physical layer for protocols outside of the MIPI ecosystem such as Mobile PCIe (M-PCIe) and SuperSpeed Inter-Chip (SSIC) USB.

Several higher-level protocols are specified for each physical layer (Fig. 3). Presently, the variants based on C-PHY are barely used. The Unified Protocol (UniPro) specification makes it possible to use the similarities for higher-layer protocols based on M-PHY for interconnecting components within mobile devices. The specification is suitable for a wide range of components including application processors, co-processors and modems, as well as different types of data traffic including control signals, user data transfer and packetized streaming. The Rohde & Schwarz' R&S RTOs

for example are oscilloscopes which the user can configure perfectly for analyzing MIPI interfaces. They offer different software options for analyzing MIPI-based protocols and their respective physical layers (Fig. 4). The following sections describe how a R&S RTO effectively handles all T&M requirements of the MIPI standards. Although both the D-PHY and M-PHY MIPI standards serve as examples, the arguments also apply to the other MIPI options offered by the R&S RTO.

### Detailed analysis of the physical layer

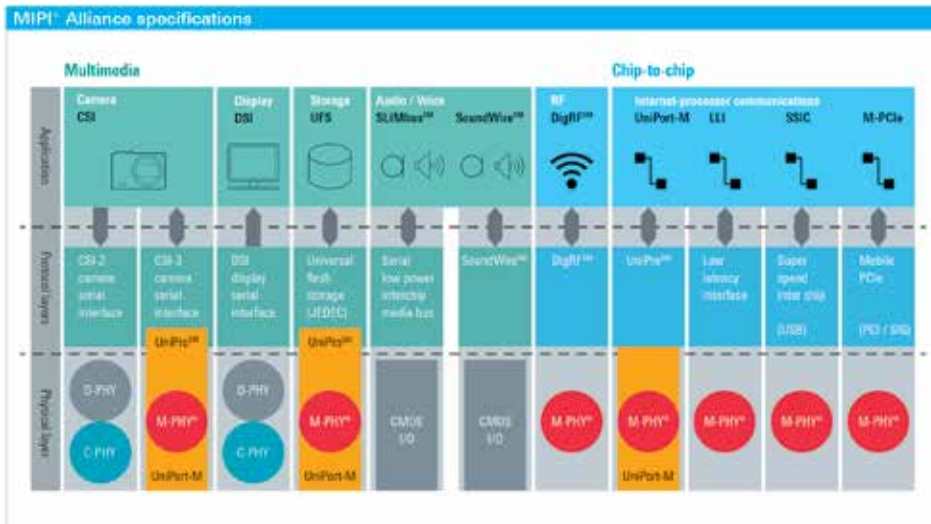
When analyzing the physical layer, it is essential to differentiate between the DUT's signal integrity and the signal fidelity of the test equipment. Critical oscilloscope parameters include noise, jitter, DC accuracy and bandwidth limitations at high amplification factors. The acquisition of consecutive LP and HS sequences, which have very different signaling

levels, is particularly challenging. They require a high signal integrity in order to determine signal quality – especially for the HS components. Fig. 5 shows the respective voltage levels.

The better the characteristics of the T&M instrument at hand, the greater the tolerance range for the DUT, resulting in cost savings, lower scrap rates and more efficient measurements. Thanks to its excellent features, this is where the R&S RTO excels – as shown in the following examples.

### Simultaneous acquisition of 200 mV and 1.2 V voltages

When characterizing the physical layer, a full scale of 1.4 V is used to acquire the LP signal. 8-bit A/D converters as used in most oscilloscopes provide a full-scale resolution of 5.5 mV/bit. While this is theoretically sufficient for measurements on the 200 mV signal



**Fig. 3: Applications, protocols and physical layers of the MIPI standards (source: MIPI Alliance).**

Physical layer	Triggering and decoding	Compliance tests
CMOS I/O	R&S®RTO-K40 RFFE (V. 1.1)	
D-PHY	R&S®RTO-K42 D-PHY (V. 1.2) CSI-2 (V. 1.2) DSI (V. 1.3)	R&S®RTO-K26 (MIPI CTS for D-PHY V1.1)
M-PHY®	R&S®RTO-K44 M-PHY 4.0 UniPro 1.6	

**Fig. 4: Overview of MIPI standards covered by the R&S RTO oscilloscopes' analysis options (source: Rohde & Schwarz).**

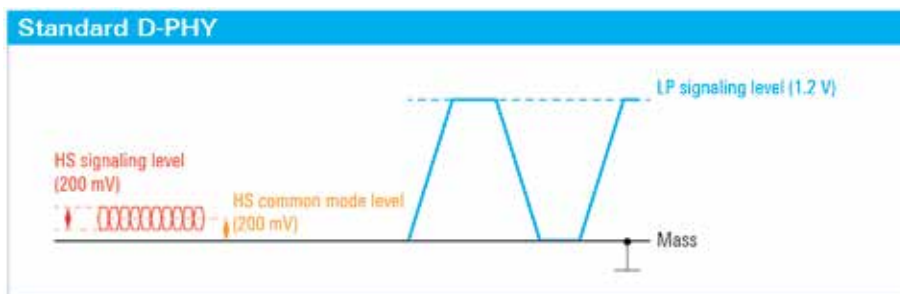
(assuming an ideal A/D converter), additional influences might render it insufficient. In practice, the A/D converter's effective number of bits (ENOB) is reduced by several influences such as offset error, gain error, nonlinearity error and static noise. The R&S RTO oscilloscopes benefit from their low-noise frontend and precise A/D converters. The converters provide an unmatched dynamic range of > 7 bit (ENOB) that can be fully utilized over the full instrument bandwidth of 4 GHz. In addition, the R&S RTO oscilloscope's low noise reduces

the influence of noise floor on the measurement. For example, actual RMS noise at the selected full scale of 1.4 V (i. e. 140 mV/div), is only about 5.0 mV. This value can be significantly higher on other oscilloscopes. The high dynamic range of the R&S RTO and its low inherent noise increase measurement accuracy, thereby reducing the rate of rejected DUTs.

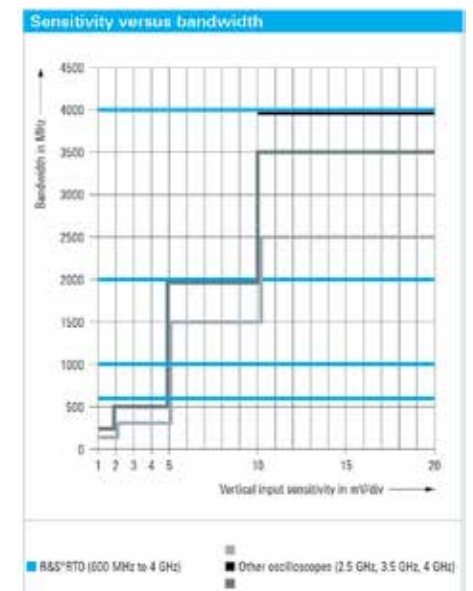
### Overloading the frontend

One workaround to reduce the oscilloscope's influence on HS signal measurements is to use

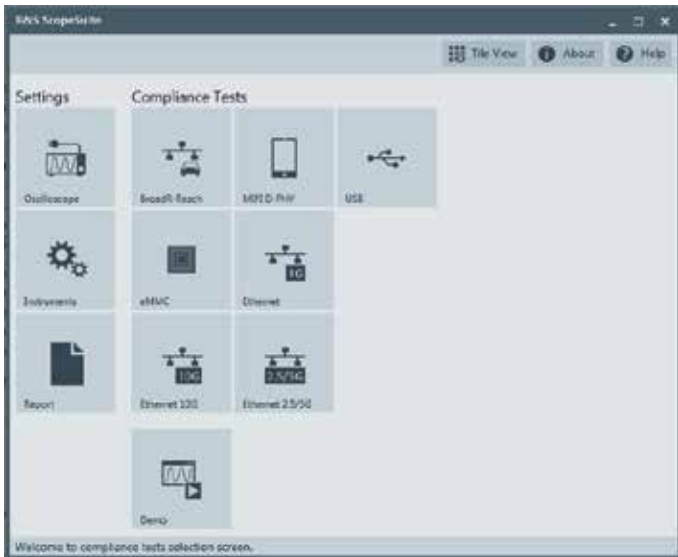
higher amplification. Using a full scale of 300 mV, for example, increases the resolution to 1.2 mV/bit and reduces RMS noise to 1.1 mV. The disadvantage to this



**Fig. 5: Voltage levels of the MIPI D-PHY signal (source: Rohde & Schwarz).**



**Fig. 6: The R&S RTO oscilloscope offers full measurement bandwidth at every input sensitivity, even at 1 mV/div (source: Rohde & Schwarz).**



**Fig. 7: The main screen of the R&S ScopeSuite shows the available compliance tests (source: Rohde & Schwarz).**



**Fig. 8: Configuration of M-PHY / UniPro protocol decoding (source: Rohde & Schwarz).**



**Fig. 9: Selection of the decoded layer (source: Rohde & Schwarz).**



**Fig. 10: M-PHY layer decoding results with zoom and table display the details of the frames and bursts (source: Rohde & Schwarz).**

approach is that the amplifier in front of the A/D converter needs recovery time if operated outside its specified range. During this period, the energy stored in the amplifier causes signal distortions and makes results useless. Using this approach would only make sense if the signal

of interest occurs much later than the transition from the LP to the HS state. The exact time needed for this is usually not specified by manufacturers but is typically in the range of several nanoseconds. Even if an overloaded amplifier does not affect the area of interest,

problems may still arise because many oscilloscopes limit the bandwidth for high amplifications in order to reduce noise. These limitations are often drastic and can go down to 500 MHz for the highest amplifications. Since the D-PHY standard requires rise and fall time

measurements in the range of 100 ps, oscilloscopes with a bandwidth of at least 3.5 GHz are necessary. With an input sensitivity of 30 mV/div and a typical active probe with an attenuation factor of 10:1, the frontend must be set to 3 mV/div in order to capture the full range of the 200 mV differential signal. The bandwidth of most oscilloscopes is insufficient when set to this value. Thanks to its low-noise frontend and powerful A/D converters, the R&S RTO oscilloscope's full instrument bandwidth down to 1 mV/div is available, offering the highest dynamic range for compliance measurements (Fig. 6).

In addition to these technical details, an intuitive workflow quickly leading to results is crucial when performing compliance measurements. The R&S ScopeSuite (Fig. 7) and the respective R&S RTO-K26 compliance test option offer quick results. Step-by-step instructions and descriptive pictures ensure that measurements succeed on the first try. In addition, the R&S RTO-K26 compliance test option uses the numerous possibilities of the oscilloscope's digital trigger system's numerous possibilities to quickly isolate the right signals and reduce measurement time.

## Data communications between components

After verifying signal integrity, the next step in design development is to analyze and debug communications between different components. Oscilloscopes with MIPI triggering and decoding options for serial communications protocols, such as those available for the R&S RTO (Fig. 4), greatly simplify these measurements.

The R&S RTO-K44 option, for example, supports debugging



**Fig. 11: M-PHY / UniPro protocol decoding setup (source: Rohde & Schwarz).**

directly on the lowest physical M-PHY layer as well as on the higher UniPro based protocol layers. The 4 GHz R&S RTO2044 covers UniPro 1.6 up to HS transmission mode gear 2 (HS-G2, 2.9 Gbit/s), making it possible to debug protocols such as CSI-3, UFS and UniPort-M.

To setup the decoding of a two-lane M-PHY signal, two differential probes (R&S RT-ZD40) are connected to channel 1 and 2. A dialog box guides the user through the configuration (Fig. 8). Users simply need to select either M-PHY or UniPro and set the number of lanes (up to four lanes are supported). Both coupled and individual threshold values can be used.

The data format and the layer to be decoded is set in a second step. Being able to choose layers is useful for debugging errors on different protocol levels, starting from the edge transitions, to the bits and symbols, up to the upper UniPro protocol layers (Fig. 9).

In Fig. 10, the setup and activated

decoding illustrate the different bursts for data and markers (MK0, MK1, MK2). The decoding table provides an overview of the bursts. A second table provides details of the data (decode results details 1) for an in-depth analysis of individual bursts.

Protocol-dependent triggering of the R&S RTO-K44 option separates the respective data telegrams from one another (Fig. 11). Use of the fast and precise digital triggers, in combination with additional software selection, results in an extremely high-performance workflow.

## Summary

Thanks to the triggering and decoding as well as compliance test options, the R&S RTO oscilloscopes cover all measurements in line with the MIPI standards. Their outstanding RF characteristics and convenient operation enable development engineers to achieve better results in a shorter time.

Ultra-Wideband  
10 MHz to 13 GHz



Power Handling  
up to 2W

**Now!**  
4-Channels  
in 1 Compact  
Device

# Programmable ATTENUATORS

0 to 120dB 0.25dB Step 1 MHz to 13 GHz\* from **\$395**

## Features

- Models with attenuation range up to 30, 60, 63, 90, 95, 110 or 120 dB
- Choose from USB, Ethernet, RS232 and SPI control options
- Use our software or yours! User-friendly GUI and DLLs included<sup>†</sup>
- Sweep or hop attenuation levels
- Save and recall customized attenuation patterns
- Pocket-sized package, as small as 3.0 x 2.0 x 0.6"
- **Now** 16 unique models in stock, ready to ship!

\* Specs may vary by model. See data sheets for specific model information.

<sup>†</sup> No drivers required. DLL objects for 32/64 bit Windows® environments using ActiveX® and .NET® frameworks.

## Perfect for...

- Fading simulators
- Handover system evaluation
- Automated test equipment
- And MORE!

Visit [minicircuits.com](http://minicircuits.com) for detailed model specs, application notes, and more!  
Place your order today and have them on your test bench as soon as tomorrow!



[www.minicircuits.com/products/  
programmable\\_attenuators.shtml](http://www.minicircuits.com/products/programmable_attenuators.shtml)





## Crystal clear choice for displays

› **Mary Tamar Tan, Applications Engineer at Microchip Technology, Rodger Richey, Director Engineering and New Product Development at Microchip Technology**

### **Microcontrollers with integrated drivers are providing a boost for the growing LCD market**

Liquid crystal displays (LCDs) have soared in popularity in recent years thanks to numerous advantages over other display technologies. Controlling them has also become easier because of the introduction of 8bit microcontrollers with integrated LCD drivers. Prominent features of such LCD controllers include contrast control, drive waveforms, biasing methods and power modes.

These devices can directly drive segmented displays with letters, numbers, characters and icons and have been developed to meet low-cost design requirements. A good example are the PIC microcontrollers from Microchip, which are available in 28-,

40-, 64-, 80- and 100-pin packages and can eliminate the need for several external hardware components.

The LCD driver module generates the timing control to drive a static or multiplexed LCD panel with support for up to 64 segments multiplexed with up to four or eight commons. Fig. 1 shows a typical LCD module block diagram.

The number of LCD registers varies depending on the maximum number of commons and segments that can be driven by the specific device.

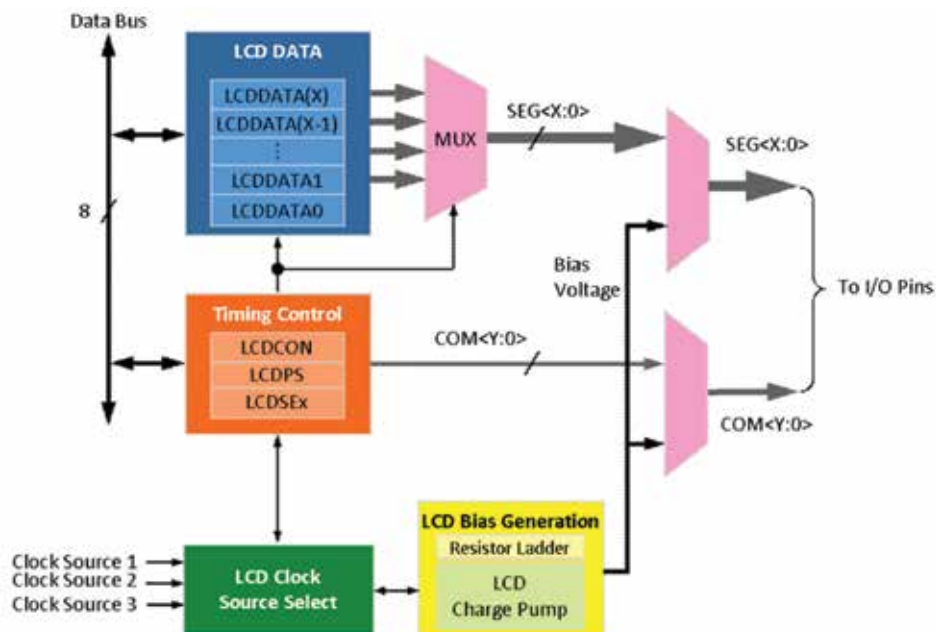
### **Timing control block**

As shown in Fig. 1, the timing control block comprises the LCD control register (LCDCON), LCD phase register (LCDPS) and LCD segment enable registers (LCDSEx). The LCDCON controls the overall

operation of the module. Once the module is configured, the LCDEn bit is used to enable or disable the LCD module. The LCD panel can also operate during sleep mode by clearing the SLPEn bit. The bits determine the LCD clock source and the configuration must comply with the LCD glass driving scheme.

The LCDPS configures the LCD clock source prescaler and the type of waveform. The prescaler select bits have a direct effect on the LCD frame frequency, so must be set accordingly to avoid ghosting or flickering on the display.

The LCDSEx configure the functions of the port pins. Setting the segment enable bit for a particular segment configures that pin as an LCD driver. Likewise, clearing the segment enable bit allows the pin to function as an IO port.



**Fig. 1: Typical LCD module block diagram**

### Data block

Like the timing control block, the data block in Fig. 1 is also present in all these PIC LCD modules. It is composed of the LCDDATAx registers. After the module is initialised for the LCD panel, the individual bits of the LCDDATAx registers are cleared or set to represent a clear or dark pixel, respectively.

Specific sets of registers are used with specific segments and common signals. Each bit represents a unique combination of a specific segment connected to a specific common.

### Bias generation block

There are two main methods of generating the bias voltages – resistor ladder and charge pump – both of which can be externally or internally supported by the device. The LCDref register determines whether external or internal resistor biasing is used. Setting the LCDIRE bit enables internal biasing.

When internal reference is enabled, contrast can be software controlled by configuring the LCDCST bits, which on some devices are found in a separate

register. The power source for the contrast control can be selected through the LCDIRS bit. The LCDref register also determines which bias pins are used internally or externally for the different bias levels.

The LCDRL register provides control for the different ladder power modes, as well as the time interval for each power mode.

Using the charge pump method requires only the LCDreg register to be configured. When the charge pump is enabled, contrast can be controlled through the bias bits. The regulator supports either 1/3 or static bias by setting or clearing the relevant bit. The regulator also has to be provided with its own clock source through CLKSEL bits.

### Frame frequency

The LCD frame frequency is the rate at which the common and segment outputs change. The clock source depends on the configured clock source select bits on the device used; PIC MCUs typically have three clock source choices for the LCD module.

The range of frame frequencies is from

25 to 250Hz with the most common being between 50 and 150Hz. Higher frequencies result in higher power consumption and ghosting while lower frequencies can cause flicker.

### Clock sources

The three possible clock sources on these modules are usually fast internal RC (FRC) oscillator, secondary oscillator (SOSC) and internal LPRC oscillator. However, for some devices the clock sources are the system clock, the timer one oscillator and the internal RC oscillator. Fig. 2 shows how a clock is typically generated for the LCD peripheral.

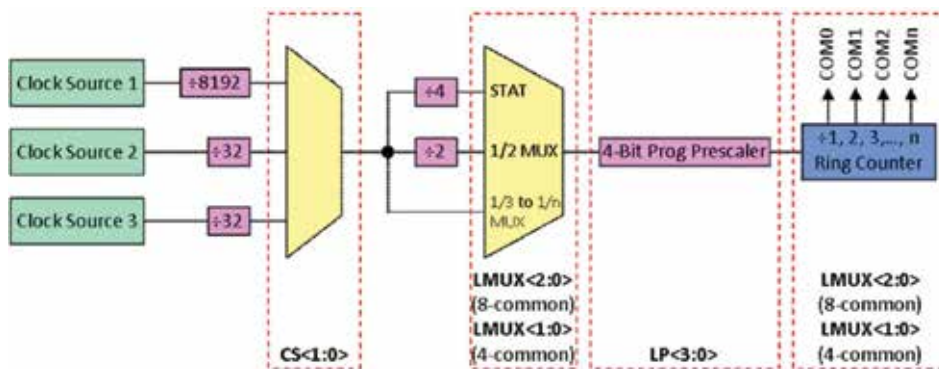
For the three clock sources, a divider ratio provides about a 1kHz output. For example, if the clock source is an 8MHz FRC oscillator, it has to be divided by 8192 to produce an approximate 1kHz output. This divider is not programmable. Instead, the LCD prescaler bits of the LCDPS register are used to set the frame clock rate. These bits determine the prescaler assignment and prescaler ratio.

Typically, two of the three clock sources may be used discretely to continue running the LCD while the processor is in sleep mode.

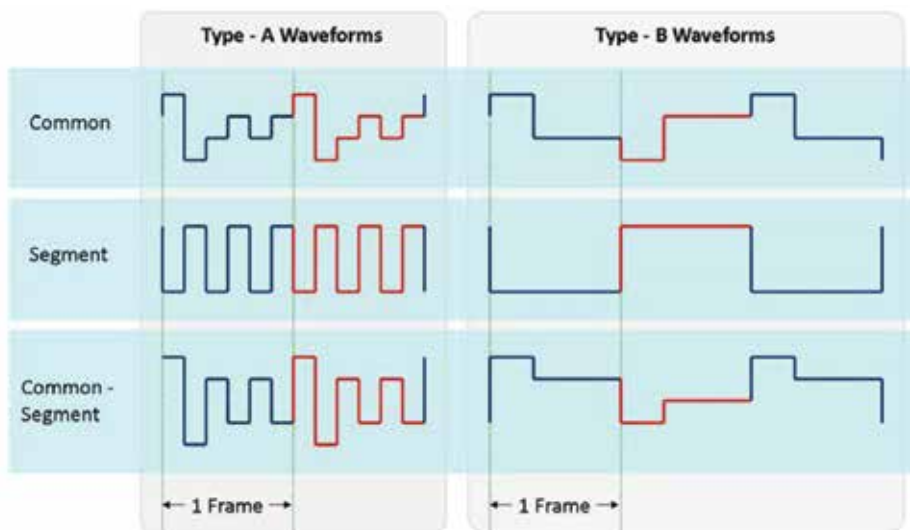
### Waveforms

An LCD can be characterised by the MUX ratio and bias, but one piece of information is still missing – drive waveforms. LCD waveforms are generated so that the net AC voltage across the dark pixel should be maximised and the net AC voltage across the clear pixel minimised. The net DC voltage across any pixel should be zero. LCDs can be driven by type A or type B waveforms.

In a type A waveform, the phase changes within each common type whereas a type B waveform's phase changes on each frame boundary. Thus type A waveforms maintain 0V DC over a single frame and type B waveforms take two frames. Fig. 3



**Fig. 2: LCD clock generation**



**Fig. 3: Type A versus type B waveforms**

shows both types of waveforms for 1/3 MUX and 1/3 bias.

The voltage applied across a particular pixel is the voltage on the COM pin minus the voltage on the SEG pin. If the resulting voltage is at or above the Von threshold then the pixel is visible. If it is at or below the Voff threshold then the pixel is not visible.

The contrast of an LCD can be determined by calculating the discrimination ratio, which is the ratio between the RMS voltage of an on-pixel and the RMS voltage of an off-pixel. Segment mapping provides a simple and organised way to determine which pixels should be on or off.

### External resistor biasing

The resistor ladder method is most commonly used for higher VDD voltages. This method uses inexpensive resistors to create the multi-level LCD voltages. Regardless of the number of pixels that are energised, the current remains constant.

The resistance values are determined by the display quality and power consumption. Display quality is a function of the LCD drive waveform. Since the LCD panel is a capacitive load, the waveform is distorted due to the charging and discharging currents. This distortion can be reduced by decreasing the resistance value.

However, this change increases the power consumption due to the increased current flowing through the resistors. As the LCD panel increases in size, the resistance value must be decreased to maintain the image quality.

Sometimes adding capacitors in parallel to the resistance can reduce the distortion caused by charging and discharging currents. This effect is limited since, at some point, a large resistor and large capacitor cause a voltage level shift that negatively impacts the display quality. Adding a potentiometer allows external contrast control.

### Internal resistor biasing

To avoid the trouble of adding external components and to save the use of up to three pins for voltage generation, PIC microcontrollers provide internal resistor biasing and internal contrast control. This mode does not use resistors but internal resistor ladders that are configured to generate the bias voltage.

The internal resistor ladder can be used to divide the LCD bias voltage to two or three equally spaced voltages that will be supplied to the LCD segment pins. To create this, the reference ladder consists of three matched resistors.

When in 1/2 bias mode, the middle resistor of the ladder is shorted out so that only two voltages are generated. This mode reduces the ladder resistance thus increasing current consumption.

### Conclusion

Various MCUs with LCD controllers provide design flexibility and straightforward ways to drive the LCD glass. The internal biasing, contrast control and power-saving features in the LCD module eliminate the need for extra hardware. They let designers make the most of these features while maintaining display quality.



# ***RF Solutions From RF Engineers***

***Largest Selection ✓***

***Expert Technical Support ✓***

***Same Day Shipping From the U.S. ✓***

***Actives,  
Passives and  
Interconnects***

***24/7  
Support***

***Application  
Engineers  
Available***

*Armed with the world's largest selection of in-stock, ready to ship RF components, and the brains to back them up, Pasternack Application Engineers stand ready to troubleshoot your technical issues and think creatively to deliver solutions for all your RF project needs. Whether you've hit a design snag, you're looking for a hard to find part or simply need it by tomorrow, our Applications Engineers are at your service.*

Visit [www.pasternack.com](http://www.pasternack.com) or Email [RFsales@Tritech.co.il](mailto:RFsales@Tritech.co.il)  
for Local Sales & Service



## High Directivity Couplers Isolate Upstream/ Downstream Paths in Full Duplex DOCSIS® 3.1 Systems

› WeiPing Zheng, Steven Scheinkopf, Jeremy Cortez, and Brandon Kaplan, Mini-Circuits

### **Background: The Push toward Symmetric, Multi-Gigabit Broadband Service**

Continuous growth in demand for consumer and enterprise broadband data service is driving the efforts of cable industry researchers, operators, and hardware suppliers to extend the DOCSIS 3.1 standard to offer symmetric, multi-gigabit service over existing hybrid-fiber-coax (HFC) networks. The current version of the standard enables downstream capacity of up to 10 Gbps, but upstream capacity is still essentially limited to under 1 Gbps. DOCSIS 3.1 uses Frequency Division Duplexing (FDD) to partition the allocated spectrum (5 to 1220 MHz) for upstream and downstream signal traffic. The upstream bandwidth, typically from 5 to 85 MHz places inherent limitations on data capacity for the return path, posing a barrier for emerging applications requiring

higher upstream speed.

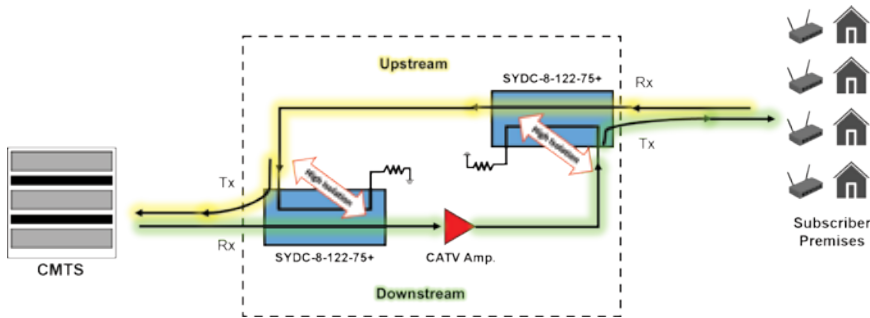
The industry has responded to this looming barrier by exploring the application of full duplex communication to the DOCSIS 3.1 standard, which would allow upstream and downstream signal traffic to utilize the same portion of spectrum at the same time, doubling the efficiency of spectrum use. Full Duplex DOCSIS 3.1 technology, once deployed over 1 GHz HFC networks, could ultimately achieve 10 Gbps capacity in both upstream and downstream directions. Since the announcement by CableLabs in 2016 of the commencement of Full Duplex DOCSIS 3.1 to an R&D phase project, CableLabs members and key suppliers have entered into a major collaboration to define the specification and develop new system architectures to achieve symmetric multi-gigabit performance over broadband networks.

### **The Challenge: Isolating**

### **Forward and Reverse Signal in Full Duplex DOCSIS 3.1 Systems**

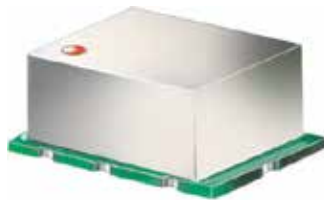
Because network nodes are transmitting at high signal power and receiving at low signal power over the same frequencies, one of the unique challenges to realizing working Full Duplex DOCSIS 3.1 systems is the tendency of transmit signal to leak into the receive path. If upstream signal leaks into the downstream signal chain, for example, it can get fed back through the CATV amplifier resulting in intermodulation products and other kinds of interference. The system therefore requires circuit elements that allow forward and return signal to pass in close proximity through network nodes with enough isolation to prevent leakage between the paths.

To address this problem, Mini-Circuits has partnered with broadband operators and hardware suppliers to



**Figure 1: Simplified schematic of high isolation directional couplers (SYDC-8-122-75+) isolating upstream and downstream signal traffic in Full-Duplex DOCSIS 3.1 system.**

develop broadband, high-isolation 75Ω directional couplers to prevent leakage between forward and return signal within network nodes. In the forward direction, downstream signal is injected through the coupled port onto the mainline toward subscriber premises. In the return direction, upstream signal is injected onto the mainline toward the head end. The difficulty is designing a wideband coupler with sufficient isolation between the coupled port and the in/out ports to prevent leakage of the injected signal into the opposing path. System requirements call for input/output operating frequency from 5 to 1218 MHz, coupled frequency range from 40 to 780 MHz and typical isolation (In/Out – Coupled Port) of roughly 30 to 35 dB or better up to 780 MHz. Achieving this level of isolation over a frequency range this wide is challenging, but Mini-Circuits leveraged our in-house design expertise to develop model SYDC-8-122-75+, a surface-mount, transformer-type 75Ω directional coupler to support the requirements for Full Duplex DOCSIS 3.1 systems. Test data for this coupler exhibits isolation greater than 40 dB up to 1000 MHz and greater than 30 dB up to 1220 MHz at the upper limit of the DOCSIS 3.1 application band. This design has a coupling ratio of 8.9 dB with ±0.5 dB flatness over the 5 to 750 MHz range and ±0.9 dB flatness over the 5 to 1218 MHz range. It provides



**Figure 2: SYDC-8-122-75+ case style**

1W RF input power handling, 1.4 dB typical mainline loss, and 18 dB typical return loss (input/output/coupling). It comes housed in a miniature plastic package (0.38 x 0.50 x 0.25") mounted on printed wiring laminate base with a wraparound terminations for excellent solderability. Its exceptional isolation of over wide frequency range, flat coupling and combination of other performance characteristics, make the SYDC-8-122-

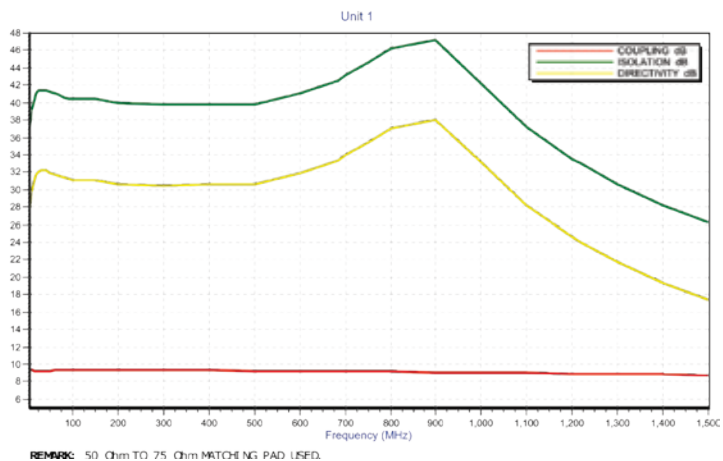
75+ an ideal candidate for isolating upstream and downstream paths in Full Duplex DOCSIS 3.1 systems.

### Conclusion: One Piece of a Complex Puzzle

Full Duplex DOCSIS 3.1 presents a number of new challenges that cable operators and suppliers are working diligently to overcome. Isolating the forward and return signal paths at the node is one of the key challenges unique to full duplex communication, requiring innovative problem solving at the component level. Mini-Circuits' SYDC-8-122-75+ enables system architects to effectively isolate forward and return signals at the same frequency and prevent signal leakage that would otherwise lead to systemic problems.

The successful implementation of Full Duplex DOCSIS 3.1 ultimately depends on a wide and complex variety of factors. Mini-Circuits is proud to contribute one piece in the puzzle and play a role in the collaborative efforts of the broadband industry to bring the market faster connectivity. The SYDC-8-122-75+ high-directivity directional coupler is an example of our ability to respond to challenging, application-specific system requirements with technical expertise, flexibility and fast turnaround.

TEST CONDITIONS: Z: 75 Ohm SYSTEM TEMPERATURE: ROOM



**Figure 3: Curves of measured test data for SYDC-8-122-75+ for Coupling, Isolation and Directivity, swept over DC to 1500 MHz.**



## RF transceivers provide breakthrough SWaP solutions for defense and aerospace applications

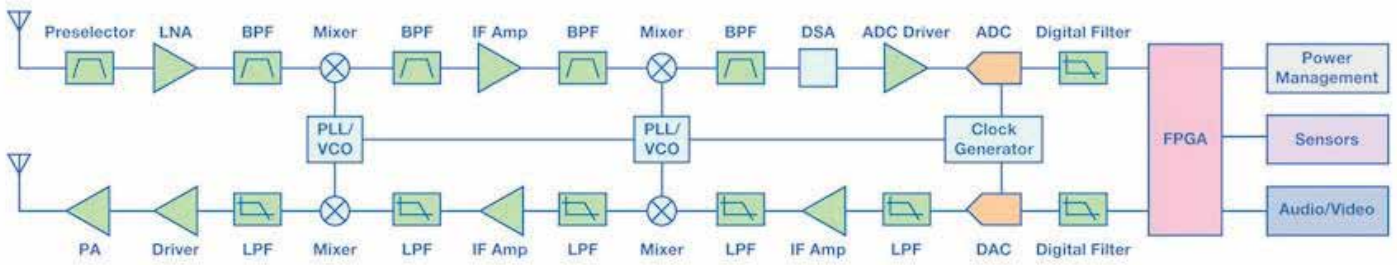
› DAVID BROWN, WYATT TAYLOR ANALOG DEVICES, INC.

**Integrating more software control and cognitive abilities to military radios demands a more frequency- and bandwidth-flexible radio frequency (RF) design. To achieve this goal, static filters need to be removed and replaced with tunable filters. Similarly, the concept of a common platform would allow for shorter development times, reduced manufacturing costs, and provide greater interoperability between systems. The common platform demands that the RF system be capable of providing full performance for applications that traditionally have had very different architectures. Future radio platforms are pushing size and power demands to a new extreme.**

Since its inception, the super-heterodyne architecture has been the backbone of radio design for defense and aerospace systems. Whether it is a handheld soldier radio, unmanned aerial vehicle (UAV) data link, or a signal intelligence (SIGINT) receiver, the single- or two-mixing-stage super-heterodyne architecture is the common choice. The benefits of this design are clear: proper frequency planning can enable very low spurious emissions, channel bandwidth and selectivity is set by the intermediate frequency (IF) filters, and the gain distribution across the stages allows for a tradeoff between optimizing noise figure and linearity. (Figure 1.) During more than nearly one hundred years of use, the super-het architecture

has seen significant gains in performance across the entire signal chain. Microwave and RF devices have improved their performance while decreasing power consumption. Analog-to-digital converters (ADCs) and digital-to-analog converters (DACs) have increased sample rate, linearity, and effective number of bits (ENoB). More performance gains: Processing capability in field-programmable gate arrays (FPGAs) and digital signal processors (DSPs) has followed Moore's Law and increased with time, allowing for more efficient algorithms, digital correction, and further integration. Additionally, strides made in packaging technology have shrunk device pin density while simultaneously improving thermal handling.

However, these device-specific improvements are beginning to reach



**Figure 1: Basic super-heterodyne architecture**

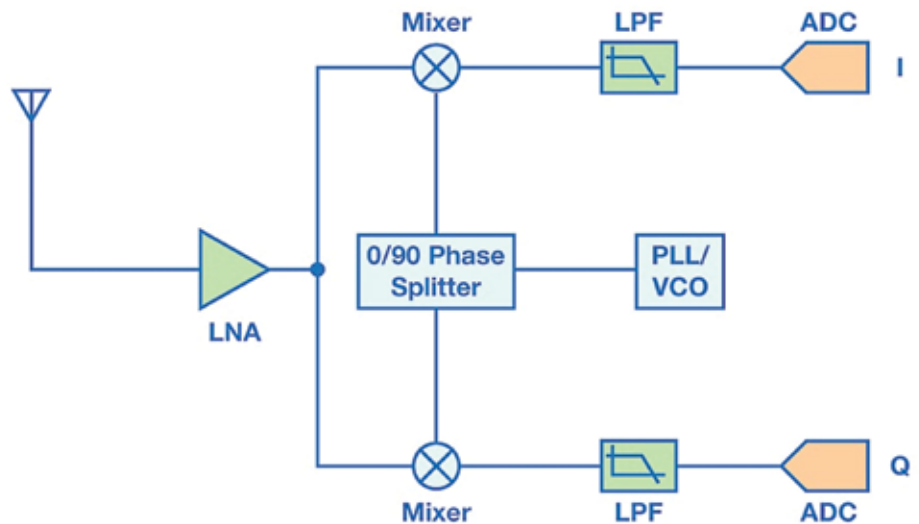
the point of diminishing returns. While the RF components have followed a reduced size, weight, and power (SWaP) trend, high-performance filters remain physically large and are often custom designs, thus adding to overall system cost. Additionally, the intermediate-frequency (IF) filters set the analog channel bandwidth of the platform, making it difficult to create a common platform design that can be reused across a wide range of systems. For package technology, most manufacturing lines will not go below a 0.65- or 0.8-mm ball pitch, meaning that there is a limit on how physically small a complex device with many input and output (I/O) requirements can become.

### Zero-IF architecture

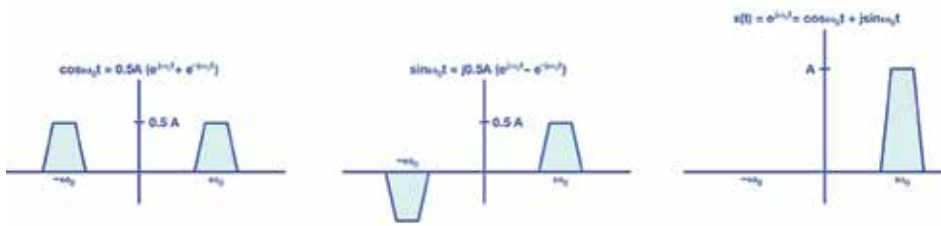
An alternative to the super-het architecture that has re-emerged as a potential solution in recent years is the Zero-IF (ZIF) architecture (Figure 2). A ZIF receiver uses a single frequency mixing stage with the local oscillator (LO) set directly to the frequency band of interest, translating the received signal down to baseband in-phase (I) and quadrature (Q) signals. This architecture alleviates the stringent filtering requirements of the super-het, since all analog filtering takes place at baseband, where filters are much easier to design and less expensive than custom RF/IF filters. The ADC and DAC are now operating on I/Q data at baseband, so the sample rate relative to the converted

bandwidth can be reduced, saving significant power. From many design aspects, ZIF transceivers provide significant SWaP reduction as a result of reduced analog front-end complexity and component count. There are, however, some drawbacks to this system architecture that need to be addressed. The direct frequency conversion to baseband introduces a carrier-leakage and image-frequency component. Mathematically, the imaginary components of I and Q signals cancel out due to their orthogonality (Figure 3). Due to real-world factors such as process variation and temperature deltas in the signal chain, it is impossible to maintain a perfect 90-degree phase offset between the I and Q signals, resulting in degraded image rejection.

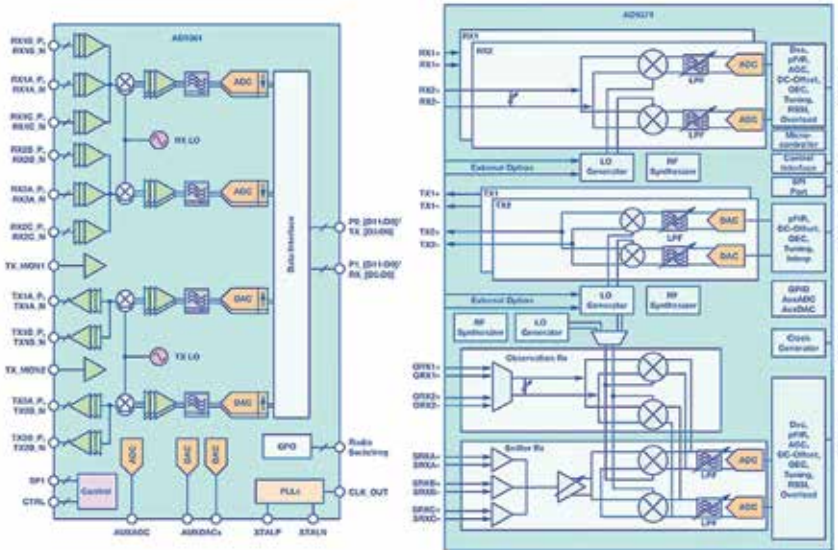
Additionally, imperfect LO isolation in the mixing stage introduces carrier leakage components. When left uncorrected, the image and carrier leakage can degrade a receiver's sensitivity and create undesirable spectral emissions. Historically, the I/Q imbalance has limited the range of applications that were appropriate for the ZIF architecture. This was due to two reasons: First, a discrete implementation of the ZIF architecture will suffer from mismatches both in the monolithic devices and also the printed circuit board (PCB). In addition, the monolithic devices could pull from different fabrication lots, making exact matching very difficult due to native process variation. A discrete implementation will also



**Figure 2: Zero-IF architecture.**



**Figure 3: Zero-IF image cancellation.**



**Figure 4: AD9361 and AD9371 block diagrams.**

have the processor physically separated from the RF components, making a quadrature correction algorithm very difficult to implement across frequency, temperature, and bandwidth.

### Integrated transceivers provide SWaP solution

Integrating the ZIF architecture into a monolithic transceiver device provides the path forward for next-generation systems. By having the analog and RF signal chain on a single piece of silicon, process variation will be kept to a minimum. In addition, DSP blocks can be incorporated into the transceiver, removing the boundary between the quadrature calibration algorithm and the signal chain. This approach provides both unparalleled improvements in SWaP and can also

match the super-het architecture for performance specifications.

Analog Devices offers two transceivers aimed at use in the defense and aerospace markets: the AD9361 and AD9371 (Figure 4). These devices integrate the RF, analog, and digital signal chain onto a single CMOS device and include digital processing to run quadrature and carrier leakage correction in real time across all process, frequency, and temperature variations. The AD9361 focuses on medium performance specifications and very low power, such as UAV data links, handheld and man-pack communication systems, and small-form-factor SIGINT. The AD9371, optimized for very high performance specifications and medium power, has an integrated ARM microprocessor for refined calibration control, as well as an observation receiver for power amplifier

(PA) linearization and a sniffer receiver for white-space detection. These features mean that communication platforms using wideband waveforms, or occupying noncontiguous spectrum, can now be implemented in a much smaller form factor. The high dynamic range and wide bandwidth enables SIGINT, EW, and phased-array radar operation in locations with highly congested RF spectrum.

### The next generation is now

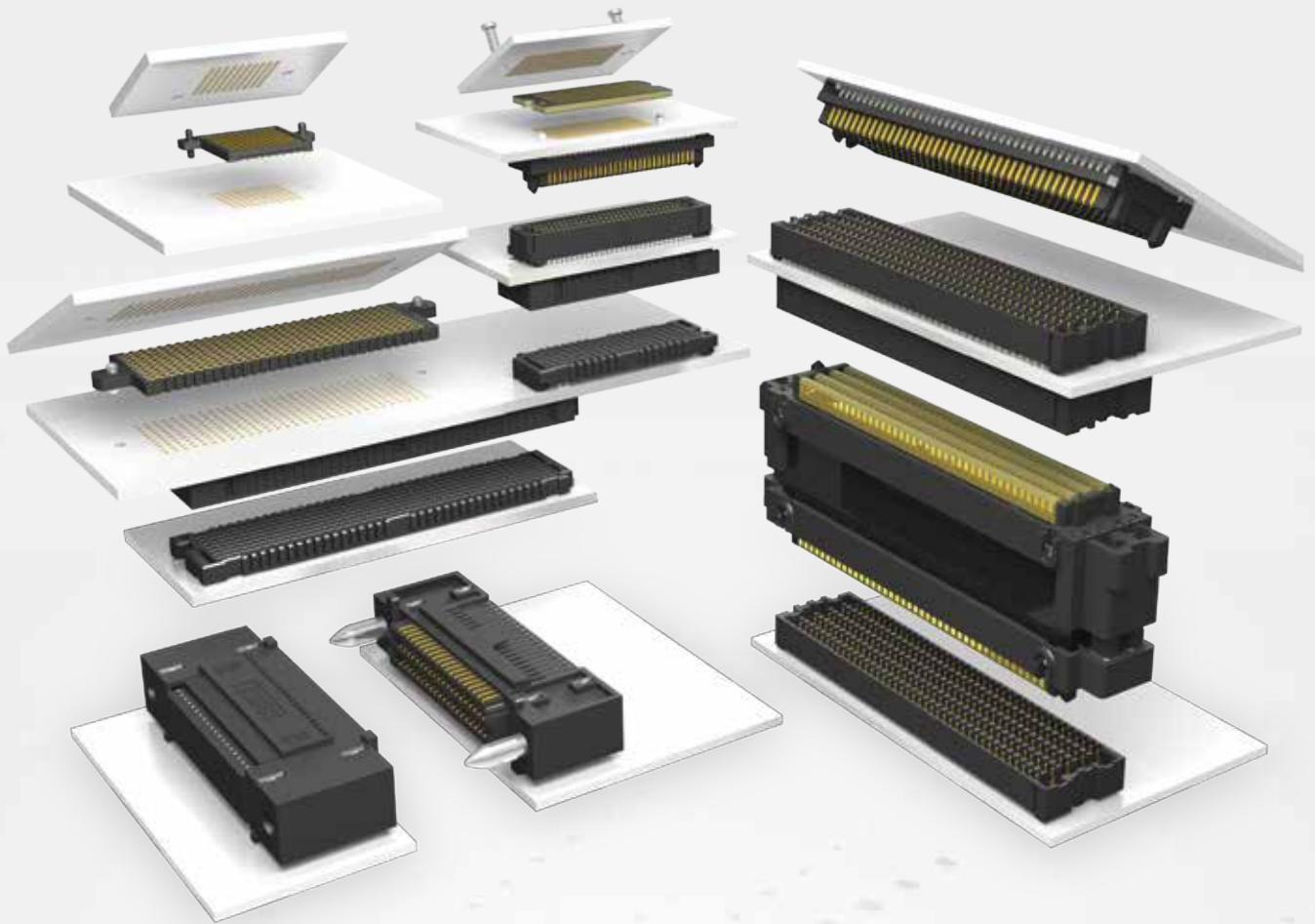
One hundred years of device optimization had allowed the super-het to achieve greater and greater performance, in continually smaller and lower-power platforms. Those improvements are beginning to slow, as physical limitations become real. Next-generation aerospace and defense platforms will demand a new approach to RF design, one where several square inches of an existing platform is integrated into a single device. In these devices the boundary between software and hardware is blurred, allowing for greater optimization and integration and where decreased SWaP no longer means decreased performance.

*David Brown is an RF system applications engineer with Analog Devices, Inc., in Greensboro, North Carolina. He joined Analog Devices in 2015 and focuses primarily on defense and aerospace applications. David graduated from NC State University in 2014 with a bachelor's degree in electrical engineering.*

*Wyatt Taylor is a senior RF systems engineer with Analog Devices, Inc., in Greensboro, North Carolina. He is focused on defense and aerospace radio applications, with a particular emphasis on integrated RF transceivers, small-form-factor microwave design, and software-defined radio (SDR). Formerly, Wyatt was an RF design engineer at Thales Communications Inc., and Digital Receiver Technology, Inc., in the Maryland area. Wyatt received his MSEE and BSEE from Virginia Tech.*

# MAXIMUM ROUTING & GROUNDING FLEXIBILITY

**THE MOST VERSATILE HIGH-SPEED HIGH-DENSITY PRODUCT LINE IN THE INDUSTRY**



With products designed for maximum routing and grounding flexibility, ultra-high-density signaling, and PCB space-savings, Samtec's family of High-Density Arrays are ideal for a variety of high-performance applications.

SEARAY™ Open-Pin-Field Arrays | SEARAY™ Ultra-High-Density Arrays | FMC / FMC+ (VITA 57) Solutions  
LP Array™ High-Speed Low Profile Arrays | Z-RAY® High-Speed Ultra Low Profile Arrays

**samtec**



## reVISION Stack: Accelerating your Embedded Vision development

> Nick Ni and Adam Taylor

Embedded Vision is ubiquitous across a range of industries and applications, from ADAS and Guided Robotics to medical imaging and augmented reality. The breadth of embedded vision penetration across multiple market segments is staggering. In most of these applications the downstream image processing pipeline is very similar. This downstream pipeline contains functions such as Image Sensor / Camera interfacing and reconstruction of the image in a format suitable for further processing. Commonly used algorithms within downstream processing are colour reconstruction (Bayer Filter), colour space conversion and noise reduction algorithms. It is the application specific algorithms where the differences between applications become apparent. Implementing these is where the embedded vision developer expends significant time and effort. These application algorithms are

often complex to implement, using techniques such as object detection and classification, filtering and computational operations. Increasingly these application algorithms are developed using open source frameworks like OpenCV and Caffe. The use of these open source frameworks enables the Embedded Vision developer to focus on implementing the algorithm. Using the provided pre-defined functions and IP contained within, removes the need to start from scratch which significantly reduces the development time.

Depending upon the application, the challenge faced by the designer is not only how to implement the desired algorithms. The Embedded Vision developer must also address both challenges faced by the application and its environment while considering future market trends.

These challenges and trends include processing and decision making at the

edge as increasingly Embedded Vision applications are autonomous and cannot depend upon a connection to the cloud. One example of this would be vision guided robotics, which are required to process and act on information gleaned from its sensors to navigate within its environment. Many applications also implement sensor fusion, fusing several different sensor modalities to provide an enhanced understanding of the environment and further aid the decision-making, bringing with it increased processing demands. Due to the rapid evolution of both sensors and image processing algorithms the system must also be able to be upgraded to support the latest requirements of the product roadmap. The rise of autonomous and remote applications also brings with it the challenges of efficient power dissipation and security to prevent unauthorized modification attempts. To address these challenges,



developers use Xilinx® All Programmable System on Chip (SoC) and Multi Processor System on Chip (MPSoC) devices from the Zynq®-7000 and Zynq® UltraScale™+ MPSoC families to implement their solution. These devices provide high performance processors closely coupled with programmable logic, allowing the Embedded Vision developer to optimize their solution. The use of Zynq SoC or Zynq UltraScale+ MPSoC devices enable the developer to benefit from the any-to-any connectivity which comes with the use of programmable logic. This programmable logic can also implement the image processing pipeline(s), providing a performance increase due to its parallel nature. Using the programmable logic increases the system performance, connectivity and the performance per watt of power dissipated providing a more efficient solution overall. The processing cores can be used for higher level application functionality, such as decision making based on the provided information and communication between systems and with the cloud. To address the security concerns which come with autonomous and remote applications, both device families provide a secure environment with support for encrypted secure boot and ARM® Trust Zone technology within the processor, and the ability to implement anti tamper functionality. Using Zynq-7000 and Zynq UltraScale+ MPSoC devices provide significant capability to the Embedded Vision developers allowing the challenges and trends to be addressed. Leveraging these capabilities requires a development ecosystem that enables the Embedded Vision developer to utilize not only the benefits of using these devices, but also provide the ability to still use the commonly used frameworks within their solution. This is where the reVISION™ Stack comes in.

## reVISION Stack

The reVISION Stack was developed to enable Embedded Vision developers to address the four key challenges identified above, which are evident within the embedded vision sphere. These challenges can be summarized as responsiveness, reconfigurability, connectivity and software defined. To address these four driving trends, the reVISION Stack combines a wide range of resources enabling platform, application and algorithm development. As such, the stack is aligned into three distinct levels:

**1. Platform layer.** This is the lowest level of the stack and is the one on which the remaining layers of the stack are built. As such it provides both a hardware definition of the configuration of the Zynq-7000 / Zynq UltraScale+ MPSoC and the software definition via a customized operating system to support the hardware definition. This hardware definition can define the configuration of either a development or production ready board such as a System on Module. It is within the hardware definition that the sensor and system interfaces are defined. The hardware platform will be captured using Vivado® HLX, and may leverage IP blocks from both Xilinx and third party suppliers along with the use of high level synthesis

to create specialist IP. This layer will also provide software drivers for IP modules and an updated PetaLinux configuration if required, to support the software defined environment at the higher level.

**2. The middle level of the stack is called the algorithm layer.** Development at this level takes place within the eclipse based SDSoC™ environment. SDSoC is a system optimizing compiler which allows development using a software defined environment. Crucially as we develop our software algorithms, bottlenecks in performance can be identified and removed by accelerating functions into the programmable logic. To the user this process is seamless, using a combination of High Level Synthesis and a connectivity framework to move a function from executing in software to implementation in the programmable logic. It is at this level OpenCV is used to implement the image processing algorithms for the application at hand. To reduce identified bottlenecks within the image processing algorithm, reVISION provides a wide range of acceleration ready OpenCV functions. Support is also provided at this level for the most common neural network libraries, including AlexNet, GoogLeNet, SqueezeNet, SSD, and FCN.

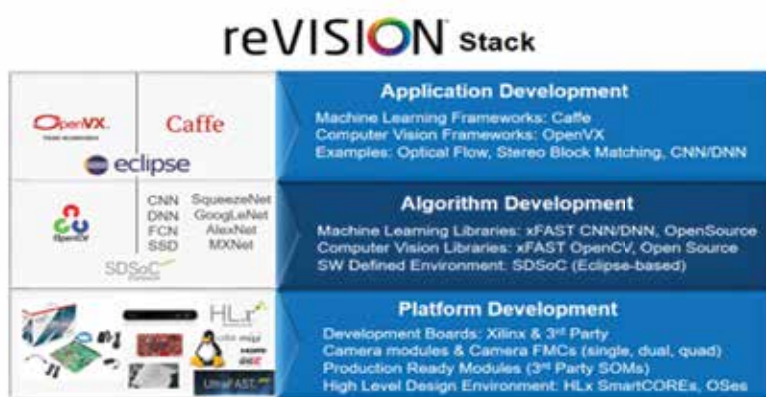


Figure 1 - reVISION Stack

3. The final layer is the application development level, and it is where the high-level frameworks such as Caffe and OpenVX are used to complete the application, implementing the decision-making functionality for example. Applications at this level are developed using an eclipse based environment targeting the processor cores within the Zynq-7000/Zynq UltraScale+ MPSoC.

The capability provided by the reVISION stack provides all the necessary elements to create high performance imaging applications across a wide range of applications from industrial internet of things, to vision guided robotics and beyond.

### Accelerating OpenCV

One of the most exciting aspects of the reVISION stack is the ability to accelerate a wide range of OpenCV functions within the algorithm development layer. Within this layer, the OpenCV functions capable of being accelerated can be grouped into one of four high level categories.

1. Computation – Includes functions such as absolute difference between two frames, pixel wise operations (addition, subtraction and multiplication), gradient and integral operations

2. Input Processing – Provides support for bit depth conversions, channel operations, histogram equalisation, remapping and resizing

3. Filtering - Provides support for a wide range of filters including Sobel, custom convolution and Gaussian filters

4. Other – Provides a wide range of functions including Canny/Fast/Harris edge detection, thresholding and SVM and HoG classifiers

Developers can use these functions to create an algorithmic pipeline within the programmable logic of the chosen device. Being able to implement logic in this way significantly increases the performance of the algorithm

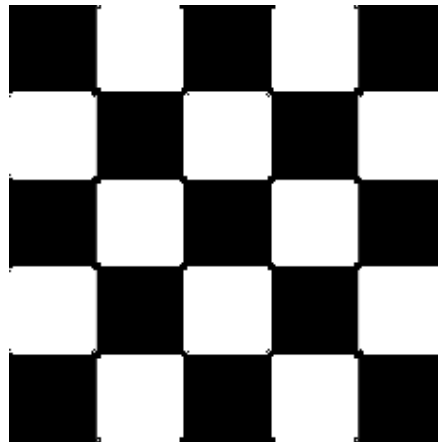


Figure 2 - Accelerated OpenCV Harris Corner Detection

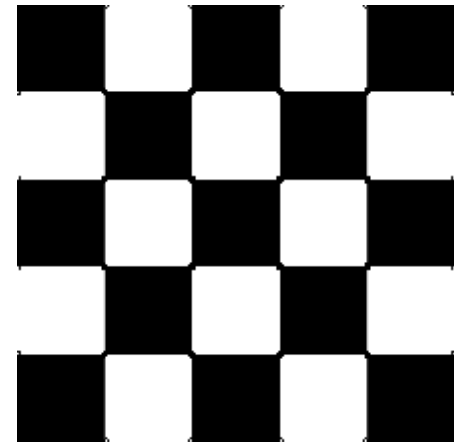


Figure 3 - Traditional OpenCV Implementation

implementation.

Of course, as these acceleration capable OpenCV libraries are software defined and support high level synthesis, they can also be used within the Vivado HLS tool. This enables the creation of IP modules which can be used within the platform layer when the hardware definition is established.

One commonly used algorithm in OpenCV is the implementation of Harris Corner detection, used to detect corners within an image. Within the reVISION Stack, there is a predefined function for Harris Corner detection. When comparing the performance of the reVISION accelerated Harris Corner detection against a normal OpenCV implementation as demonstrated below, both provide identical performance. However, using the reVISION Harris Corner function accelerated into the PL the user gains an increase in system performance which enables a more responsive and power efficient solution.

Within the reVISION stack, if developers chose to accelerate OpenCV functions, they can optimize the design for resource usage and performance within the programmable logic. The main method through which this is achieved is the number of pixels which are processed on each clock cycle. For most accelerated

functions, they can choose to process either a single pixel or eight pixels. Processing more pixels per clock cycle increases the resource utilization required while reducing the processing time. Processing one pixel per clock will provide a reduced resource requirement, which comes at the cost of an increased latency. This selection of number of pixels per clock is configured via the function call, providing a very simple method to optimize the design as required.

With the design performance optimized using the acceleration capable OpenCV libraries, the embedded vision developer can then develop the higher levels of the application using the capabilities provided by the Algorithm and Application layers of the stack.

### Conclusion

The use of All Programmable Zynq-7000 and Zynq UltraScale+ MPSoC devices within embedded vision applications brings several advantages in flexibility, performance, security/safety and power-efficient processing. Developing the application within the reVISION stack allows several commonly used industry-standard frameworks to be utilized, bringing with it reduced development times and faster time to market.

# New-Tech Europe

Read  
To  
Lead





## Hints and tips on the use of cooling fans for power supplies

› Andrew Bryars, Applications Engineering Manager, XP Power

Everyone knows that if you dissipate heat inside a confined space then the temperature in that space will increase i.e. the ambient temperature inside the enclosure will rise.

If you have an enclosure containing a power supply and its load i.e. the PCBs that its powering then as the ambient air temperature increases due to the heat dissipated by both, the power supply and the PCBs will further heat up, possibly beyond their maximum operating temperatures.

This is a bad situation as heat is the number one cause of unreliability or reduced lifetime within an electronic system due to the life time of electrolytic capacitors being

strongly linked to their operating case temperature.

Other components are also less reliable the hotter they become and with the trend of making power supplies smaller with less heat-sinking then they must be carefully thermally managed.

An easy way to do this is to use a fan to remove excess heat from the enclosure.

Some power supplies are designed to be forced cooled by use of a system fan. In these cases, the air flow required for adequate cooling will be specified in the power supply data sheet. It is important to bear in mind that this is the air flow needed at the power supply itself and not at some point even a short

distance away. As air will always follow the path of least resistance, only a portion of the air pushed by the fan will actually reach the power supply where it is needed. Internal baffles will help to direct air along the required path to reach and cool the target components.

For the cases where the power supply is perhaps a convection cooled design, or where the equipment just needs to run at a lower temperature, the air flow needs to be calculated using the steps below.

Firstly it is required to establish the maximum operating temperature that either the power supply or the electronics could safely operate in. For the power supply itself this may

The formula is:

$$\text{Airflow (in m}^3\text{/hr)} = \frac{2.6 * \text{Total power dissipated (in W)}}{\text{Allowable temperature rise (in }^\circ\text{C)}}$$

In our example, the airflow required would be  $2.6 * 325\text{W} / 10^\circ\text{C} = 84.5 \text{ m}^3\text{/hr}$

typically be  $50^\circ\text{C}$  which may be related to the safety approvals or a lower value to increase the lifetime. As a general rule of thumb, a reduction of an electrolytic capacitor case temperature of  $10^\circ\text{C}$  results in a doubling of its lifetime.

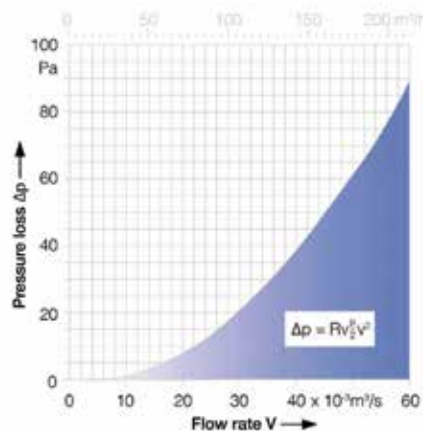
We then need to consider the highest air temperature surrounding the equipment enclosure containing the power supply and the difference between the two is the maximum allowable temperature rise. As an example, if the power supply is able to operate at an ambient of  $50^\circ\text{C}$ , and if the equipment containing the power supply is intended to be operated in a non-air conditioned environment where the maximum temperature could reach as high as  $40^\circ\text{C}$ , then the allowable temperature rise is  $10^\circ\text{C}$ .

The next step is to establish the amount of power to be dissipated. The total power dissipated inside the enclosure is the sum of the power used by the load plus the power lost by the power supply as waste heat. As an example, if the load taken by the electronics is normally  $260 \text{ W}$  and assuming that the power supply is  $80\%$  efficient then the total heat dissipated is  $260 \text{ W} / 0.8$  i.e.  $325 \text{ W}$ . Establishing the volume of airflow required can then be calculated. There is a simple universal formula for working out how much airflow is required to maintain a particular temperature rise for a given amount of heat which uses a constant of  $2.6$ .

Unfortunately, finding a solution

is not as straight forward as working out the required airflow as in the above solution and using the result to select a fan with the corresponding rating as fan air flow figures are given for use in free air but in reality an enclosure will have a natural resistance to air flow known as pressure drop or loss which will detract from the fan's free air performance.

The pressure loss will be different for every application due to PCB sizes and locations, size of inlet



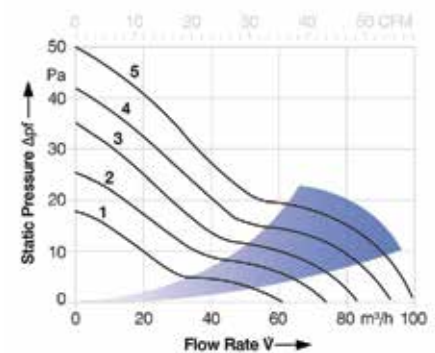
**Figure 1 – Characteristic device curve**

would require detailed knowledge of fluid dynamic equations but it can be approximated by using the characteristic device curve shown below in Figure 1. This will give an initial starting point which can be used for further evaluation.

If we consider the air flow calculated previously, the curve indicates that

and outlet vents, cross sectional area within the enclosure that the air flows through etc. Where things get a little tricky is that the pressure loss also depends on the speed of the air as it passes through the enclosure and that pressure loss in turn is affected by air speed. A faster air speed will result in a higher pressure loss, but a higher pressure loss will reduce the air speed. If careful fan selection is not done, then the fan could become useless in an application where the resulting pressure loss and air speed reach an equilibrium point that is below the required level to remove the heat from the enclosure.

It would be too complex to determine the actual pressure loss for every application as it



**Figure 2 – Fan flow rates at different air pressures**

the pressure loss would be  $11\text{Pa}$ . We then know that a fan able to generate an air flow of  $84.5\text{m}^3\text{/hr}$  into a pressure loss of  $11\text{Pa}$  is required. Each fan manufacturer will publish a graph for every fan indicating the air flow at differing pressure losses. In the example below, Figure 2, curves are given

for 5 fans. The light coloured cone shows the optimum operating range for each of the 5 fans. In our example, fan 5 would need to be used to ensure the required air flow of 84.5m<sup>3</sup>/hr with a pressure drop of 11Pa.

Once the pressure drop and air flow required have been established, there are a few other considerations to think of.

As previously stated, for general equipment cooling, the fan can be located anywhere as long as the air flows amongst the heat

source components. However, for a power supply that is designed to be forced cooled, the amount of air flowing over the

power supply is critical for correct and reliable operation. If the fan cannot be located right at the power supply, or if the entire air flow cannot be directed over the power supply then the fan chosen will need to have a very much larger rating. Some fans are specified with an air speed in linear feet per minute (LFM). Others have a volumetric rating in cubic feet per minute (CFM) or cubic meters per hour (m<sup>3</sup>/hr). To convert between the two, the cross sectional area of the fan venturi needs to be known. For a forced cooled power supply, the required air flow may be given in either a speed rating such as LFM or a volumetric rating such as CFM. The only reliable way to convert between the two is to use the cross sectional area of the power supply. Equipment with fans will often have dust filters to prevent unwanted dust entering into the equipment. A filter will add to the resistance of air flow contributing to the pressure loss and will need to be taken into consideration but more importantly, as the filter clogs with dirt, the

pressure loss may get significantly higher and a fan with suitable rating at the beginning of operation may become the wrong choice after a period of use. For this reason, dust filters should be regularly cleaned or replaced.

Adding a fan to a piece of equipment makes it audible noisy. Some applications cannot tolerate any noise for example in some hospital applications, recording studio applications etc. Even in applications going into a noisier environment, it is usually desirable to minimise audible noise. This can be done by several methods. Firstly, using a fan with a higher quality bearing. Ball bearing fans are generally quieter than sleeve bearing fans and have the advantage of a longer lifetime. Of course, there are fans that use impregnated oil within sleeve bearings which may negate this.

Also, for a given air volume, a larger fan is generally more quiet than a smaller fan due to the slower blade speed required.

Consideration should also be given to any noise generated by fan blades passing by a nearby fixed part of the fan such as a fan strut or a finger guard. If a finger guard can be separated even slightly from the fan blades, then the noise may be reduced.

Another method to minimise noise is to reduce the fan supply voltage. Fans are specified with an operating voltage range and those with a DC input usually spin at a speed dependant upon the actual DC voltage supplied. The slower spinning fan will emit less audible noise.

As the thermal management of modern power supplies is becoming increasingly important due to smaller heat sinks volumes and



**Figure 3 - GCS250 from XP Power requires just 7 CFM of air flow**

higher power densities, data sheets now contain information essential for equipment designers to ensure that the power supplies are not operated at too high a temperature in the form of specific maximum temperatures for a selection of components. Once the fan has been chosen using the preceding method, a final check should be done by measuring these component temperatures in the final configuration. If it looks like the component temperature will exceed the value indicated in the data sheet then the air flow and direction should be re-assessed. An example of an air cooling power supply is the GCS250 from XP Power. It requires just 7 CFM forced air flow. Compared to many in the industry, some of which need up to 30 CFM, the lower air flow requirements of the GCS250 help keep audible noise to a minimum.

# Ultra-Wideband MMIC SPLITTER/COMBINERS



Single Unit Coverage as Wide as **2 to 26.5 GHz**

Models from **\$5<sup>56</sup>** ea. (qty. 1000)

## **THE WIDEST BANDWIDTH IN THE INDUSTRY IN A SINGLE MODEL!**

Our new EP-series ultra-wideband MMIC splitter/combiners are perfect for wide-band systems like defense, instrumentation, and all cellular bands through LTE and WiFi. These models deliver consistent performance across the whole range, so you can reduce component counts on your bill of materials by using one part instead of many! They utilize GaAs IPD technology to achieve industry-leading performance, high power handling capability and efficient heat dissipation in a tiny device size, giving you a new level of capability and the flexibility to use them almost anywhere on your PCB! They're available off the shelf, so place your order on [minicircuits.com](http://minicircuits.com) today, and have them in hand as soon as tomorrow!

- Series coverage from 0.5 to 26.5 GHz
- Power handling up to 2.5W
- Insertion loss, 1.1 dB typ.
- Isolation, 20 dB typ.
- Low phase and amplitude unbalance
- DC passing up to 1.2A

■ EP2K-Series, 4x4x1mm  
■ EP2W-Series, 5x5x1mm



# Considering EMC Emissions Early in the Design Process

› Bruce Rose, Applications Engineer, CUI

One of the design activities often left to the end of a project is verifying that the product meets electro-magnetic compatibility (EMC) emissions requirements. EMC regulations help to ensure unintentional electro-magnetic conducted and radiated emissions do not interfere with other electronic devices. While delaying EMC compliance testing until the end of the project is a common practice, unexpected costs and project delays can be avoided by considering EMC compliance earlier in the design process.

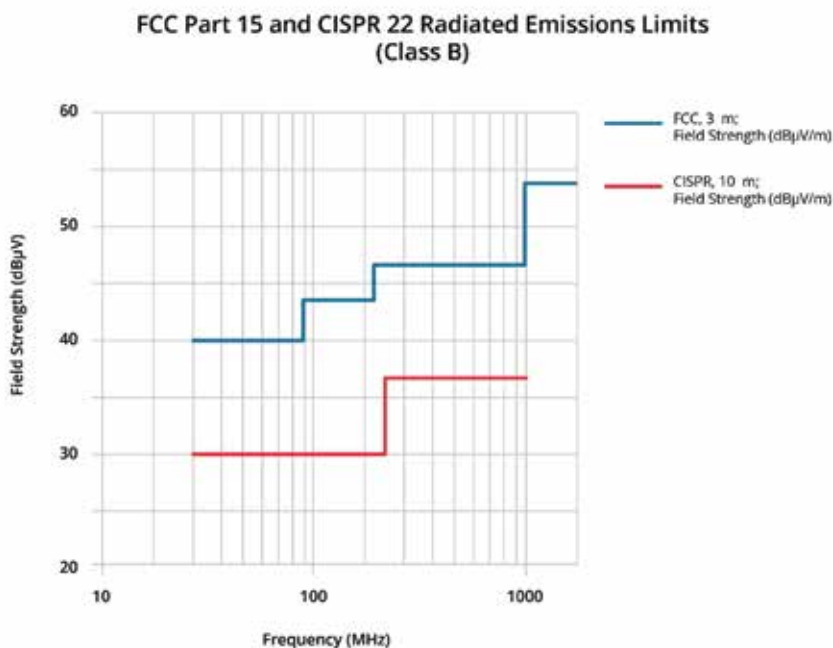
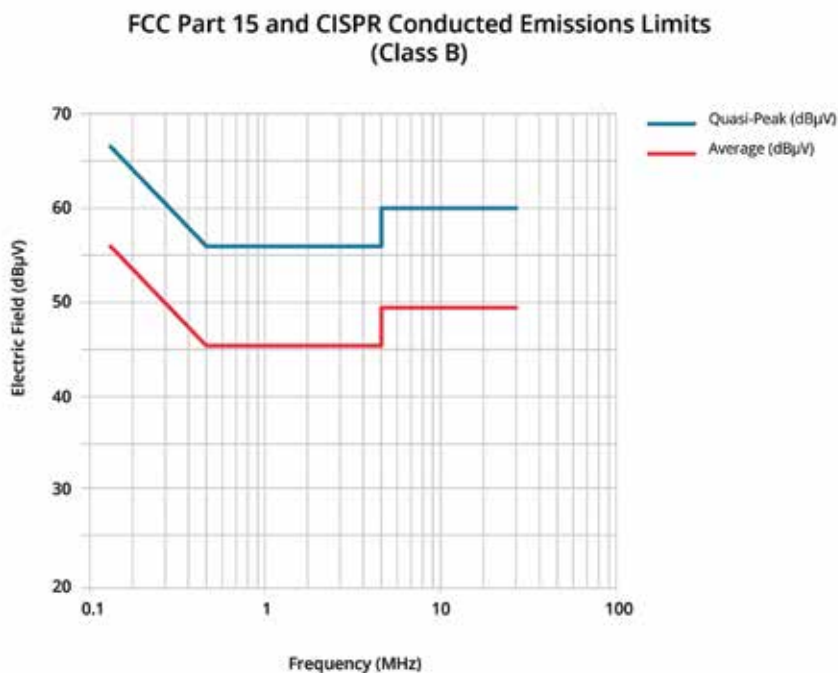
Electro-magnetic conducted and radiated emissions are the radio frequency (RF) energy emitted by a product. The level of RF emissions are regulated to ensure they do not cause unreasonable harm to other electronic products. At low frequencies (less than about 30 MHz) the conductors and cables of most electronic devices

are ineffective as antennas and thus radiated emissions are not an issue. At these low frequencies the conductors and cables can conduct RF energy through shared power sources or loads and cause issues with other electronic products, while at high frequencies (above about 30 MHz) the impedances of the conductors and cables attenuate the conducted energy sufficiently to prevent it from being an issue. However, at these higher frequencies the conductors and cables can serve as antennas and radiate the RF energy with the ability to cause interference with nearby electronic products.

Most industrial and consumer electronic products sold in the United States are required to meet conducted and radiated emissions standards as described in FCC regulations Title 47 Part 15, often referred to as FCC Part

15. Similar standards for products sold in Europe are governed by European regulations CISPR 22/EN 55022. Both sets of these regulations describe limits for conducted and radiated emissions and are applied to the final system, including the internal or external power supply. While these two sets of regulations are created and administered by separate organizations they have been constructed to be similar or "harmonized". One benefit of harmonizing these regulations is that designing a product to meet one set of regulations typically ensures it will also satisfy the requirements set forth in the other set of regulations. Conducted radiation specifications cover emissions in the frequency range of 150 kHz through 30 MHz. A separate set of radiated emissions specifications covers the spectrum of





**Figure 1: Conducted and radiated emissions limits**

30 MHz and greater. Test procedures and tools are slightly different for conducted versus radiated emissions and the filter components used to mitigate the EMC issues are similar but differ in electrical values. The conducted emissions frequency band is lower than the radiated emissions frequency band and

thus the filter components used to address conducted emissions will be electrically and physically larger than those required to address radiated emissions.

### EMC for Power Supplies

Most internally mounted power supplies are designed and tested

to meet EMC regulations and the testing is performed with the supply configured as a stand-alone product. After the power supply has been installed into a system the completed system must also be tested to ensure it meets EMC regulations. Incorporating compliant power supplies into systems minimizes the potential for EMC related issues during system testing, but does not guarantee that the completed system will pass emissions testing. Many vendors of internally mounted power supplies will provide recommended circuits to address EMC issues encountered during system integration. Because the requirements vary with each application, these recommendations are left to the discretion of the designer; this way each design incorporates only the components required for the specific application.

Similarly, most wall plug and desktop versions of external power supplies are also designed and tested to meet EMC regulations as stand-alone units. If the power supply customer is a manufacturer combining the power supply with a load then they will be required to perform testing to ensure the complete system meets EMC regulations. As the circuitry is housed in an enclosed case, adding external components to address EMC issues will be more challenging for wall plug and desktop versions as compared to internally mounted power supplies.

EMC regulatory testing of power supplies is performed with static resistive loads, but almost all power supplies are based upon switching regulator topologies. A switching regulator inherently produces conducted and radiated emissions which need to be mitigated in the design of the supply. The load applied to the power supply may create additional emissions. The uncertainty of the conducted and radiated emissions from the combined power supply and load is addressed by allowing a margin in the stand-alone

power supply test results to take into account variations when a load is applied to the power supply.

### **The Case for Early Testing**

Often EMC testing is put off until the end of a project due to time, cost and workload constraints. Unfamiliarity with compliance testing also contributes to the perception of the difficulty of such testing. While the required equipment and facilities for EMC compliance testing can be unique, many testing labs are available with experienced staff to assist in the testing.

The costs associated with compliance testing often become a 'pay me now or pay me more later' event. As testing is usually done at the end for full certification this cost can be high, but for preliminary screening the cost is minimal. Availability of lab time can be an issue as many labs are booked up several weeks out. However, small blocks of time for preliminary testing typically can be found outside of peak hours. The small amount of resources spent performing preliminary EMC testing early in the design cycle may prevent considerable and expensive redesign efforts late in the product schedule.

Another common reason for delaying the EMC testing of a system is the misconception that the power supply causes the EMC issues and thus a system will pass testing if the supply has already passed stand-alone regulatory testing. In many instances, the power supply is the recipient of the blame for EMC issues within the system when in reality it is 'only the messenger'.

While system conducted and radiated EMC issues are often addressed at the end of a project, that phase in the schedule is perhaps the worst time to introduce unexpected tasks and delays. A more reasonable and often lower cost strategy is to perform preliminary EMC compliance testing

as soon as the system assembly has begun. Earlier in a project, schedules are more flexible and design teams are more receptive to modifications in the design.

By the end of a project much effort has been applied to designing the system to meet performance criteria and if an EMC compliance issue arises the power supply is perceived as the easiest target for compliance efforts without affecting other system performance parameters. Although the system is often the source of RF emissions, the cabling on the input and the output of the power supply may be serving as antennas for radiated emissions and conductors for conducted emissions. It is often possible to add noise suppression components to the power supply to address the EMC issues, but this activity should be recognized as mitigating the effects of the problem and not addressing the source of the problem. The EMC suppression activities associated with the power supply require time from the design team and may affect the safety certificates associated with the power supply. Any changes to the safety certificates will also require time and resources from the power supply vendor. The system circuitry may need to be modified to minimize the generation of RF signals if adding conducted and radiated emission suppression components are insufficient to adequately reduce the EMC problems.

For products which use internal power supplies, EMC noise suppression components can be added either on the conductors feeding into the power supply or on the cabling between the output of the power supply and the power input to the system. Bypass capacitors and ferrite cores are suppression components used to create filters to address EMC issues. Ferrite cores introduce additional inductive impedance in series with the path of the unintended noise

and bypass capacitors provide a low impedance path to shunt noise signals to minimize signal propagation.

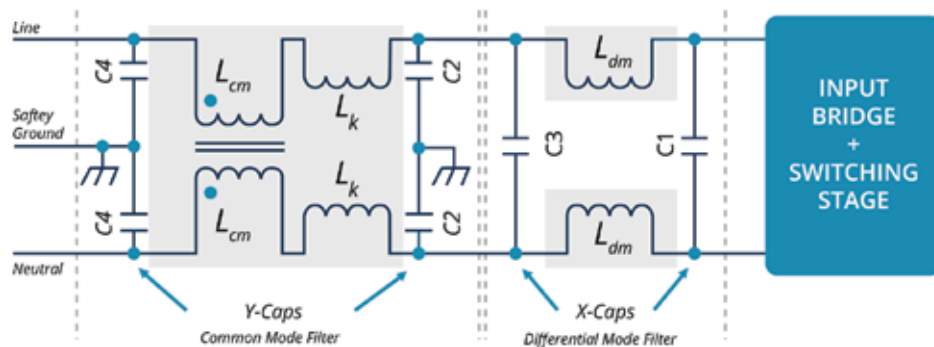
Systems employing external power supplies may be more limited in their ability to add EMC suppression components on the input or output paths of the power supply. Radiated emissions issues are typically addressed with a ferrite core placed on the cable between the power supply and the system. The frequencies of concern associated with conducted emissions are low enough such that the size of a ferrite core required to fit around a power cord and mitigate EMC issues will be unacceptable for many applications. Conducted emission issues observed in systems with external power supplies are often most easily addressed by working with the power supply vendor to modify the design of the existing supply or selecting a different external power supply incorporating enhanced conducted emissions suppression components

#### **Pre-Compliance Testing**

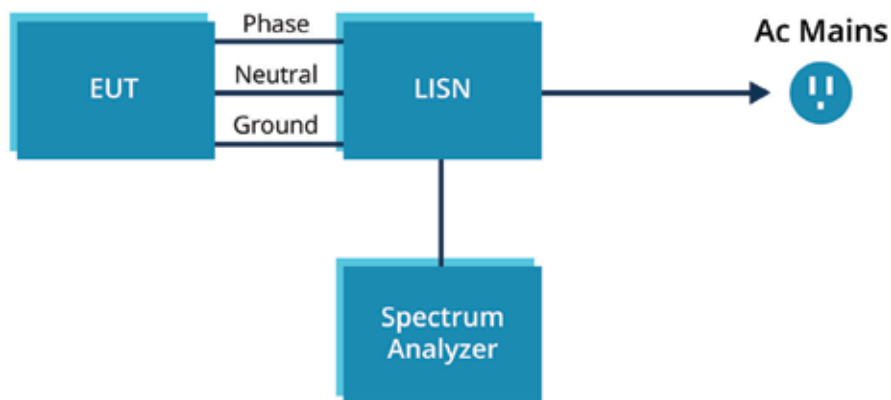
Final testing of conducted and radiated emissions needs to be performed in a certified laboratory using calibrated test equipment and a controlled electrical environment. Testing labs will cooperate to perform pre-compliance testing early in the design phase. If the design team desires to conduct the pre-compliance testing themselves the tests can be performed in a room with a minimal amount of test equipment. The equipment required for conducted emissions testing is an LISN (Line Impedance Stabilization Network) and a spectrum analyzer. The LISN is a passive network used to minimize the noise conducted from commercial power lines and also provides a controlled impedance test port to monitor the conducted emissions from the EUT (Equipment Under Test). The spectrum analyzer used for conducted emissions testing can be a basic model with the ability to

perform measurements from 150 kHz through 30 MHz. Many vendors of spectrum analyzers include the ability to perform quasi-peak measurements and incorporate conformance parameter limits in the display to simplify EMC compliance testing. Preliminary testing for radiated emissions can be accomplished with a spectrum analyzer and an appropriate antenna. The spectrum analyzer should have the capability to make measurements from 30 MHz through at least 900 MHz. The ability of the spectrum analyzer to perform quasi-peak measurements and display conformance parameter limits in the display will make the preliminary testing tasks easier to perform. The antenna used for preliminary radiated emissions testing should have a bandwidth similar to the spectrum analyzer and the gain versus frequency characteristics needing to be known. It is preferable to be able to perform the radiated emissions testing in an electrically quiet room with at least three meters (10 feet) between the radiated emissions EMC antenna and the EUT. An initial measurement in the room with the EUT powered off will provide information regarding the ambient RF noise present during the testing.

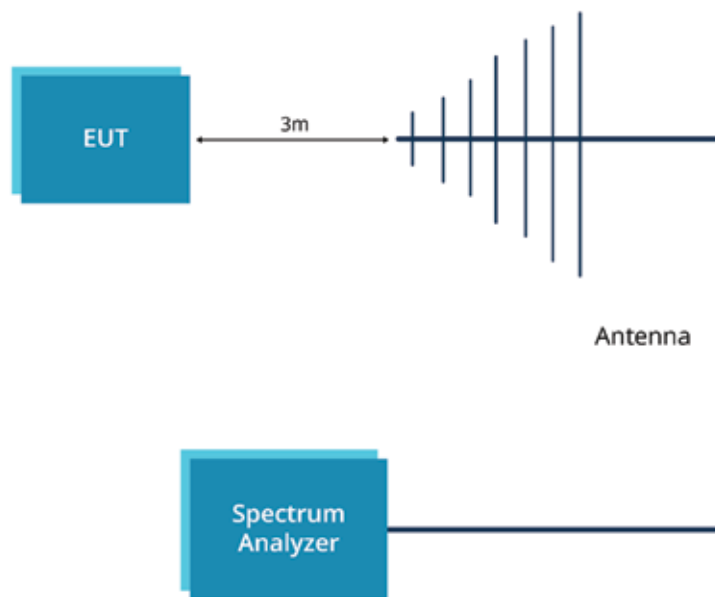
Most management teams appreciate projects completed under budget and ahead of schedule. Unfortunately, EMC compliance issues can be a common source of last minute budget and schedule increases for projects. Performing pre-compliance EMC testing during the system assembly phases of a project can help to eliminate those last minute changes to a design that impact budgets and schedules. Pre-compliance EMC testing also helps to ensure no issues arise during final compliance testing. Full service power supply vendors, such as CUI, have the equipment and experience to assist in power supply design and selection, including pre-compliance and final EMC testing.



**Figure 2: Conducted emissions filter components**



**Figure 3: Conducted emissions test set-up**



**Figure 4: Radiated emissions test set-up**



## Interline Transfer EMCCD Technology Enables a New Regime of Very Low Light Imaging

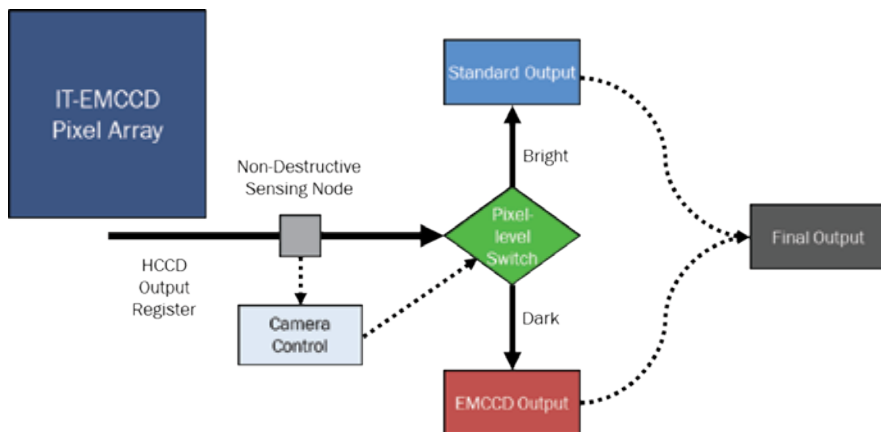
› Michael DeLuca, Go to Market Manager, Industrial and Security Division, Image Sensor Group, ON Semiconductor

While light sensitivity is an important specification for all image sensors, some applications require devices that are capable of operating under very low lighting conditions, beyond the range where standard image sensors are useful. Whether detecting a fluorescent marker viewed under a microscope, an image of the retina captured with an ophthalmic fundus camera, or a surveillance image operating on a cloudless, moonless night, technologies that enable very low light imaging – enabling 30 fps image capture at illuminations down to 0.1 lux – can be critical to success. Historically, Electron Multiplication Charge Couple Device (EMCCD) technology has been very successful

in enabling the capture of scenes with very low light levels. This technology takes the very small charge detected in a pixel under low light and multiplies it many times before reaching the sensor's amplifier, allowing the initially unresolvable low signal level to be raised above the amplifier noise floor for detection. While this technology excels at image capture under low light levels – even down to the detection of single photons – the electron multiplication cascade can overflow and create blooming artifacts if signal levels entering the EMCCD register are too high, limiting use of sensors with this technology to scenes that do not contain any bright components. In addition,

the Full Frame Transfer technology traditionally used for EMCCD designs limits the resolution available from these devices to approximately one megapixel or lower, restricting the spatial image quality available when using this technology in video applications.

Interline Transfer EMCCD technology addresses these limitations directly by combining the low light sensitivity available from an electron multiplication output register with the image uniformity, resolution scaling, and electronic global shutter capabilities of Interline Transfer CCD. This combination enables the development of image sensors that can capture continuously from very low light to bright light in



**Figure 1: Intra-scene Switchable Gain Output**

designs that can range to multiple megapixels in resolution.

Key to the performance of this technology is an Intra-Scene Switchable Gain feature, which avoids overflow in the EMCCD output register under bright illumination conditions by selectively multiplying only those portions of the scene that require it. This output design is shown in Figure 1, where charge from each pixel passes through a non-destructive sensing node which can be read by the camera control electronics to provide an initial measurement of the signal level for each pixel. This information is used to drive a switch in the sensor that routes charge packets to one of two outputs based on a camera-selected threshold.

Pixels with high charge levels (corresponding to bright parts of the

image) are routed to a standard CCD output for conversion to voltage, while pixels with low charge levels (corresponding to dark parts of the image) are routed to the EMCCD output for additional amplification before conversion to voltage. These two datasets are then merged to generate the final image. Since the charge from pixels with high charge levels does not enter the EMCCD register, this output architecture allows both very low light levels and bright light levels to be detected while avoiding the image artifacts associated with overflow of the EMCCD output register.

The power of this technology can be seen in Figure 2, which shows image captures of a single scene that includes both a bright light as well as very dark shadows, where the darkest portion of the image



**Figure 2: A scene with both bright and very dark components, imaged by a standard IT-CCD (left), a standard EMCCD (center), and an Interline Transfer EMCCD device (right)**

is illuminated only by moonlight or starlight.

A traditional image sensor (the left image in Figure 2) images the bright part of the image well, but doesn't have the sensitivity to "see" in the very darkest part of the image. A traditional EMCCD (center) can be configured to image in the very darkest part of the scene, but when the gain is turned up to enable this low light imaging, artifacts from the bright part of the scene destroy the image integrity. Interline Transfer EMCCD technology (right) allows the scene to be imaged continuously from the brightest to the darkest part of the image, where "dark" can extend all the way down to illumination only by moonlight or by starlight.

Having been moved forward from the research labs to use in production devices, Interline Transfer EMCCD technology is being used today in a growing family of products. ON Semiconductor's KAE 02150 image sensor uses Interline Transfer EMCCD technology to enable low light image capture at 1080p (1920 x 1080) resolution while operating at 30 fps, making this device well suited to security, surveillance, and situational awareness applications that require high sensitivity image capture with video frame rates. For higher resolution needs, the 8 megapixel (2856 x 2856) KAE 08151 image sensor is designed in a square aspect ratio with a 22 mm diagonal, aligning with the native optical format of many scientific microscopes and other medical equipment. By leveraging the advances available with Interline Transfer EMCCD technology, these devices are the first in a new class of image sensors that achieve high levels of performance under low lighting conditions.

## VxWorks 653 Multi-core Edition Update: Why COTS Certification Evidence Matters

› Stephen Olsen, Product Manager, Wind River

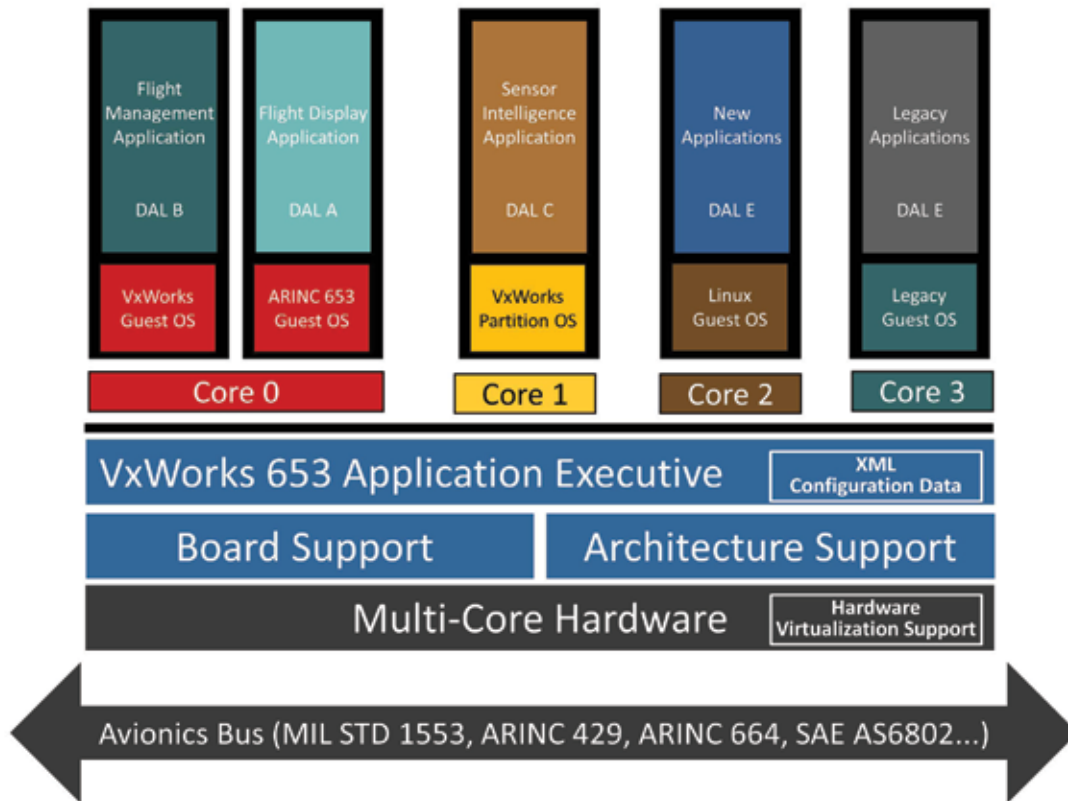
The growing demand for highly complex aircraft systems is placing increased pressure on suppliers to deliver aircraft with far greater capabilities while complying with a growing demand for safety certification, as most advanced cockpits require software that is considered safety-critical. One way to address this complexity is to use more commercial-off-the-shelf (COTS) software technologies that come with certification evidence that can be included in the submission with the Federal Aviation Administration (FAA), EASA, or other safety agencies who grant the authorization to operate an aircraft. When technology suppliers create this evidence significant risk

is removed from avionics companies who must minimize this risk at all levels of a new program. This becomes even more important when using multi-core processors where there is no straightforward path to certification; therefore the project risk increases exponentially. To help avionics suppliers reduce the risk and cost of certification, Wind River today announced the certification evidence release for VxWorks® 653 Multi-core Edition on an advanced PowerPC multi-core processor, meeting the rigorous RTCA DO-178C and EUROCAE ED-12C DAL A requirements. This release adds the certification evidence package needed to comply with the FAA's safety requirements –

designs, tests, reviews, source code, build files, test results, annotated object-level code coverage, and tool qualification data for critical integrated modular avionics (IMA) systems.

The delivery of this COTS certification evidence:

1. Allows suppliers to leverage the safety-proven base platform from Wind River, building against the certified binaries to speed up their certification process in next generation safety-certified systems using multi-core processors
2. Removes significant certification and deployment risk from avionics programs
3. Increases certification evidence quality and depth that is not



affordable using single program budgets

**4.** Decreases overall costs for certification including any recertification work

**5.** Accelerates the time-to-deployment for challenging FAA RTCA DO-178C DAL A multi-core certification programs

Certification: Multi-core systems use case

Multi-core systems bring an additional layer of complexity in terms of system integration and certification. Beyond the technical aspects related to safe partitioning, avionics suppliers must also manage the business concerns related to pulling in applications from various providers. These applications must all share the same processor, but they often times can be certified at different certification design

assurance levels (DAL), according to their impact on mission safety. Another critical issue for avionics companies is shortening the development cycle and certification cost of adding features to software. For instance, if one application is updated, or another one added, this raises the question whether the whole system should go through a recertification process or if certification can be done only on the affected application.

In VxWorks® 653 Multi-core Edition these platforms can run on different partitions. They can be updated and certified separately. Using robust partitioning and a qualified XML compiler, one partition can be updated and certified without affecting the rest of the system. This is extremely valuable when deploying applications at different

levels of safety criticality. Without a robust partitioning strategy all applications would have to be certified at system high – with robust partitioning each IMA application only needs to be only at its minimum DAL level. Investing in multiple recertification projects for the entire system at system high creates far higher cost and schedule risk for the avionics project.

With the release of the certification evidence for VxWorks 653 Multi-Core Edition, Wind River is providing practical evidence of its premier certification of the multi-core solution for ARINC 653 IMA systems, allowing avionics companies to lower project risks for multi-core systems certification.



## The Cloud Comes to You: AT&T to Power Self-Driving Cars, AR/VR and other Future 5G Applications Through Edge Computing

### > Powerful Compute Capabilities will Drive Down Latency for Next-Gen Applications

AT&T is reinventing the cloud to boost the potential of self-driving cars, augmented reality and virtual reality, robotic manufacturing, and more. We're embracing a model called edge computing (EC) to move the data crunching from the device to the cloud. Driving it will be the single-digit millisecond latency that only tomorrow's 5G can deliver. And powering it all will be our software-defined network, the most advanced of its kind in the networking industry.

Here's the challenge: Next-gen applications like autonomous cars and augmented reality/virtual reality (AR/VR) will demand massive amounts of near-real time

computation.

For example, according to some third-party estimates, self-driving cars will generate as much as 3.6 terabytes of data per hour, due to the clusters of cameras and other sensors required to enable their digital vision. Some functions, such as braking, turning and acceleration will likely always be managed by the computer systems in the cars themselves. But what if we could offload to the cloud some of the secondary systems? These include things like updating and accessing the detailed maps these cars will use to navigate.

Or consider AR/VR. The industry is moving to a model where those

applications will be delivered through your smartphone. But creating entirely virtual worlds or overlaying digital images and graphics on top of the real world in a convincing way also requires a lot of processing power. Even when phones can deliver that horsepower, the tradeoff is extremely short battery life.

Edge computing addresses those obstacles by moving the computation into the cloud in a way that feels seamless. It's like having a wireless supercomputer follow you wherever you go.

"Edge computing fulfills the promise of the cloud to transcend the physical constraints of our



mobile devices," said Andre Fuetsch, president of AT&T Labs and chief technology officer. "The capabilities of tomorrow's 5G are the missing link that will make edge computing possible. And few companies have the sheer number of physical locations that AT&T has that are needed to solve the latency dilemma."

The faster speeds and particularly the lower latency expected with 5G will be critical elements to enabling edge computing. But latency is also determined by the physical distance between a mobile device and the network resources to which it's connected.

For example, say you want to run a virtual reality experience in the cloud. And the data center powering that experience is hundreds of miles away from you and your VR glasses. As a result, every time you turn your head, there's a good chance there will be a noticeable delay between when you turn and when the image moves to follow your gaze. That lag is an unavoidable byproduct of the time it takes that data to cross those large physical distances.

So we're shrinking the distance. Instead of sending those commands hundreds of miles to a handful of data centers scattered around the country, we'll send them to the tens of thousands of central offices, macro towers, and small cells that are generally never farther than a few miles from our customers.

If the data centers are the "core" of the cloud, these towers, central offices, and small cells are at the "edge" of the cloud. Intelligence is no longer confined to the core. The cloud comes to you.

We'll outfit those facilities with high-end graphics processing chips and other general purpose computers. We'll coordinate and manage those systems with our virtualized and software-defined network.

Eventually, we could embed these systems in everyday items like traffic lights and other infrastructure. That could enable self-driving cars to talk to their surroundings or alert fire and medical services almost instantly when there's a problem. You could get amazing virtual reality and augmented reality images delivered instantaneously to the super-slim device in your pocket. Doctors would be able to view and share and adjust complex medical images without having to invest in expensive imaging systems.

Edge computing could also spark the next generation of robotic manufacturing. The 5G service on the horizon could play a vital role in what's called "Industry 4.0 - Digital Manufacturing". The anticipated low-latency wireless connections could eliminate the traditional wired connections to robotic assemblers. Manufacturers will be able to quickly retool their operations as robots in the factory will be connected wirelessly, eliminating the need for time-consuming rewiring. Products can get to market faster.

We're already deploying EC-capable services to our enterprise customers today through our AT&T FlexWareSM service. Customers can currently manage powerful network services through a standard tablet device. We expect to see more applications for EC in areas like public safety that will be enabled by the FirstNet wireless broadband network.

We're committed to deploying mobile 5G as soon as possible and we're committed to edge computing. As we roll EC out over the next few years, dense urban areas will be our first targets, and we'll expand from those over time. Our network virtualization initiative will go hand in hand with our mobile edge computing program. Our goal is to virtualize 75% of our network functions by 2020. We aim to cross the halfway mark this year, reaching 55%. As we've said before, we think 5G and software defined networking will be deeply intertwined technologies. We don't think you can claim to be preparing for 5G and EC if you're not investing in SDN.

We're all in. Now.

Our AT&T Labs and AT&T Foundry innovation centers are playing a key role in designing and testing edge computing. In February, the AT&T Foundry in Palo Alto released a white paper discussing the computing and networking challenges around AR/VR. In the coming weeks, our second white paper will discuss how we can apply edge computing to enable mobile augmented and virtual reality technology in the ecosystem.

There's no time to lose. We think edge computing will drive a wave of innovation unlike anything seen since the dawn of the internet itself. Stay tuned.



## **BLOODHOUND IS GO! A supersonic racing car designed to hit speeds of 1,000mph is to be tested for the first time.**

The world's most advanced straight-line racing car, BLOODHOUND SSC, will be driven for the first time, at Cornwall Airport Newquay, this October, twenty years after the current record of 763.035 mph was set. Wing Commander Andy Green steered Thrust SSC to victory on 15th October 1997 and will be at the wheel of BLOODHOUND SSC as it is put through its paces this autumn.

Runway trials will mark the culmination of a month of tests to prove the car's steering, brakes, suspension, data systems, and so on, as well as the EJ200 jet engine, sourced from a Eurofighter Typhoon. Thousands of visitors are expected to come and see history being made as BLOODHOUND SSC is driven at speeds of up to 200mph on the 1.7mile (2.7km) long runway.

Before it moves under its own power, BLOODHOUND SSC will first undergo several days of static 'tie-down' tests. The jet engine will be run up, with the Car chained to the ground, so that the performance of car's bespoke air intake, fuel and electrical systems can be checked. All being well, dynamic testing will then follow on.

Of primary interest is the low-speed capability of the jet engine intake, positioned above the cockpit. Designed to work best at speeds over 800mph, the Project's engineers need to understand how it performs at very low speeds.

Knowing how soon full power can be applied minimises this risk while having 'real world' acceleration data will



enable Ron Ayers, Chief Aerodynamicist, to plan the sequence of runs in South Africa that, it is hoped, will result in a new record. The Newquay Trials will also be Andy Green's first opportunity to drive the Car and experience the steering feel, throttle and brake action, noise and vibration – things that can't be simulated.

It takes a team to run BLOODHOUND SSC and this will be the first opportunity to train the support crew, as well as develop the Car's operating procedures, prove and refine the safety protocols, and practice radio communications, before heading overseas in late 2018. During tests the Car will powered by the jet engine alone and use wheels shod with pneumatic tyres, 84cm in diameter, from a English Electric Lightning

# Out Of the box



fighter, specially reconditioned by Dunlop. As the runway wheels and suspension are slightly thicker than the solid aluminium wheels that will be used in the desert, some sections of carbon fibre bodywork will not be fitted.

Richard Noble, Project Director, said, "The runway trials at Cornwall Airport Newquay will be the biggest milestone in the history of the Project so far. They will provide important data on the performance of the Car and give us a first opportunity to rehearse the procedures we'll use when we go record breaking.

Just as importantly, it is a way of saying 'thank you', to the schools, students, families and companies, big and small, who support The Project. We are proud to

be waving a flag for British skills and innovation on a world stage but, most of all, this is about inspiring young people. Last year alone we directly engaged with over 100,000 students in the UK and we have already seen more students take up engineering as result of Project BLOODHOUND. With the Car running, we can showcase science, technology, engineering and mathematics in the most exciting way possible. BLOODHOUND is Go!"

Gavin Poole, chairman of the Aerohub Enterprise Zone board and a board member of the Cornwall and Isles of Scilly Local Enterprise Partnership, said: "The BLOODHOUND team has already been using Aerohub to test components so we can't wait to welcome the complete car. It will be very exciting to see the world leading engineering, aerodynamics, computing and jet engine moving at speed. BLOODHOUND is an inspirational project that is making the most of Cornwall's excellent testbed facilities. We're really looking forward to welcoming the BLOODHOUND team."

The BLOODHOUND Project centres on BLOODHOUND SSC, a supersonic car that is designed not only to go faster than the speed of sound (supersonic) but to over 1,000mph (1,600km/h). It will cover a mile in just 3.6 seconds.

BLOODHOUND SSC is approximately 13.4m long and weighs 7.5 tonnes. The design is a mix of car and aircraft technology, with the front section being a carbon fibre monocoque (like a racing car) and the back portion being a metallic framework and panels (like an aircraft). The two front wheels sit within the body and two rear wheels are mounted externally within wheel fairings.

The Car will be powered by both a jet engine and a rocket, which together will produce more than 135,000 horsepower: that's more than six times the power of all the Formula 1 cars on a starting grid put together. Over 110 man years of effort have been invested in the design, build and manufacture of BLOODHOUND SSC.

## **■ A new window will open Toshiba's Visconti™4 Image Recognition Processor Powers DENSO's Front-Camera-Based Active Safety System**

Toshiba Electronic Devices & Storage Corporation today announced that DENSO Corporation (DENSO) is deploying Visconti™4, its latest image-recognition processor dedicated to automotive applications, in next generation, front-camera-based active safety systems. Visconti™4 is a leading-edge, multi-engine road-safety solution that provides drivers with real-time analytics of road conditions and potential dangers.

Electronic systems are taking on an increasingly central role in driving, including advanced driver assistance systems and support for autonomous vehicles, and particularly in promoting road safety. The latest iteration of the influential European New Car Assessment Programme (Euro NCAP), the EU-backed safety standard, adds criteria for evaluating anti-collision features that improve protection for bicyclists and pedestrians.

The Visconti™4 image recognition processor is equipped with eight media processing engines, allowing it to execute eight applications simultaneously. It can detect and analyze camera-generated images and recognizes traffic lanes; nearby vehicles, both parked and moving; traffic signs and signals; the headlights of oncoming vehicles; plus the most vulnerable road users of all, bicyclists and pedestrians.

Visconti™4 has double the number of processing engines of its predecessor, the Visconti™2, used by DENSO since 2015. It also integrates a new image recognition algorithm, Enhanced CoHOG Accelerator[1] that delivers enhanced processing of luminance differences between objects and their backgrounds to better detect pedestrians at night and low light conditions.

Toshiba and DENSO are also cooperating in AI, on the development of deep neural network-intellectual property (DNN-IP) for use in image recognition, and plan to bring this state-of-the-art technology to future additions to the Visconti series.

The global market of vehicle-mounted cameras is expected to approach \$9.6 billion in 2021[2]. Toshiba is committed respond to with automotive semiconductor solutions that further pursue traffic safety.



## **■ Hitachi Automotive Systems' Lightweight, Compact and Highly Reliable Lithium-Ion Battery Module has been Chosen for Suzuki's New "Swift" Vehicles with Hybrid Technology**

Hitachi Automotive Systems, Ltd. today announced that its lightweight, compact and highly reliable lithium-ion battery module has been chosen for Suzuki Motor Corporation's new Swift HYBRID SG and Swift HYBRID SL, fitted with hybrid technology. The new models were launched on July 12, 2017.

The lithium-ion battery module features high performance and a highly reliable battery cells cultivated through previous experience and combined into a single unit with a voltage detection substrate for detecting voltage in the battery cells. This made it possible to reduce the weight by 35% (compared to the previous product by Hitachi Automotive Systems) and lower its height by 37% (compared to the previous product by Hitachi Automotive Systems).

Since Hitachi Automotive Systems began pioneering the in-vehicle lithium-ion battery business in 1999, it has produced many lithium-ion batteries. In the manufacturing of lithium-ion batteries, the company uses expertise related to mass production and quality control that has been cultivated over many years by Hitachi Vehicle Energy, Ltd., a group company. Its lithium-ion batteries have been highly evaluated by manufacturers both within and outside of Japan.

Thanks to the strong evaluations of Hitachi Automotive Systems' track record and the potential for in-vehicle use of its progressively lightweight and compact batteries, the batteries were chosen for the new Swift HYBRID SG and Swift HYBRID SL. This follows their use in the latest Solio/Solio Bandit, which was released in November 2016.

Going forward, Hitachi Automotive Systems will contribute to the development of electric vehicles while

also helping to conserve the environment by providing electric powertrain products such as high performance and highly reliable lithium-ion batteries for the electric vehicle market, which is predicted to continue expanding.



### Intersil Ships Automotive Industry's First Full HD LCD Video Processor

Intersil, a subsidiary of Renesas Electronics Corporation (TSE: 6723), today announced the TW8844 LCD video processor that interfaces with the latest generation of automotive SoCs. The highly integrated TW8844 is the first high-definition (HD) 1080p LCD video processor with analog video decoder, two scalers and MIPI-CSI2 SoC interface, and builds on Intersil's automotive video leadership in infotainment and display systems. The TW8844 provides the reliability automakers require to ensure their rearview camera systems are compliant with the U.S. Federal Motor Vehicle Safety Standard (FMVSS-111) for preventing injury or death caused by backover accidents. The TW8844 enables the migration from analog to digital camera systems, and supports a variety of video interfaces and LCD panel resolutions up to full HD 1920 x 1080. The TW8844 LCD video processor is ideal for center stack/head units, full display rearview mirrors, instrument cluster displays, and dual headrest rear-seat entertainment systems. Watch a video on the TW8844 solution.

Automakers are starting to make rearview camera systems standard equipment for all new car models worldwide. In the U.S., the National Highway Traffic Safety Administration mandated in March 2014 that automakers implement "rear visibility technology" as standard equipment for all vehicles under 10,000 pounds, as part of the Kids Transportation Safety Act. The new FMVSS-111 regulation specifies that the area behind a vehicle must be visible to the driver when the

vehicle is placed into reverse, thereby minimizing blind spots. The law aims to reduce the number of deaths and injuries caused by driver backup accidents, many involving young children. The FMVSS-111 law requires that all new vehicles sold in the U.S., beginning in May 2018, have rearview backup cameras and the rear camera video must display in less than two seconds after the driver places the vehicle into reverse gear.

The TW8844 video processor with MIPI-CSI2 output and TW8845 video processor with BT.656 output exceed the requirements of the FMVSS-111 law, displaying live video with graphics overlay in less than 0.5 seconds after vehicle ignition. The TW884x provides a robust rear-camera architecture to overcome the fast boot reliability issues inherent with today's more complex center stack systems. Today's head units are prone to operating system (OS) software freezes and hang-ups that display a frozen image or prevent the rear camera from displaying live video. With SoCs running increasingly complex operating systems, software freezes and hang-ups are more common. The TW884x eliminates this problem by monitoring the SoC and camera output to determine if they are in a frozen or corrupted state. If the TW884x detects any issue, it bypasses the SoC and instantly displays the rearview camera video.

"The TW884x's frozen detection feature is hardwired to trigger an interrupt signal if thresholds are violated, ensuring the vehicle's rearview camera is FMVSS-111 compliant and live video is instantly displayed," said Philip Chesley, senior vice president of Precision Products at Intersil. "In addition, the TW884x's rearview camera bypass architecture decouples the camera-to-display signal path from the rest of the infotainment system, which makes attaining an ISO 26262 functional safety rating on the camera system easier for automakers."

Key Features and Specifications of TW8844 and TW8845 video processors

■ Support several video inputs from analog or digital HD cameras:

- 10-bit ADC NTSC/PAL analog video decoder supports differential, pseudo differential, and single ended composite video inputs (two differential or four single-ended), with built-in short-to-battery and short-to-ground diagnostics
- Two independent digital RGB input ports up to 24-bit RGB at 160MHz (1080p) each

- Two LVDS OpenLDI input ports (shares pins with the 2nd DRGB input) in 1-ch or 2-ch input mode, with 100MHz (max) per channel in 1-ch mode or 160MHz in 2-ch mode
- Support either one full HD input (1080p) or two HD inputs (720p)
- Provide system flexibility to drive most LCD panels:
- LCD path for TTL/TCON up to 24-bit DRGB, 160MHz (max)
  - LVDS OpenLDI: dual channel, 100MHz (max) per channel in 1-ch mode or 160MHz in 2-ch mode
  - TW8844 supports 4-lane MIPI-CSI2 output for up to 1080p, with up to 1Gb/lane
  - TW8845 supports BT.656 output to the SoC with resolutions up to 720p
- Two input measurement engines with frozen/abnormal image detection diagnostics to monitor input from the SoC and camera
- EEPROM fast boot allows register programming without need for external microcontroller
- Two separate H/V scalars for outputting up to 1080p (1920 x 1080) resolution, allow processing of two different sources simultaneously, while outputting different data to the SoC and display, or they can simultaneously drive two different displays with different content
- Automatic Contrast Adjustment (ACA), white balance and gamma correction optimizes video quality
- Smooth input switching allows switching between various input sources without screen flicker
- AEC-Q100 Grade-2 qualified for operation from -40°C to +105°C

The TW8844 and TW8845 can be combined with Renesas' R-Car SoC family, as well as the ISL78302 dual LDO, ISL78322 dual 2A/1.7A synchronous buck regulator, and ISL78228 dual 800mA synchronous buck regulator to provide power rails for the TW884x, SoC and other key components on the automotive infotainment system board.

#### Pricing and Availability

The TW8844 video processor with MIPI-CSI2 output is available now in a 14mm x 20mm, 156-lead LQFP package, and is priced at \$10.00 USD in 1k quantities. For more information on the TW8844 and evaluation board, please visit: <http://www.intersil.com/products/tw8844>.

The TW8845 video processor with BT.656 output is

available now in a 14mm x 20mm, 156-lead LQFP package, and is priced at \$9.50 USD in 1k quantities. For more information on the TW8845 and evaluation board, please visit: <http://www.intersil.com/products/tw8845>.



#### ■ VPG Foil Resistors Announces Ultra-High Precision Military and Space Grade Resistors for High-Performance Current Sensing within Mission-Critical Applications

The VPG Foil Resistors product group of Vishay Precision Group (NYSE: VPG) ([www.vpgfoilresistors.com](http://www.vpgfoilresistors.com)), manufacturers of the industry's most precise and stable precision resistors, today introduced the Model 303337 ultra-high precision military and space-grade resistor, offering high-performance current sensing within mission-critical applications.

The Model 303337 produces a highly precise voltage that is directly proportional to measured current levels, with significantly reduced component sensitivity to applied power changes, including PCR and thermal resistance values. The industry-exclusive design of the Model 303337 incorporates VPG's own proprietary Bulk Metal® Z Foil resistive technology, along with a four-terminal Kelvin connection, for ultra-high precision current sensing and temperature stability to 3W. Additional attributes include a low temperature coefficient of resistance (TCR) of  $\pm 5$  ppm/°C (-55°C to +125°C, at +25°C ref.), for reduced risk of measurement errors due to temperature changes; improved load-life stability of  $\pm 0.02\%$  (typ.), at +70°C for 2000 hours (rated power); a low power coefficient of resistance (PCR) of 5 ppm/W at rated power; a resistance tolerance to  $\pm 0.1\%$ ; a 100 to 200 mΩ resistance range; a short-time overload of 0.005% typical; an electrostatic discharge (ESD) limit of < 25 kV; solderable terminations; and a choice of either lead (Pb)-free or tin/lead alloy solder finish.

To ensure total resistor reliability and conformance to

published specifications, each unit undergoes stringent testing across its full batch lot. A Quality Conformance Inspection report accompanies each shipment, detailing all test data collected during Environmental Test Laboratory studies. The report offers design engineers a reliable set of data for the anticipation of actual resistor performance within an intended installation environment. Data includes screen/test flow per EEE-INST-002 (Tables 2A and 3A, Film/Foil, Level 1), MIL-PRF-55342 and MIL-PRF-49465, among other parameters. For customer convenience, prototype quantities of the Model 303337 resistor are also available with expedited deliveries. Please contact [foil@vpgsensors.com](mailto:foil@vpgsensors.com) for details.

The Model 303337 ultra-high precision surface mount resistor may be specified within demanding and mission-critical military, aerospace, defense and space applications, including those where a precision resistor is required to quickly reach thermal equilibrium, within circuits that either require fast response times, or which are characterized by rapid current changes. Within the military, aerospace, defense and space industries, typical applications include commercial and military avionics, switching linear power supplies, power amplifiers, power management systems, feedback circuits, measurement instrumentation and associated automatic test equipment. Other applications include switching and linear power supplies, precision high current-sensing, power management systems, feedback circuits, power amplifiers, and precision electronic scales. To learn more about VPG Foil Resistors and its available product offerings, visit [www.vpgfoilresistors.com](http://www.vpgfoilresistors.com).



### Maxim's Dual Channel Transceiver Adopted by Omron for IO-Link Sensor Applications

Maxim Integrated Products, Inc. (NASDAQ:MXIM) announced that its MAX14827A dual IO-Link®

transceiver has been adopted by Omron Corporation. The high-performing device from Maxim, which utilizes IO-Link sensors to reduce maintenance and increase uptime, provides continuous diagnostics and monitoring at Omron's customers' production sites. It dissipates > 50% less heat than other solutions and is the smallest solution available.

IO-Link, a standardized IO technology which has rapidly been adopted in Europe, is now tracking on the same growth curve in the Japan market. It has recently been attracting attention as a technology to realize smart factory applications by seamlessly connecting facilities with various plant sensors through digital communications. Recognizing the importance of IO-Link, Maxim has developed a variety of products using IO-Link technology, including products like the MAX14827A IO-Link dual-channel transceiver in new Industry 4.0 applications.

Omron is expanding its IO-Link sensor series primarily in photoelectric and proximity sensors. Equipped with an individual identification confirmation feature and unique ability to detect abnormalities and monitor situations, Omron's IO-Link sensors deliver solutions that shorten downtime, lower frequency of sudden failures, and increase efficiency in changing arrangements. This enables smarter production facilities by collecting critical data for stable facility operations, with PLCs and other superior controllers, via EtherCAT through a master unit. IO-Link Overview

IO-Link is the first standardized IO technology worldwide (IEC 61131-9) for communication with sensors and actuators. The powerful point-to-point communication is based on the long established 3-wire sensor and actuator connection using existing cables.



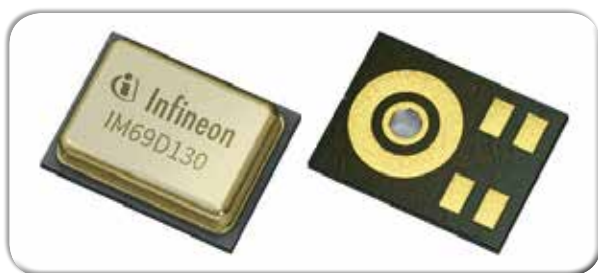
## Infineon introduces packaged MEMS microphones with a 70 dB signal-to-noise ratio

Infineon Technologies AG (FSE: IFX / OTCQX: IFNNY) is entering the packaged silicon microphone market. With this it is addressing the needs for high performance, low noise MEMS microphones. The analog and digital microphones are based on Infineon's dual backplate MEMS technology and distinguish themselves with a 70 dB signal-to-noise ratio (SNR). This is combined with an exceptionally low distortion level of 10 percent at a 135 dB sound pressure level (SPL). In a 4 mm x 3 mm x 1.2 mm MEMS package, the microphones are very well suited for high-quality acoustic recordings and far field voice capturing applications.

"This is an expansion of the established high volume bare die MEMS and ASIC business model with our packaging partners around the world," said Dr. Roland Helm, Senior Director and Head of Product Line Sensors for Infineon's Power Management and Multimarket Division. "We will continue to strengthen and grow our business with our partners with bare dies; additionally we now address low noise high-end use cases with our two new packaged microphones."

Current MEMS microphone technology uses a sound wave actuated membrane and a static backplate. Infineon's dual backplate MEMS technology uses a membrane embedded within two backplates thus generating a truly differential signal. This allows improved high frequency immunity for better audio signal processing and increases the acoustic overload point of 10 percent Total Harmonic Distortion (THD) to 135 dB SPL.

The SNR of 70 dB is an improvement of 6 dB compared to a conventional MEMS microphone. This improvement is equivalent to doubling the distance from which a user can give a voice command that is captured by the microphone. Additionally, the analog and digital microphones have excellent microphone-to-microphone matching ( $\pm 1$  dB sensitivity matching and  $\pm 2^\circ$  phase matching) which is ideal for implementing in arrays. For this reason the MEMS microphones are a perfect fit for ultra-precise beam forming and noise cancelling



## 20V, 20A Monolithic Synchronous Silent Switcher®2 Buck Regulator Reduces EMI & Enables High Power Density Applications

Analog Devices, Inc., which recently acquired Linear Technology Corporation, announces the LTC7150S, a 20V, 20A monolithic synchronous buck converter with differential VOUT remote sensing. The device's unique phase lockable controlled on-time constant frequency current mode architecture eases compensation and is ideal for high step-down ratio applications that operate at high frequencies while demanding fast transient response. The LTC7150S uses Silent Switcher®2 technology, including integrated bypass capacitors to deliver a highly efficient solution with excellent EMI performance while easing layout constraints. Multiphase operation with up to 12 phases provides the capability to directly parallel multiple devices for higher current with minimal increase in input and output capacitance. VOUT remote sense ensures that voltage regulation at the load is accurate regardless of load current or board layout. The LTC7150S's wide 3.1V to 20V input range supports a wide variety of applications, including most intermediate bus voltages, and is compatible with many battery types. Integrated N-channel MOSFETs deliver continuous load currents as high as 20A with minimal thermal derating, at output voltages ranging from 0.6V to VIN, ideal for point-of-load applications such as powering high current/low voltage DSPs, FPGAs and ASICs. Other applications include telecom/datacom systems, distributed power architectures and general high power density systems. The LTC7150S's very low 25ns minimum on-time allows for a high step-down ratio power supply at high frequencies supporting both forced continuous and discontinuous mode operation. The operating frequency is selectable from 400kHz to 3MHz and can be synchronized to an external clock. The LTC7150S's total differential output voltage accuracy is  $\pm 1\%$  over the  $-40^\circ\text{C}$  to  $125^\circ\text{C}$  operating junction temperature range. Additional features include differential remote VOUT sensing directly at the load, PHMODE phase selector pin, accurate 1.2V RUN pin threshold, VIN overvoltage protection, power good and programmable soft-start/tracking.





### 105V, 2.3A Synchronous Step-Down Regulator Delivers 96% Efficiency with Ultralow EMI/EMC Emissions

MILPITAS, CA & NORWOOD, MA – July 17, 2017 – Analog Devices, Inc., which recently acquired Linear Technology Corporation, announces the LTC7103, a 2.3A, 105V input capable synchronous step-down switching regulator. Its wide 4.4V to 105V input voltage range is designed for operation from a continuously high voltage input source or from an input that has high voltage surges, eliminating the need for external surge suppression devices. This makes the LTC7103 ideal for a variety of transportation, industrial and communications applications such as 48V automotive, 36V to 72V telecom, avionics and dual battery vehicle systems.

The LTC7103's high efficiency internal power switches can deliver up to 2.3A of continuous output current. The LTC7103 incorporates proprietary technology that reduces EMI/EMC emissions to an ultralow level, easily passing automotive CISPR#25, Class 5 limits without sacrificing efficiency. The LTC7103 delivers efficiencies over 96% while regulating a 12V output and over 90% while regulating a 3.3V output. To avoid noise-sensitive frequency bands, the switching frequency can be set between 200kHz and 2MHz, or synchronized anywhere in this range using the LTC7103's internal phase-locked loop.

The LTC7103 uses a unique constant frequency average current mode control architecture. This enables a fast transient response with excellent loop stability as well as fast and accurate output current programming and monitoring with no external sense resistor. This adjustable, brick-wall style current limit feature makes the LTC7103 well suited for current source applications such as battery or capacitor charging and LED lighting. The LTC7103 draws only 2µA of input quiescent current while regulating the output voltage at no load, extending

battery operating life in always-on applications. Low ripple Burst Mode® operation maintains high efficiency at light load currents while keeping output ripple small. To further minimize ripple, a pulse-skipping mode can also be selected. The LTC7103 features a low minimum on-time of 40ns and a maximum duty cycle of 100%, enabling the output voltage to be set anywhere from 1V up to the input voltage. The LTC7103 features eight pin-selectable fixed output voltage set points that include commonly used rails from 1.2V to 15V. These pre-programmed output voltages save board space and reduce the no-load quiescent current by eliminating an external resistor divider. Internal voltage loop compensation automatically adjusts based on the switching frequency to ensure both speed and stability. Alternatively, the voltage loop can be optimized externally using OPTI-LOOP® compensation.

The LTC7103 is packaged in a thermally enhanced 5mm x 6mm QFN-36(26) package with high voltage pin spacing. An industrial temperature version, the LTC7103IUHE, is tested and guaranteed to operate from a -40°C to 125°C operating junction temperature. Similarly a high temperature version, the LTC7103HUHE, operates from a -40°C to 150°C operating junction temperature. Finally, a high reliability version, the LTC7103MPUHE, operates from a -55°C to 150°C operating junction temperature. Pricing starts at \$4.50 each in 1,000-piece quantities and all versions are available from stock. For more information, visit [www.linear.com/product/LTC7103](http://www.linear.com/product/LTC7103).

Photo Caption: 105V, 2.3A (IOUT), Synchronous Step-Down with Fast Current Programming

#### Summary of Features: LTC7103

- Wide VIN Range: 4.4V to 105V (110V Abs Max)
- Ultralow EMI/EMC Emissions: CISPR#25 Class 5 Compliant
- 2µA IQ When Regulating 48VIN to 3.3VOUT
- Fast and Accurate Output Current Programming & Monitoring with No External RSENSE
- Brick Wall Current Limit
- Low Minimum On-Time: 40ns
- Wide VOUT Range: 1V to VIN
- 100% Maximum Duty Cycle Operation
- Programmable Fixed Frequency: 200kHz to 2MHz
- Eight, Pin-Selectable Fixed (1.2V to 15V) or Adjustable Output Voltages
- Selectable Pulse-Skipping or Low Ripple Burst Mode®
- Operation at Light Loads

- PLL Synchronization to External Clock
  - EXT VCC LDO Powers Chip from VOUT = 3.3V to 40V
  - OPTI-LOOP® or Fixed Internal Compensation
  - Input & Output Overvoltage Protection
  - Thermally Enhanced (5mm × 6mm) QFN Package
- Pricing shown is for budgetary use only and may differ due to local duties, taxes, fees and exchange rates.



### **36V, 2A Monolithic Synchronous Step-Down LED Driver with Silent Switcher Topology Minimizes EMI Concerns**

MILPITAS, CA & NORWOOD, MA – July 11, 2017 – Analog Devices, Inc., which recently acquired Linear Technology Corporation, announces the LT3932, a monolithic, synchronous, step-down DC/DC converter with internal 36V, 2A power switches and an internal PWM generator. Its fixed frequency, peak current mode control accurately regulates current within  $\pm 1.5\%$  for strings of up to 2A LEDs. Its integrated PWM generator offers a 128:1 dimming ratio. If dimming ratios of up to 5000:1 are required, the LT3932 and an external PWM generator can accommodate these applications. The LT3932's 3.6V to 36V input voltage range is ideal for a wide variety of applications, including automotive, industrial and architectural lighting. The combination of its Silent Switcher® topology and spread spectrum frequency modulation minimizes EMI concerns. The LT3932 can drive up to eight 2A white LEDs from a nominal 32V input, delivering in excess of 50 watts. The LT3932 can deliver efficiencies of 93% while switching at 2MHz, eliminating the need for external heat sinking and offering a tiny, compact solution footprint. Internal open/short LED protection and fault indication offers added reliability. The LT3932's switching frequency is programmable from 200kHz to 2MHz or it can be synchronized to an external clock signal.

Combined with a thermally enhanced 4mm x 5mm QFN package, the LT3932 offers a very compact high power LED driver solution. Other features include accurate LED current sense with a monitor output, 99.9% duty cycle operation and programmable UVLO.



### **New Ruggedized Capacitor from New Yorker Electronics is Designed for Long Life in Harsh Conditions**

New Yorker Electronics has released a new ruggedized capacitor with an extraordinary shelf-life and built for applications demanding very high-performance under all operating conditions. The new Cornell Dubilier Electronics HHT Series of Ruggedized Axial-Lead Aluminum Electrolytic Capacitors are designed to endure the rigors of extreme industrial and aerospace applications.

The HHT is the only axial-lead electrolytic featuring a glass-to-metal seal to prevent dry out of the capacitor electrolyte. Shelf life is an extraordinary ten years and operational rated life is 2,000 hours at rated voltage and at +175°C. At 150°C and full-rated voltage, HHT capacitors outperform competitive technologies in a 5,000-hour test with ripple currents of up to 10 Arms. This level of performance makes the HHT an excellent match for high-stress applications in military, aerospace, down-hole and off-road transportation applications. Nine values are offered, from 470µF to 4,700µF, with ratings from 16Vdc to 40Vdc.

The CDE HHT Series is the only aluminum electrolytic capacitor available in the market with +175°C performance. This is usually the domain of the considerably more expensive wet tantalum technology. The reason is the HHT's glass-to-metal seal. Without the seal, high temperatures will cause conventional electrolytics to lose electrolyte over time. This causes a drop in capacitance and an increase in ESR. With capacitance stability at high temperature, low leakage

current with very competitive ESR and ripple current specifications, these devices provide new options for mission-critical applications. Like other CDE capacitors, the HHT Series is subject to the industry's most rigorous dynamic testing. The 20g vibration testing follows procedures outlined in MIL-STD-202, method 204.

HHT case diameter is a low-profile 20mm for all values, with length varying from 37 to 53mm depending on values. The axial lead wires are a substantial 18 AWG. They are RoHS compliant and free of conflict materials.

#### Features & Benefits

- Only aluminum electrolytic on the market with 175°C performance
- Glass-to-metal seal prevents normal dry-out of the capacitor electrolytic
- 10-year shelf life; operational rated life is 2,000 hours at 175°C rated voltage
- Low profile case
- High capacitance retention at -40°C
- Comes in 9 values from 470µF to 4,700µF

#### Applications

- Downhole Drilling & Fracking
- Military & Aerospace
- Extreme Off-Highway Industrial/Transporting

New Yorker Electronics is a franchise distributor for Cornell Dubilier carrying the full line of Aluminum Electrolytic Capacitors, AC Oil Filled Capacitors, DC Oil Filled Capacitors, Film Capacitors, MICA Capacitors, Ultracapacitors, Surface Mount Capacitors, Aluminum Polymer Capacitors, Supercapacitors, plus Capacitor Hardware and Capacitor Kits.



### Toshiba Memory Corporation Develops World's First 3D Flash Memory with TSV Technology

Toshiba Memory Corporation, the world leader in memory solutions, today announced development of the world's first[1] BiCS FLASH™ three-dimensional

(3D) flash memory[2] utilizing Through Silicon Via (TSV) [3] technology with 3-bit-per-cell (triple-level cell, TLC) technology. Shipments of prototypes for development purposes started in June, and product samples are scheduled for release in the second half of 2017. The prototype of this groundbreaking device will be showcased at the 2017 Flash Memory Summit in Santa Clara, California, United States, from August 7-10.

Devices fabricated with TSV technology have vertical electrodes and vias that pass through silicon dies to provide connections, an architecture that realizes high speed data input and output while reducing power consumption. Real-world performance has been proven previously, with the introduction of Toshiba's 2D NAND Flash memory[4].

Combining a 48-layer 3D flash process and TSV technology has allowed Toshiba Memory Corporation to successfully increase product programming bandwidth while achieving low power consumption. The power efficiency[5] of a single package is approximately twice[6] that of the same generation BiCS FLASH™ memory fabricated with wire-bonding technology. TSV BiCS FLASH™ also enables a 1-terabyte (TB) device with a 16-die stacked architecture in a single package. Toshiba Memory Corporation will commercialize BiCS FLASH™ with TSV technology to provide an ideal solution in respect for storage applications requiring low latency, high bandwidth and high IOPS[7]/Watt, including high-end enterprise SSDs.

#### General Specifications (Prototype)

Package Type	NAND Dual x8 BGA-152	
Storage Capacity	512 GB 1 TB	
Number of Stacks	8	16
External Dimension	W	14 mm 14 mm
	D	18 mm 18 mm
	H	1.35 mm 1.85 mm
Interface	Toggle DDR	
Interface Max. Speed	1066Mbps	

Note:

- [1] Source: Toshiba Memory Corporation, as of July 11, 2017.
- [2] A structure stacking Flash memory cells vertically on a silicon substrate to realize significant density improvements over planar NAND Flash memory, where cells are formed on the silicon substrate.
- [3] Through Silicon Via: the technology which has vertical electrodes and vias to pass through the silicon

dies for connection in a single package.

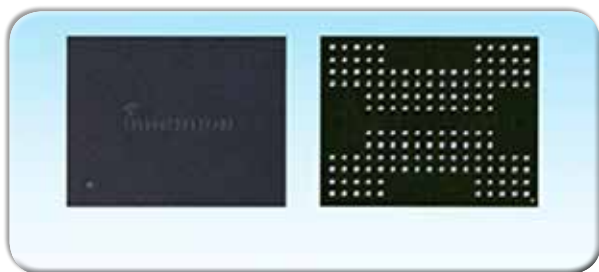
■ [4] “Toshiba Develops World’s First 16-die Stacked NAND Flash Memory with TSV Technology”

<http://toshiba.semicon-storage.com/ap-en/company/news/news-topics/2015/08/memory-20150806-1.html>

■ [5] The rate of data transfer rate per power unit. (MB/s/W)

■ [6] Compared with Toshiba Memory Corporation’s current products.

■ [7] Input Output per Second: The number of data inputs and outputs for processing through an I/O port per second. A higher value represents better performance.



### ■ Belden Introduces Cables to Meet New European Standard for Use in Transportation Industry

Belden Inc., a global leader in signal transmission solutions for mission-critical applications, has received approval from the United Nations’ Economic Commission for Europe (ECE) on data, coax and microphone cables. These cables now have ECE R118.02 approval and meet the fire protection standards required for use in the European transportation industry. The approved product range includes data cables (100 Mbit/s, 1Gb/s and 10 Gb/s solid or flexible versions), 50 ohm low loss coaxial and a microphone cable.

“As passengers demand more technology when they travel by bus or coach, the need for high-speed, reliable data communication isn’t an option any more – it’s expected. To manage the increasing volumes of data, the right Ethernet cabling is required behind the scenes. Additionally, video and microphone signal quality are becoming a priority for most bus and coach manufacturers,” said Gihan Thabrew, marketing director at Belden. “When selecting data cables to use in small spaces, like passenger and engine compartments, it’s critical that the cabling is flame resistant to protect passengers in case of a fire.”

The new European standard sets high fire protection requirements for cabling used within the transportation industry, specifically in coaches and buses.

“Our cabling has undergone intense testing and meets the ECE’s strict standards. Now, not only do our cables transmit large quantities of data at high speeds, they are enclosed in jacket material that resists flames,” added Thabrew. “In the event of a fire, the jacket burns slowly, does not produce any harmful substances when burning and won’t reignite later on. This is now a required safeguard for the transportation sector to put passenger safety first.”

### ■ New space-saving Alpha Wire Micro Coaxial cable makes routing in medical and imaging devices easier – now at Aerco

Alpha Wire has introduced a new Micro Coaxial Cable so fine and light it can pass through the eye of a needle, making it ideal for a wide range of applications where space is at a premium. Micro Coax is especially suitable for in-the-box medical devices such as medical probes, endoscopy systems and oximetry systems. Alpha Wire’s micro coax cable is now available from Aerco, the distributor of electrical and electronic components servicing hi-rel markets.

Alpha Wire Micro Coax Cable is available in a full range of standard sizes from 50 AWG to 32 AWG and features stranded conductors made from high strength silver-plated or silver copper alloys for increased flexibility. To cope with demanding environments, Micro Coaxial Cable is insulated with a white PFA dielectric jacket, which provides excellent signal integrity, low capacitance and consistent controlled impedance (50Ω characteristic impedance). Shielding is silver-plated or tinned copper alloy spiral braid with a minimum of 90% shield coverage for excellent EMI protection. Micro Coaxial Cable has a voltage rating of 30Vrms. Alpha Wire Micro Coaxial Cable is available now in 100m spools, and samples are available

These cabling elements help transportation companies maintain high safety standards, while also delivering on customer conveniences, such as information displays updated in real time and personal entertainment systems for individual seats.

“As new coaches are being built or retrofitted, bus manufacturers and suppliers face these two critical priorities – how their cabling system can capture and share the level of data that’s expected, and how it can also meet safety requirements and regulations. Our cables make both possible,” added Thabrew..



#### Molex ValuSeal IP65 Wire-to-Wire

##### Connectors, Now Available at Mouser Electronics

Mouser Electronics, Inc., the industry’s leading New Product Introduction (NPI) distributor with the widest selection of semiconductors and electronic components, is now stocking the ValuSeal wire-to-wire connector system from Molex, LLC. ValuSeal connectors are designed to provide cost-effective, reliable, and sealed performance, all within a one-piece housing design. The IP65-rated wire-and-ring seal system is capable of 11.0 A of power and is ideal for consumer, industrial, non-automotive transportation, robotics, and lighting applications.

The Molex ValuSeal wire-to-wire connector system, available from Mouser Electronics, features an innovative one-piece housing design that simplifies the assembly process and protects against harsh and wet environments, dust, and low-pressure jets of water. The design also boosts efficiency by reducing the number of components needed. A compact 4.00mm pitch enhances design flexibility in applications where space is limited. The connectors also offer a positive latch feature that ensures secure retention when the receptacle and plug are mated, which prevents accidental un-mating

The ValuSeal wire-to-wire connectors also include an integrated wire strain-relief within the connector body to prevent over-bending, wire failure, and leak-paths. Mouser

also stocks ValuSeal pre-crimped leads that are suitable for simplifying wire assembly for added cost efficiency.

For more information about the ValueSeal IP65-rated wire-to-wire connectors, visit <http://www.mouser.com/new/molex/molex-valuseal-ip65-connectors/>.

With its broad product line and unsurpassed customer service, Mouser strives to empower innovation among design engineers and buyers by delivering advanced technologies. Mouser stocks the world’s widest selection of the latest semiconductors and electronic components for the newest design projects. Mouser Electronics’ website is continually updated and offers advanced search methods to help customers quickly locate inventory. Mouser.com also houses data sheets, supplier-specific reference designs, application notes, technical design information, and engineering tools.



#### The new and inexpensive 2.5 A appliance inlet of the type 2570 in various versions

The new and inexpensive 2.5 A appliance inlet of the type 2570 in various versions

The appliance inlet series of the type 2570 by SCHURTER provides various mounting variants and terminal options. Because of its cost effective design and the wide range of approval certificates for Europe, America and Asia, the C8 inlet is best suited for both industrial and consumer applications.

The appliance connector for snap-in mounting is available with solder-, quick connect- or PCB-terminals. The PCB-terminals in combination with the sandwich mount are specially for the application on printed circuit boards. This way the board can be fully equipped and tested before being mounted. The mounting is done by introducing the connector into the back wall, and placing the appliance housing into the groove on the inlet.

Thanks to the use of rolled contact pins, the variants with solder or PCB terminals are very inexpensive and therefore suitable for consumer goods. Nevertheless do

they comply with all the security requirements and are approved by all the relevant international standards.

#### Technical data:

- Ratings IEC/CCC: 2.5 A / 250 VAC; 50 Hz
- Ratings UL/CSA: 2.5 A / 250 VAC; 60 Hz
- Operating temperature from -25 °C to 70 °C
- Variants for sandwich- or snap-in mounting
- Solder-, quick connect- or PCB-terminals



### RS Components adds new RJ45 industrial connector solutions to extensive Phoenix Contact portfolio

RS Components (RS), the trading brand of Electrocomponents plc (LSE:ECM), the global distributor for engineers, has augmented its extensive range of products from Phoenix Contact used in industrial and electronics applications with a new series of RJ45 connector devices.

Combining the trusted RJ45 format with innovative tool-free installation techniques, the Phoenix Contact CUC series offers a one-piece design providing easy installation even in hard to reach places. One of the most popular types of connectors, the RJ45 format is widely used by engineers working in networking and data communications.

Ideal for applications that require version 14 push-pull interlocking, preventing inadvertent connector removal, the series also allows users to assemble parts without special tools, as well as offering high shock and vibration resistance capability. The series also delivers 360° shielding with high resistance to ESD and EMC to protect data transmission integrity.

The CUC series includes a range of IP65/IP67-rated RJ45 connector plugs for Cat5e cabling, including straight and right-angle cable-mount options; panel-mounting frames for use with RJ45 connectors; a Cat5e

and Cat6a RJ45 STP-shield straight socket insert; and an RJ45 protective cover.

The Phoenix Contact CUC series of RJ45 industrial connectivity devices is shipping now from RS in the EMEA and Asia Pacific regions.



### Paragon Software Releases NTFS USB Plugin for Android TV

Paragon Software Group (PSG), a cross-platform technology leader in mobile device and embedded system solutions, today releases Paragon NTFS USB Android, a software plugin that enables instant, non-root access to 40GB and beyond HD and 4K video files from external storage drives formatted with any popular file systems directly on Android TV and set-top boxes. Paragon NTFS USB Android allows Android users to watch high-definition and ultra high-definition videos of any size from previously incompatible removable media formatted in macOS and Windows file systems, such as NTFS, FAT32, or HFS+.

Android TV users can easily utilize storage media formatted by macOS and Windows operating systems on smartphones, tablets, digital media players, and home TV screens, and not just view but even copy files. Navigation and tasks can be accomplished simply and efficiently thanks to the technology's intuitive and well-designed user interface that has been optimized to support larger screens.

#### How it works in just three easy steps:

- Download the free Total Commander app for Android.
- Install the free Paragon USB Plugin for Android.
- Connect macOS or Windows-formatted disks or thumb sticks via USB cable. The app automatically detects the file system, prompting you to mount the storage device. The app offers a two-day trial mode, after which time the user is required to purchase access to the required file system, or unlock all file systems at once.
- Availability:

Paragon NTFS USB Android works in tandem with Total Commander, a popular free cross-platform file manager app available for download on the Google Play Store: <http://play.google.com/store/apps/details?id=com.ghisler.android.TotalCommander>

Users can unlock the required file system individually or as ■ a pack via in-app purchase:

All file system support pack: \$9.99

All file system drivers are available for licensing to OEMs as components of Paragon Storage SDK for Android: <https://www.paragon-software.com/technologies/ufsd/ums-sdk.html>. For more details about new technologies and evaluation options, please visit the company's website: <https://www.paragon-software.com/technologies/universal-file-system-drivers/storage-sdk-android/index.html>

or contact [technology@paragon-software.com](mailto:technology@paragon-software.com)



### ■ New Medical Wall Plug Power Adapters Comply with IEC 60601-1 4th Edition Standards

CUI's Power Group today announced the addition of a new line of wall plug-in power adapters to its portfolio of external medical power supplies. (<http://www.cui.com/medical-external-power-supplies>) The SWM6, SWM6-USB, SWM12, and SWM30 series, available with either North American or European input blades, are all certified to the medical 60601-1 edition 3.1 safety standards for 2 x MOPP applications and 4th edition EMC requirements. Featuring high efficiency, class II construction, and no-load power consumption as low as 0.075 W, these ac-dc power supplies are a continuation of CUI's initiative to provide customers with the most efficient global power solutions for medical, dental, and home healthcare equipment.

The compact 6 W, 12 W, and 30 W wall plug adapters all feature a wide universal input voltage range of 90 to 264 Vac and input-to-output isolation of 4,000 Vac, with

output voltage options from 5 to 48 Vdc, depending upon the series. The SWM6, SWM6-USB, and SWM12 series offer horizontal and vertical blade orientations, while the SWM6-USB series also incorporates an integrated USB connector. Protections for over voltage, over current, and short circuit are included for all models as well as a range of dc output connector options.

Models with input blades for North American applications carry medical UL/cUL 60601-1 safety certifications and meet FCC Part 15B Class B limits for EMI/EMC, while models with European input blades carry medical TUV EN 60601-1 safety approvals and bear the CE mark.

The SWM6, SWM6-USB, SWM12, and SWM30 series are available immediately with prices starting at \$8.31 per unit at 500 pieces through distribution. Please contact CUI for OEM pricing. (<http://www.cui.com/contact>)



### ■ Murata's DC-DC converters feature high isolation for industrial power installations

Murata has introduced a series of high isolation DC-DC converters developed by Murata Power Solutions. The MGJ6 wide, low-profile series converters feature a 14 mm creepage and clearance distance for use in reinforced-rated isolated-gate drive-power applications in higher efficiency 690 VAC industrial electrical distribution systems. They provide optimised voltages for best system performance and efficiency.

This high isolation DC-DC converter series is designed for powering high- and low-side gate-drive circuits for IGBTs and silicon and silicon carbide MOSFETs in bridge circuits used in motor control applications and industrial power installations. Rated at 6 W, the dual output converters provide a wide 2:1 input voltage range with nominal values of 5, 12 and 24 V, and with output voltages of 15/-10 V, 20/-5 V and 15/-5 V.

Suitable for power applications that require a DC link voltage up to 3 kVDC, asymmetric outputs provide an optimum drive level to maintain a high system efficiency

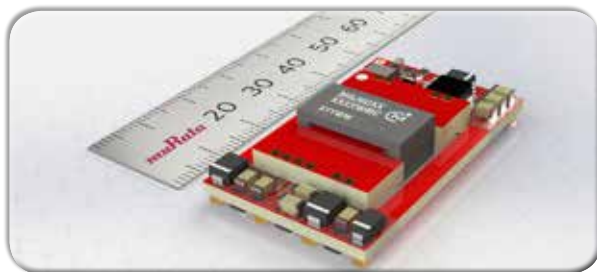
with low EMI levels. With their frequency synchronisation-capability and very low coupling capacitance, typically 13 pF, EMC compliance is easier.

The converters' compact design reduces board space and development time, whilst their characterised  $dV/dt$  immunity of 80 kV/microsecond gives users confidence in a long service life, and similarly the use of planar magnetics increases product reliability and repeatability of performance. Typical applications include motor drives/motion control, solar inverters, UPS, alternative energy (wind-power generators), high-power AC-DC conversion, traction, EV/HEV and welding.

The MGJ6 series converters offer an operating temperature range of -40 to 105 °C, with derating above 90 °C. Standard features of the patent protected converters include enable pin, short-circuit and overload protection, and a frequency synchronisation pin that simplifies EMC filter design.

The series is pending IEC 61800-5-1 approval based on a high working voltage of 690 Vrms maximum between primary and secondary, and similarly is also pending UL approval to UL 60950 for reinforced insulation to a working voltage of 690 Vrms.

As a targeted application solution featuring high isolation construction, high efficiency electronics and planar magnetics, no other manufacturer offers this type of product.



### NI Announces Multiple Antenna UE Support for Its MIMO Application Framework to Further 5G Research

The provider of platform-based systems that enable engineers and scientists to solve the world's greatest engineering challenges, today announced multiple antenna User Equipment (UE) support for its LabVIEW

Communications MIMO Application Framework. This makes the MIMO Application Framework the world's only commercially available physical layer reference design that powers true Massive MIMO prototyping that goes beyond just desktop simulations to fully functional 5G deployments.

Wireless researchers can pair the MIMO Application Framework with NI software defined radio hardware to conduct real-time, over-the-air experiments for a wide range of MIMO research topics including multi-user MIMO, single-user MIMO and Massive MIMO. This multi-FPGA physical layer reference design ships with well-documented LabVIEW Communications source code that is fully reconfigurable and modifiable, making it possible to create a complete network of multiple antenna devices with minimal system integration or design effort.

Researchers can now explore beamforming techniques not just at the base station, but also at the UE to further improve overall network throughput, extend cell coverage, reduce interference and more. The MIMO Application Framework supports a maximum network throughput of more than 1.5 Gb/s, a flexible and reconfigurable Time Division Duplex-based frame structure and a fully bidirectional communications link that can be used out of the box to conduct Massive MIMO experiments and seamlessly integrate custom signal processing algorithms in a fraction of the time compared to other approaches.

As participants in NI's RF/Communications Lead User program, wireless researchers at Lund University in Sweden have used NI's flexible prototyping platform for 5G research and have recently demonstrated the feasibility of Massive MIMO under mobile conditions for users moving at both pedestrian and vehicular speeds. "Massive MIMO has emerged as one of the leading 5G technologies that has the potential to provide unprecedented levels of spectral efficiency that will be critical in supporting the vast number of wireless devices expected to come online in the coming years," said Fredrik Tufvesson, IEEE fellow and professor of radio systems at Lund University. "NI's MIMO Application Framework provides the hardware and software



capabilities needed so that beamforming techniques can be explored at not just the Massive MIMO base station, but also at the multi-antenna UEs to further enhance the overall system performance of 5G networks.”



### **Advantest's New Massively Parallel Test Fixture Extends the T6391 System's Capabilities to Include Chip-on-Film Testing of Display Driver ICs**

New RND440 Type 3 Unit is the First High-Throughput Test Solution for ICs that Drive LCD Screens in Smart Phones and Other Electronic Products

MUNICH, Germany – July 24, 2017 – Leading semiconductor test equipment supplier Advantest Corporation (TSE: 6857) has introduced the RND440 Type 3 fixture, an optional enhancement on its T6391 display driver IC (DDI) tester that makes the system capable of massively parallel testing of chip-on-film (CoF) packages for the latest generation of smart phone screens. The unit is designed to handle the growing number of pins on DDIs, the increasing speeds of interfaces and the highly integrated functions that enable high-resolution displays.

Mobile devices have evolved from using traditional chip-on-glass (CoG) ICs to more advanced CoF devices for several reasons. For example, today's smart phones have begun to incorporate OLED screens with rounded edges, which require CoF packaging.

Along with CoF packaging, other developments are driving the need for better test solutions. These include the increasing number of output lines for DDIs used in smart phones, tablet computers, notebooks and other products with LCD screens as well as the growing use of touch embedded display driver ICs (TDDI).

The new RND440 Type 3 fixture can perform both high-pin-count, high-speed wafer testing and CoF testing, also called tape testing. It can test all of the electrical components within a CoF package, which include an IC mounted on a base film, several passive elements and signal-input circuitry for receiving and transmitting data. The fixture works with substrates as large as 440 mm and its massively parallel testing capability doubles the throughput of single-device systems on the market.

“The T6391 system is the only highly parallel package testing system for DDIs and TDDIs,” said Satoru Nagumo, executive vice president of the ADS Business Group at Advantest Corporation. “Our test solution provides users with a huge productivity advantage and the lowest available cost of test for DDIs and TDDIs in either production or engineering environments.”

Advantest's T6391 system uses the same engineering environment model and TDL programming language as other members of the T6300 product series while providing faster data transfer and calculation. It is the only platform capable of testing touch-sensor functions and power-management IC (PMIC) functions integrated in DDIs. It can accommodate high-resolution DDIs with up to 3,584 pins, sufficient for testing LCDs used in full high-definition (HD), WXGA and HD720 displays.

A stand-alone T6391 can handle I/O pin frequencies up to 1.6 gigabits per second (Gbps) while the addition of a separate measurement module allows it to test interfaces up to 6.5 Gbps, which will be used in the DDIs for ultra-high-definition televisions including the 4K (2160p) generation.

The RND440 Type 3 fixture has already begun shipping to customers earlier this calendar year.



# Advertisers index

ANALOG DEVICES	5	NEW TECH EUROPE	51 ,84
<a href="http://www.analog.com">www.analog.com</a>		<a href="http://www.new-techeurope.com">www.new-techeurope.com</a>	
ARROW	31	ON SEMI	3
<a href="http://www.arrow.com">www.arrow.com</a>		<a href="http://www.onsemi.com">www.onsemi.com</a>	
AWR	7	PASTERNAK	41
<a href="http://www.awrcorp.com">www.awrcorp.com</a>		<a href="http://www.pasternack.com">www.pasternack.com</a>	
LINEAR TECHNOLOGY	6	SAMTEC	47
<a href="http://www.linear.com">www.linear.com</a>		<a href="http://www.samtec.com">www.samtec.com</a>	
MINI CIRCUITS	4 ,37 ,55 ,83	Würth	2
<a href="http://www.minicircuits.com">www.minicircuits.com</a>		<a href="http://www.we-online.com">www.we-online.com</a>	

**New-Tech**  
Europe

Read To Lead

[www.new-techeurope.com](http://www.new-techeurope.com)





**SPEED UP THE SOLUTION!**

**Mini**

# ***VCO's and Synthesizers***

***You Define It. We'll Design It.***

***Replacement Solutions for End-of-Life Parts. Custom Designs as Easy as 1-2-3.***

Whether you need replacement parts or you have a new requirement for VCOs or synthesizers, Mini-Circuits is here to support you. Our engineers will work with you to find a solution from our extensive library of existing designs or develop a custom design to meet your needs, as easy as 1-2-3! Reach out to [apps@minicircuits.com](mailto:apps@minicircuits.com) today, and see why so many customers trust Mini-Circuits as the industry's solid source.

- *VCOs from 3 to 7000 MHz*
- *Synthesizers from 56 to 7800 MHz*
- *Thousands of Models in Stock*
- *Industry-leading design capability*
- *Reliable supply through the life of your system!*



