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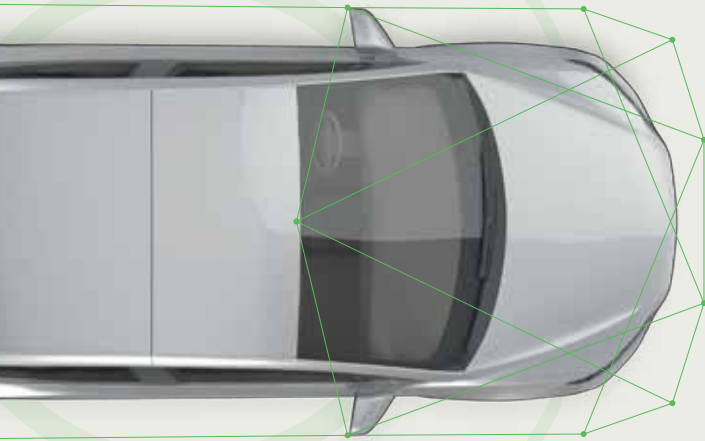
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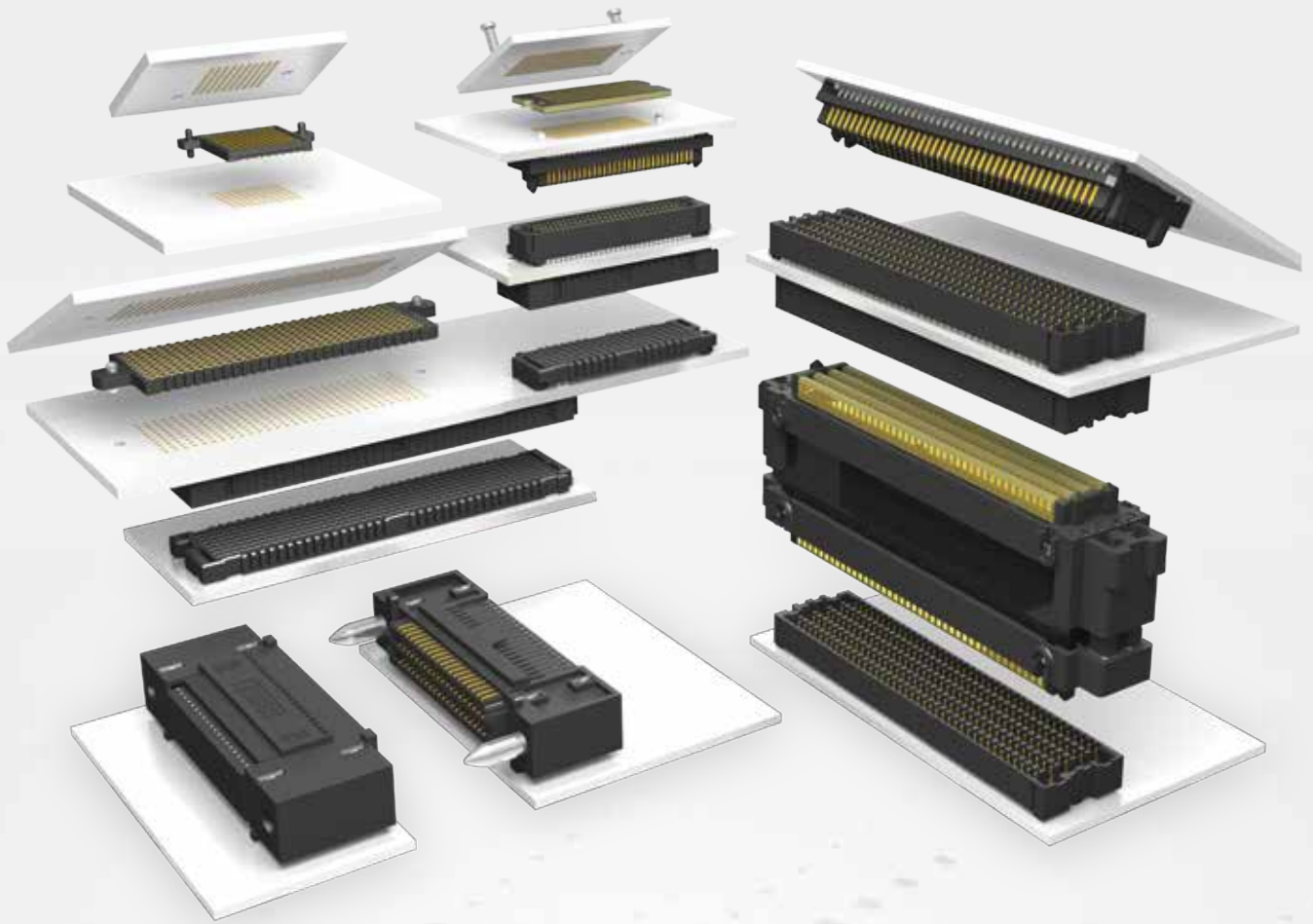
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New-Tech Europe

Read To Lead

November 2017

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

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

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

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BMW Group lays the foundation for expansion of its Research and Innovation Centre (FIZ)

The BMW Group is embarking on an extensive expansion of its FIZ Research and Innovation Centre in the north of Munich. The "FIZ Future" masterplan, which was developed as part of an urban development competition, will expand the development centre by around 50 per cent by 2050. The BMW Group will invest around 400 million euros in the first phase of construction, which will create a viable infrastructure for developing tomorrow's mobility. Bavarian Prime Minister Horst Seehofer, Mayor of Munich Dieter Reiter and Harald Krüger, Chairman of the Board of Management of BMW AG, launched the construction project today in the Milbertshofen district of Munich. In an official ceremony, the foundation was laid for a building complex with a total floor area of 157,000 m2. From 2019 on, around 5,000 employees will work here in innovative open-plan workspaces, developing hardware and software for the company's future vehicles.

"Here in Munich, we will be creating the next generations of electrified drive trains, with decisive innovations for the mobility of the future. Focusing on IT and artificial intelligence, this will also be home to a new industry and a new generation of engineers and IT specialists," according to Harald Krüger, Chairman of the Board of Management of BMW AG. "Today, we are laying the foundation together for our new idea factory. FIZ Future signals our strong commitment to the Munich location and Germany's innovative strength. We are building the future right here."

Prime Minister Horst Seehofer: "My congratulations on this far-sighted choice of location. This day will continue a 100-year success story. The mobility of tomorrow is being created right here. The expansion of the BMW Group's Research and Innovation Centre in Munich is a strong vote of confidence in Bavaria's future strength."

"BMW's development, creating jobs and promoting research and development here in the north of Munich is a great gain for our city," explained Dieter Reiter, Mayor of the City of Munich, at the ceremony. "And the fact that FIZ Future in Munich is thinking about the future of the car, researching and developing electro-mobility and alternative drive trains and forms of mobility is also a gain for urban mobility in general."

FIZ Future masterplan

As part of its Strategy NUMBER ONE > NEXT, the BMW Group and its FIZ Future programme aim to create a framework for the long-term development of its Research and Innovation Centre in the north of Munich. With around 26,000 workspaces and approx. 1 million m2 net floor space, the development centre is already the BMW Group's largest location. In several stages, the expansion will create workspaces for another 15,000 employees by 2050. The aim is not just to create space, but, more importantly, to provide the right conditions for working in the future. Technological changes, driven by digitalisation and connectivity, demand agile team structures, quick decisions and immediate implementation. That is why the new buildings will primarily offer open, flexible spaces where staff members can meet, discuss and implement their ideas quickly – for example, by testing new software for a vehicle prototype in a workshop just a few steps away and seeing the results immediately. The FIZ expansion and remodelling is therefore not only an investment in the future competitiveness of the company, it is also an investment in attractive state-of-the-art workplaces. In the urban development competition, organised in September 2014 in close collaboration with the Department of Planning and Building Regulations of the City of Munich, it was the proposal of the architectural firm HENN that impressed the most. On this basis – and with regular involvement of the people living in the north of Munich - a FIZ Future masterplan was developed and approved by Munich City Council in July 2016 as the basis for the expansion. Following today's start of construction, other administrative, research and workshop facilities will be created over the medium and long term, as well as test benches and design studios.

170 years of Siemens: from an inner courtyard to the cloud

On October 12, 1847, the predecessor of today's Siemens AG was founded in a workshop tucked away at the back of a Berlin courtyard. In the course of the 170 years that followed, Siemens constantly reinvented itself, survived crises, and continuously adapted its portfolio – thus proving itself capable of change. Today, Siemens is one of the leading companies in the field of digitalization. Over the decades, certain constants – such as internationality, a quality mindset and customer orientation – have remained guarantors of success. The guiding principle behind all this? "Whatever we do must offer long-term benefits and generate value – for our shareholders, employees and customers as well as our business partners and society," said Siemens AG President and CEO Joe Kaeser.

From the pointer telegraph to MindSphere
The invention of the pointer telegraph in 1847 and the discovery of the dynamo electric principle in 1866 laid the foundation for Siemens' success. Werner von Siemens is considered one of the founders of modern electrical engineering. The "Telegraphen-Bauanstalt von Siemens & Halske" telegraphy company launched with 10 employees. This small workshop – which, in addition to telegraphs, manufactured electrically triggered railroad warning bells, wire insulation, and water meters – advanced to become one of the world's largest electrical engineering and technology companies within just a few decades. Over its 170-year history, the company has overcome major challenges, including the consequences of two world wars and the associated loss of assets. It also had to deal with a compliance crisis which started a little over ten years ago, and from which Siemens ultimately emerged as a role model for clean business. Today, with around 350,000 employees, Siemens has rigorously geared its activities towards the fields of electrification, automation and digitalization. The company's early orientation toward the area of digitalization aligns well with the other major milestones from the company's history. Today, Siemens is a leader in the area of digitalization and uses MindSphere, for instance, to connect machines and systems with the cloud in order to create completely new business models. The company laid the cornerstone for its digital expertise as early as ten years ago. Since then, Siemens has invested more than €10 billion to further expand its position as one of digitalization's driving forces.

Internationalization as a pathway out of crises
Since its early days, the company has repeatedly demonstrated the ability to chart new territory. The sales crises on Prussia's telegraph market in the 1850s forced Siemens to find new markets and aim for international expansion – for instance by building a 9,000-kilometer telegraph line in Russia and by laying submarine cables from England. After the establishment of offices in London in 1850 and St. Petersburg in 1855, other Siemens locations quickly followed around the world. To name just a few: Brussels in 1871, Paris and the Hague in 1878, Vienna and Warsaw in 1879, Stockholm and Turin in 1880, New York in 1886, Tokyo in 1887, Rio de Janeiro in 1888, Budapest in 1890, Chicago in 1892, and Johannesburg in 1895. Today, Siemens is active in nearly 200 countries.

8,000th Hybrid electric drive system produced for transit buses

BAE Systems has achieved a major milestone with the production of its 8,000th series hybrid electric drive system for transit buses. This milestone signifies a dramatic increase in demand for the company's electric platforms that save fuel and reduce emissions. In the last two years, BAE Systems has delivered 3,000 systems, double the number the company shipped in the prior four years.

"The continued high demand for these systems is driven by the flexibility of the Series-E product line," said Bob Lamanna, director of global transit sales and service at BAE Systems. "The line provides the reduced and zero-emission travel that transit agencies are looking for without the infrastructure challenges presented by fully electric solutions."

BAE Systems' flagship Series-E system not only provides, hybrid electric propulsion, but also operates all accessories on vehicles with electric power. The system offers stop/ ➡

start technology as well that eliminates emissions while the bus is stopped. This technology has now advanced to give an operator up to 35 percent engine-off operation without needing to stop and charge the vehicle's batteries. With an on-board generator, the bus is available for service 24/7 and there is no need for charging systems or scheduling time to use them.

The company has been supplying hybrid electric drive

systems for more than 20 years, and it continues to advance electric solutions for transit including full battery electric systems and fuel cell electric systems for those looking for zero emission solutions. BAE Systems' 8,000 electric drive systems operate around the globe, transporting more than 1.3 billion passengers and saving 17 million gallons of fuel while preventing 170,000 tons of CO_2 from entering the Earth's atmosphere each year.

Würth Elektronik eiSos and Audi use Electric Power to drive into the Future

Würth Elektronik eiSos has been a technology partner to the Formula E racing team founded by ABT Sportsline from the very outset. Now it's official: Following the takeover of the team led by FIA Formula E world champion Lucas di Grassi by Audi, Würth Elektronik eiSos has become technology partner of the new team under the name of Audi Sport ABT Schaeffler. The new partnership agreement was signed by Dieter Gass, Head of Motorsport, AUDI AG, and the three managing directors of Würth Elektronik eiSos, Oliver Konz, Thomas Schrott and Alexander Gerfer on 27 September 2017 as part of the premium manufacturer's exclusive team presentation of the first purely electric racing team in Neuburg.

Audi Sport takes over the starting position from ABT Sportsline. The team from the Allgäu region in Bavaria has successfully participated in Formula E since the electric racing series was founded and in the future, will support the Audi racing cars as an operative team. Audi Sport ABT Schaeffler starts its fourth season of the Formula E racing series on 2-3 December 2017 in Hong Kong. The Würth Elektronik eiSos Group will also continue to shape the success of the team as a technology partner. The agreement with Audi runs until 2021.

"Our passion for Formula E and our technological support for the team's success has grown from season to season. With the racing event in Berlin and the world championship title of

our driver Lucas di Grassi, this enthusiasm has reached a new peak", explains Alexander Gerfer, CTO Würth Elektronik eiSos Group. "With Audi joining as the first German car manufacturer, Formula E now receives a decisive boost as an innovation driver for eMobility. We are proud and happy to be part of this exciting development as a technology partner", says Oliver Konz, CEO Würth Elektronik eiSos Group. Audi, a Volkswagen subsidiary and Würth Elektronik eiSos, a Würth Group company, are an ideal match. Both companies stand for visionary thinking, pioneering concepts and for future-oriented technologies.

"I'm pleased Würth Elektronik eiSos has extended the existing successful partnership and will continue to contribute to our project", says Dieter Gass, Head of Motorsport at AUDI AG.

Strong partners

Audi has lent its name to the team since the first Formula E season in 2014 and provides one of its factory drivers – the Brazilian Lucas di Grassi. Lucas di Grassi crowned the season with the Formula E championship title. Based on his performance, Daniel Abt looks well placed to become a Top 5 driver in the coming season. Taking an overall average of all races from Season 1 to 3, with 24 podium places in 33 races, ABT Schaeffler Audi Sport was the team to appear most often on the podium in the series.

World premier of the Audi e-tron FE04 and tests in Valencia

The vehicle that will take to the track in Season 4 has been under development with the technology partners since November 2016. Audi together with world champion di Grassi presented the corporation's first purely electric racing car at the world premier in Neuburg. The new racing car for the coming season with the illustrious name Audi e-tron FE04 has a completely newly developed drive train with just one gear. A progressive new design in the primary colors of white, metallic green and black, immediately makes the Audi e-tron FE04 stand out from other cars. On the day of the team presentation, a new chapter will begin in Daniel Abt's career. Abt will officially become an Audi factory driver and the former FIA WEC world champion Allan McNish will become team manager of the new Formula E racing team.

So the fourth Formula E season promises to be even more exciting. The race series originally started with the same car for all teams, but with each season more areas were opened up giving teams optimization opportunities through their own innovations.

Extensive tests are currently in progress in Valencia before all four Audi e-tron FE04's set off on their journey to Hong Kong at the beginning of November for the start of the new Season on 2 December at 4pm local time.

Technological support

Würth Elektronik eiSos managed to put innovative solutions onto the race track in the past. For example, high current 'REDCUBE' terminals have been installed on the inverter boards since the second season. In the third season, Würth Elektronik eiSos and ABT Sportsline jointly optimized the backup battery for the cockpit. The associated battery charger was also jointly developed as part of the technology partnership. Würth Elektronik eiSos views the fact that it can be specifically involved in the development of the Audi Sport ABT Schaeffler Team racing car as an outstanding opportunity to deploy components under extreme conditions and to advance solutions for eMobility.

Picture: Ready to go: The Audi Sport ABT Schaeffler Team is looking forward to the new fourth season 2017/2018 of the Formula E racing series.

Microsoft, GE sign agreement on new wind project in Ireland

Microsoft commitment will add 37 megawatts of clean energy to Irish grid.

Microsoft Corp. announced a new wind energy agreement in Ireland. With the agreement, Microsoft will become one of the first multinational technology companies to support a new wind project in Ireland.

Microsoft is entering into a 15-year power purchase agreement (PPA) with GE to purchase 100 percent of the wind energy from its new, 37-megawatt Tullahennel wind farm in County Kerry, Ireland. The agreement will help support the growing demand for Microsoft Cloud services from Ireland. As part of the deal, Microsoft also signed an agreement with Dublin-based energy trading company ElectroRoute; it will provide energy trading services to Microsoft.

In addition to producing energy, the project will produce valuable data on energy storage. Each turbine will have an integrated battery; Microsoft and GE will test how

these batteries can be used to capture and store excess energy, and then provide it back to the grid as needed. This provides more predictable power to an increasingly green Irish grid, by smoothing out peaks and valleys in wind production. This will better enable intermittent clean power sources like wind energy to be added to the Irish grid. This will be the first deployment of battery integration into wind turbines to store energy in Europe.

"Microsoft is proud to be deepening our long history of investment and partnership in Ireland with this agreement," said Christian Belady, general manager, Datacenter Strategy at Microsoft. "Our commitment will help bring new, clean energy to the Irish grid, and contains innovative elements that have the potential to grow the capacity, reliability and capability of the grid. This will make it easier to incorporate new clean power sources like wind energy, and that

is good for the environment, for Ireland and for our company."

This PPA builds on Microsoft's strategic partnership with GE, announced last year. The wind farm will integrate GE's Digital Wind Farm technology, which makes renewable energy outputs even more reliable. Digital models, built on the Predix platform, ensure energy generation supplied can meet demand forecasted and reduce intermittency concerns.

Andres Isaza, chief commercial officer of GE Renewable Energy, said, "This partnership with Microsoft expands GE's considerable presence and investment in Ireland, where we already employ over 1,500 people and in particular in the renewable energy sector. Wind is now one of the most competitive sources of electricity on the market today, and we're excited about the capability to use data generated from these wind turbines, using the Predix platform, to maximize the output and value of this project."

Microsoft is also acquiring an Irish energy supply license from GE. The supply license will benefit both Microsoft and the Irish power grid, as it allows the company the flexibility

to easily grow and invest in renewable energy in Ireland over time. ElectroRoute will act as trading service provider for the supply company.

"ElectroRoute is delighted to work with Microsoft and GE to structure and manage the energy trading activities for the supply company," said Ronan Doherty, chief executive at ElectroRoute. "The wind energy sector is particularly vibrant in Ireland at the moment, and we are seeing the emergence of an array of new structures and procurement approaches, which I feel will persist and grow into the future."

This agreement continues Microsoft's history of supporting sustainability projects in Ireland, including a new forestry initiative announced earlier this year and investments in energy efficiency measures and technologies that have greatly reduced its energy and water footprint.

Once operational, the new wind project will bring Microsoft's total global direct procurement in renewable energy projects to almost 600 megawatts. In 2016, Microsoft set clean energy commitments to power its datacenters and bring new renewable energy sources online in the communities in which it operates.

R-PHY vs R-MACPHY debate is over: Nokia leapfrogs competition with cable industry's first virtualized Distributed Access Architecture

Espoo, Finland – Nokia today announced the next generation of its Unified Cable Access solution that will fundamentally change the way cable operators implement a Distributed Access Architecture (DAA). The enhanced, virtualized solution gives cable operators the flexibility to deploy both R-PHY and R-MACPHY devices within the same network and easily switch from one to the other based on their network requirements and strategic direction.

Cable operators are leveraging DAA to increase throughput, reduce costs and accelerate the delivery of new services by moving cable access layer functions that are traditionally placed in the headend and hub sites to the access nodes. To date, cable operators have had to choose between two DAA approaches: R-PHY, which moves only the DOCSIS signal generation (PHY) to the access node; and R-MACPHY, which moves both the PHY

and DOCSIS processing (MAC) to the access node.

Having to choose one option or the other greatly limits the flexibility to deploy the best technology for each use case. This has forced many operators to lock in a decision before fully understanding the potential impact on their network. With Nokia's next-generation Unified Cable Access solution, operators are no longer forced to choose between R-PHY and R-MACPHY. Features of Nokia's new vDAA include:

■ vCMTS Anywhere – Nokia has virtualized a cable modem termination system (CMTS), which includes the DOCSIS MAC, as a virtual network function (VNF). This provides the flexibility to run the vCMTS anywhere in the network: on the node, or on an off-the-shelf server in the outside plant, hub, headend or data center.

■ Universal Node – Cable operators can convert a

Gainspeed cable access node from R-PHY to R-MACHPHY, or vice versa, on the fly. This capability lets operators choose the best approach to a node for a given use case. It also enables an operator to seamlessly evolve from an R-PHY to R-MACPHY deployment.

■ Unified Control – The Gainspeed access controller can simultaneously support both R-PHY and R-MACPHY nodes, expanding its current cable and fiber unified control capabilities. This helps operators reduce costs and simplify network design by using the same controller to manage all types of Nokia access nodes deployed across HFC and fiber networks

■ Interoperability – Nokia is committed to full solution interoperability and will support any R-PHY or R-MACPHY node as part of its solution.

Liliane Offredo-Zreik, principal analyst at ACG, said: "The industry has been consumed with the R-PHY vs R-MACPHY debate. However, operators' networks are far from homogeneous. Operators need the flexibility to deploy the right solution in each market. Nokia's virtualized Distributed Access Architecture offers operators this flexibility by virtualizing the CMTS function, enabling them to place it in the most optimal location – data center, headend, hub, OSP cabinet, or access node. This will enable operators to deploy R-PHY, R-MACPHY, or a combination of both. With the CCAP market projected to exceed $2B in 2021 – largely driven by DAA implementations starting in 2018 – Nokia's innovative solution will help position the company as a key player in this fast-growing market."

Cash Hagen, chief operations officer of WOW! Internet, Cable & Phone, said: "Nokia is revolutionizing the cable industry with an innovative new cable solution that gives operators the flexibility to implement a distributed access architecture without being handcuffed to a specific approach. Virtualizing the DAA not only simplifies the network and drives cost savings, it also allows us to accelerate the delivery of new services that ultimately provide a better customer experience."

Federico Guillén, president of Nokia's Fixed Networks Business Group, said: "Nokia is changing the game in the cable industry with a vDAA solution that gives operators the flexibility to support both Remote-PHY and Remote-MACPHY approaches. While running the vCMTS on the node as part of a Remote-MACPHY deployment will garner the most significant savings in cost, space and power, there is no such thing as one size fits all. Nokia's enhanced cable solution gives operators the flexibility to choose from a full range of options across both fiber and cable to meet their unique network needs."

Nokia's Gainspeed product family offers cable operators a Unified Cable Access solution that provides industry-leading fiber, HFC and cable technology products and innovations. The Nokia Gainspeed portfolio of cable access products includes:

■ Gainspeed Access Controller
■ Gainspeed Video Engine
■ Gainspeed Access Node SC-2D supporting both R-MACPHY and R-PHY approaches along with DOCSIS 3.0 and 3.1
■ Gainspeed Access Node SF-4X supporting 10G EPON and DPoE

The new enhancements to Nokia's Unified Cable Access solution leverage the company's expertise in virtualization , and are part of its Intelligent Access approach to fixed access, helping make broadband operations faster, better and smarter.

Join Nokia at SCTE 2017, booth 387, to see a demo of the new enhanced solution and discover how we can help you navigate the possibilities of the connected world to enable new experiences in people's lives each day.

Lockheed Martin Delivering Next-Generation Apache Sensor Systems Under New U.S. Army Contract

Lockheed Martin received $337 million in orders to supply Apache Modernized Target Acquisition Designation Sight/Pilot Night Vision Sensor (M-TADS/PNVS) systems and services to the United States, United Kingdom and the Kingdom of Saudi Arabia. The awards are part of an initial task order under a new indefinite-delivery/indefinite-quantity (ID/IQ) contract signed with the U.S. Army. The ID/IQ, with at least $2 billion in potential orders and a five-year period of performance, serves as the contracting vehicle to provide M-TADS/PNVS systems and services to U.S. and international customers.

"Lockheed Martin is committed ➡

to a strong and sustained partnership with our customers in the United States and around the world," said Paul Lemmo, vice president of Fire Control/Special Operations Forces Contractor Logistics Support Services at Lockheed Martin Missiles and Fire Control. "This contract enables us to respond rapidly to their emerging defense needs, including requirements for new M-TADS/PNVS systems and upgrades."

Under an order for the U.S. Army, Lockheed Martin is providing upgrade kits for the M-TADS/PNVS Modernized Day Sensor Assembly (M-DSA) and Modernized Laser Range Finder Designator. For the U.K. Ministry of Defence, it is delivering M-DSA upgrade kits for M-TADS/PNVS refurbishment as part of a remanufacture effort to upgrade D-model Apaches to E models. For the Saudi Ministry of National Guard, it is providing M-TADS/PNVS systems for new E-model Apaches.

M-TADS/PNVS, known as the "eyes of the Apache," provides pilots with long-range, precision engagement and pilotage capabilities for safe flight during day, night and adverse weather missions. M-DSA increases M-TADS/PNVS designation and ranging capabilities to fully accommodate current weapons and those planned for the future. The upgraded sensor enables Apache pilots to see high-resolution, high-definition, near-infrared and color imagery on cockpit displays. M-DSA also provides a new laser pointer marker that improves coordination with ground troops, and an updated multi-mode laser with eye-safe range designation that supports flight in urban environments and critical training exercises.

CPI invests in STEM activities to inspire the UK's next generation of scientists and engineers.

CPI today announced that it has been involved in a vast number of STEM (science technology, engineering and mathematics) activities, inspiring science across the UK. The company's STEM activities include presenting career talks, providing work experience and work placements, supporting apprenticeship programmes as well as carrying out tours around CPI's world-leading facilities in the North East. With innovation centres spanning across a range of disciplines including biologics, formulations, printable electronics, graphene, and industrial biotechnology and biorefining, CPI is well positioned to offer different STEM pathways, ultimately helping to inspire the next generation of budding scientists and engineers.

STEM subjects are considered to be an accelerating force for future economic growth across the UK, therefore encouraging students to participate in STEM subjects is of key interest. In order to increase the number of students participating in STEM subjects, students need to understand the range of STEM career opportunities, the positive impacts they can have on society, and how STEM applies to real world challenges. CPI recognises this need and has presented career talks and offered career advice to students of all ages at a number of local schools, academies, and universities, including Durham School, St Michaels Primary School (years 3,4,5,6), and Newcastle University. The company has also taken on a large number of placement students from numerous universities across the UK, including the University of Nottingham, University of Leeds, University of Strathclyde, University of Oxford, University College London, Teeside University and others; several of these placements have resulted in permanent employment for the students.

CPI is part of the Science Industry Apprenticeship Consortium (NE) (SIAC), which focuses on developing the right apprenticeship standards for the industry and collaborating with other local companies to plan and deliver apprenticeship programmes. CPI's apprenticeships have significantly increased over the last two years with sixteen new roles created to date. The company has invested heavily into the process, procedures and training plans for apprentices. Recently one of CPI's apprentices, Jodie Clemmit, was awarded with the Outstanding Achievement Award from the Sembcorp Skills Development Programme (SSDP). This award recognises and celebrates exceptional apprentices that have excelled in the life

science sector. Jodie has gained a permanent contract as Laboratory Technician at CPI. She has also decided to enrol for the BSc Biological Sciences degree at Teesside University, and is being fully supported by CPI. Another CPI apprentice, Michael Stokes, recently won the Outstanding Achievement Award at the TTE (Training Group) Celebrating Success event. Michael has successfully transitioned from a level 3 apprentice to a higher level apprentice, and is a valued member of the Asset Engineering Team, working predominantly at the National Printable Electronics Centre, and also the National Biologics Manufacturing Centre. Joe Henderson, a Junior Process Technician and CPI apprentice, received the Team Player Award at the TTE Celebrating Success Event. Joe has been recognised for his impressive input in the Operations team at the National Biotechnology and Biorefining Centre, contributing across multiple department disciplines from process to analytical.

"STEM subjects are going to play a critical role in the UK's economic growth and in tackling the sustainability challenges we look to face in the future. At CPI we actively encourage participation in STEM activities by a wide range of students, emphasising the positive impact of STEM jobs on society," said Nigel Perry, Chief Executive Officer, Centre for Process Innovation. "We're proud to be inspiring so many scientists of the future and we are committed to continue finding new avenues to make STEM subjects more accessible to everyone."

Robotics MSc next step for University of Plymouth graduate mentored by Plessey CEO

Tamar Engineering Project (TEP) scholar Brian Viviers has graduated with first-class honours in BSc Computer Science from the University of Plymouth and has now begun a master's degree course in Robotics at the University of Bristol.

TEP is a mentoring and financial award programme introduced by University of Plymouth to help remedy the growing technical skills shortage in the UK. The programme aims to provide one-to-one mentoring and financial support to high-performing students who may face socio-economic barriers in their academic pursuits.

One of the first TEP Ailot project's scholars to graduate, Brian Viviers, was selected among the top performing students across 29 engineering-related courses including computer science, civil engineering and mechanical engineering.

Receiving one-to-one mentoring from industry veteran LeGoff, Viviers was guided through the essential commercial skills that employers look for, helping him to develop confidence and sense of direction in his career. Demonstrating his determination to succeed, Brian not only achieved first-class honours in his degree, but was also awarded Best Overall Computing Student from the British Computing Society.

A pre-graduation ceremony reception was held in September at the Lord Mayor's residence at Elliot Terrace in Plymouth to congratulate Brian on his achievements. The event was hosted by the University of Plymouth's Vice-Chancellor, Professor Judith Petts CBE and Professor Kevin Jones, Executive Dean of the Faculty of Engineering; and Michael LeGoff – the CEO of Plessey – who played a pivotal role as Brian's TEP mentor.

The Tamar Engineering Project is championed and driven by former chiefs and serving executives of industry leading companies like Lockheed Martin, BT, SC Group, and Dawnus.

TEP aims to support up to five new students every year throughout their study at the University of Plymouth to help shape confident, employable, conscientious engineers of the future.

The Royal Academy of Engineering estimates that British industry will require 100,000 new graduates in science, technology, engineering and mathematics (STEM) subjects every year until 2020 if it is to meet its growth aspirations. However, the UK higher education sector has been producing fewer than 90,000 STEM graduates each year.

New solutions from Rohde & Schwarz for automotive radar echo generation and radome measurements at EuMW 2017

Rohde & Schwarz is developing a new range of solutions for automotive radar testing based on its expertise in microwave and millimeterwave testing. The soon-to-be-available innovative solutions range from analyzing radomes to generating multidimensional automotive radar echo environments. Visitors to European Microwave Week 2017 in Nuremberg, Germany, can learn about tomorrow's automotive radar test solutions for R&D, validation, certification and production at the company's dedicated technology exhibition area.

With the advent of advanced driver assistance systems (ADAS), vehicles are increasingly being equipped with radar sensors that support drivers in critical situations. To meet the industry's testing needs, Rohde & Schwarz is developing a range of new radar test solutions. These are being presented to the public for the very first time at EuMW 2017.

Echo generator for end-of-line production testing of automotive radar sensors

Rohde & Schwarz offers visitors a product preview of the new R&S AREG100A automotive radar echo generator for reliable testing of radar sensors in production. The R&S AREG100A supports all automotive radar bands (24 GHz, 76 GHz and 79 GHz). Up to three customer-definable fixed radar distances plus an optional Doppler offset for simulation of radial velocity make it a powerful solution for production testing.

Together with the R&S ATS1000 shielded chamber and the R&S QuickStep test execution software, it ensures fail-safe testing

of automotive radar sensors. With this setup, end-of-line testing becomes a standardized, conclusive process to ensure continuous quality control of radar sensors.

Thanks to its small footprint and low weight, the R&S AREG100A can be easily integrated into existing test racks for final inspection of the integrated radar sensor at the OEM's manufacturing sites.

Quality automotive radome scanner

Rohde & Schwarz has developed the R&S QAR specifically to characterize the performance of automotive radar covers such as emblem radomes and car bumpers. The test solution uses an innovative imaging technique that allows very fast measurement of the reflectivity of the DUT. Car manufacturers can now precisely localize and identify any material errors or inhomogeneous material that might impact the sensor's performance. A complete frequency sweep from 75 GHz to 82 GHz is used to measure material attenuation in the 77 GHz and 79 GHz automotive radar ranges. With both sets of measurements, the R&S QAR offers the comprehensive and detailed analysis required for future radar generations. The R&S QAR is scheduled to be available in the first quarter of 2018.

Fast automotive radar testing

Rohde & Schwarz will also demonstrate a breakthrough technology in testing and evaluating radar. The new measurement system allows precise angle simulation. This and other features can be seen in a live demonstration.

Panasonic Develops 3D LiDAR Sensor Enabling 3D Detection of Distances with Wide Angle of View

Panasonic Industry Europe announced Panasonic Corporation has developed a 3D LiDAR (Light Detection and Ranging) Sensor equipment that measures distance between the equipment and the object from the round-trip travelling time of the pulse laser that is projected to the object. sensor that accurately measure the direction of and distance to objects

with a wide angle of view, which is critical for autonomous operation of mobile robots. Employing Panasonic's propriety laser-scanning technology, this 3D LiDAR is capable of scanning the laser as wide as up to 60 degrees vertically and 270 degrees horizontally to achieve stable operation of autonomous robots. Sample shipments will start in January 2018.

LatestNews

The wide scanning angle of the newly developed 3D LiDAR helps the detection of objects on the ground precisely as well as the roughness of the ground surface. In addition, the range of scanning angles and the resolution can be tailored precisely by adjusting the rotation angle and speed of the mirrors in the system. This feature gives users accuracy and flexibility to choose the most appropriate conditions for the measurement depending on their usage. That will facilitate the wide-spread use of autonomous robots that navigate inside or outside facilities with moving objects around, including people. Sudhanshu Kapoor, Business Development Manager with Panasonic Industry Europe, says: "Panasonic's 3D LiDAR is one big step forward in the existing LiDAR ecosystem, with best-in-class wide angle detection range of vertical field of view of 60 degrees, and distance detection of 50m. Our 3D LiDAR will come up with IP65 protection and M12 plug, hence is capable of withstanding all types of outdoor conditions. Therefore, Panasonic's innovative 3D LiDAR is a big value addition in the field of autonomous navigation. With our 3D-LiDAR, we expect to collaborate together with customers to develop applications for industrial forklifts, AGVs, mobile robotics, construction and smart buildings ecosystem."

Autonomous robots need to detect the condition of the ground as well as the objects around them since they will be operated inside and/or outside facilities with many moving objects including people. Conventional 3D LiDARs that are designed for autonomous driving of automobiles cannot scan the laser in a wide range of vertical angles. Therefore, they cannot precisely detect the conditions of the ground. For this reason, conventional LiDARs need to be combined with other sensors that can detect the ground condition. This results in complicated configuration and the design of the autonomous robots. Suitable applications are autonomous robots such as delivery robots, fork lifts, agricultural machinery, construction machinery and security systems.

Panasonic's new 3D LiDAR has the following features:

- Wide view angles: 60 degrees in vertical and 270 degrees in horizontal directions
- Variable detection settings for viewing angles and resolution in vertical
- Accurate detection under strong sunlight

New and existing investors increase financial resources to accelerate development and speed up worldwide market entry

Dresden, Germany – 12th October 2017 – Heliatek, a world leader in organic photovoltaic and a manufacturer of solar films, announced today that it has raised €15 million from new and existing investors. A strong interest among potential investors lead to an extension of the last round of financing. It will enable Heliatek to accelerate its development and speed up its worldwide market entry. The company supplies HeliaFilm® to partners in the building and construction materials industry for application directly on facades and roofs of industrial and commercial buildings. These solar films generate green, delocalized, decarbonized electricity. An Asian Family office, based in Hong-Kong, and a German Family Holding participated in this round alongside existing shareholders that include innogy SE, Engie, BASF, BNP-Paribas, AQTON, eCapital, Innogy Venture Capital and Wellington Partners. The Asian Family office has extensive experience in China where it holds an interest in a large Xiamen-based manufacturing company in the touch solution area. The German Family Holding brings a deep first-hand knowledge and understanding of the construction and material industry.

"We are very happy to welcome these two new key investors. Our first Asian investor will help us refine and execute our strategy in that important region for our future," stated Thibaud Le Séguillon, Heliatek's CEO. "The decision of the German Family Holding to invest is one more validation of our business model. We will follow our strategy by expanding the BIOPV-market (Building Integrated Organic PhotoVoltaic) through supplying large quantities of our HeliaFilms® to our customers in the building and construction material field."

Heliatek is in the middle of sourcing and installing its new manufacturing roll-to-roll facility on its site in Dresden. It will offer a capacity of one million square metres per annum of solar films when fully ramped up.

Going the distance: LoRa+BLE makes it possible for IoT to go nearly anywhere geographically

> Jonathan Kaye, Laird

IoT networks that utilize low-power Bluetooth Low Energy (aka BLE and previously marketed as Bluetooth Smart) can be deployed in nearly any physical space, given its small footprint and energy-miser architecture—which enable small wireless sensors and controls to operate on a battery charge for years.

Those benefits of BLE allow these small devices to be placed into the nooks and crannies that were unfeasible with prior generations of wired and wireless devices. But until now, in order to get the data transmitted via BLE out to a cloud server, all those nooks and crannies needed to be in very specific geographic locations where traditional telecom infrastructure was available in the form of Wi-Fi connectivity or cell coverage.

In 2017, you would think that telecom infrastructure is ubiquitous, but the reality is that there are huge swaths of the map where telecom connectivity is minimal or nonexistent. Readers of EP&T can see that firsthand if they venture outside the metro areas of major cities like Toronto and Vancouver. It doesn't take long for the bars on your phone to start shrinking and other connectivity to disappear as well.

LoRa transfers data, communications with IoT networks

IoT has depended on fiber and cell infrastructure as the conduit for data that is sent to and from wireless sensor networks, which has limited the geographic reach of IoT as a result. But there is a great big world out there where IoT networks could be used for things like equipment monitoring, environmental monitoring, scientific measurement, industrial controls and much more—if only there were a way to send and receive data in the absence of traditional telecom infrastructure (or as an alternative to expensive cell charges in remote areas.

The solution to this geographic conundrum involves marrying BLE short-range technology with a new long-range, ultra-low power technology that provides the data relay over very long distances. LoRa, often referred to as a LPWAN (Low-Power Wide Area Network), provides secure, bi-directional data transfer and communications with IoT networks over long distances for years without a battery change. It can send and receive signals up to 15km, and that distance can extend to hundreds of kilometers with additional gateways if needed. By combining BLE with the ultra-long range and low-energy capabilities of LoRa, companies no longer have to limit their enterprise IoT (EIoT) deployments to a specific geographic location, regardless of whether there are cell towers, utility poles or underground fiber anywhere on the horizon.

Image 1: Sentrius™ RG1xx LoRa-Enabled Gateway from Laird

LoRa is highly-scalable and interoperable

LoRa technology is ideal for battery-powered networks of IoT devices because, like BLE, it is also an ultra-low-power technology that can operate for an extended time on a battery and requires very infrequent maintenance. The inexpensive nodes allow companies to bypass the high cost of cellular data fees or fiber/copper installation to create the long-distance data backhaul for remote installations. Just as important is LoRa's ability to perform in harsh environments, including industrial settings where temperature, vibration and interference are common. LoRa is also highly-scalable and highly-interoperable, supporting many thousands of nodes and compatible with both public and private networks for the data backhaul and bi-directional communications.

The primary limitation that LoRa has involves data throughput, which makes it a poor fit for high-data applications that involve constant streaming of information. But luckily, the vast majority of EIoT sensor implementations simply

Image 2: Communications in IoT network

involve event data that are sent by the networks back to a central location and/or small-packet instructions sent by managers to the networks in the field. Those are small batches of data rather than live streaming, making LoRa an ideal technology to provide the bi-directional communications.

LoRa+BLE complement one another perfectly

* BLE connects small wireless devices in any physical location they are needed, creating an integrated, short-range network that can operate for a very long time without battery changes and be controlled from anywhere via a smartphone or tablet. BLE also can enable a wireless interface to the sensor using the phone/tablet screen in place of buttons and switches, reducing the overall cost / size of the sensors.
* And LoRa allows those BLE-powered networks of devices to go anywhere geographically by providing an ultra-low power means of communicating to those IoT networks over a longer distance.

Together, BLE and LoRa allow IoT to go anywhere on the globe, making them a critical technology pairing for driving a new wave of IoT deployments that don't have geography as a limitation. So what does an integration of LoRa and BLE look like in action?

IoT implementations involving temperature, light or proximity sensors Most readers of EP&T Magazine have likely done IoT implementations involving temperature, light, or proximity sensors that are connected with BLE wireless technology. Those types of sensor deployments are very common in industrial settings and for environmental monitoring, so it is an example that should feel very familiar to most readers. In this application note, Laird engineers give a detailed outline of how BLE and LoRa collaborate in a typical temp sensor

Image 3: 900MHZ / 868 MHZ Module With LoRa + Central Or Peripheral BLE network

project to enable these deployments to go in dramatically different geographies than previously possible.

The specs of the project will look very familiar to most readers: a typical board for the sensor, a temp sensor that most readers have likely worked with a dozen times before, etc. But by using a LoRa+BLE module as the heart of the deployment's wireless strategy, the network of sensors can rely on the LoRa long-distance backhaul for data transfer, all while operating seamlessly with BLE for short-range communication with each sensor.

The beauty of this example is that it looks just like one of a dozen (or dozens of) projects that each of you has worked on in the past. Fundamentally, it is still a BLE-based IoT deployment. But a closer look makes it clear that this type of implementation opens up doors that were previously closed and locked and boarded up as far as IoT was concerned. LoRa breaks down those barriers, but it does so without requiring engineers to design in a radically different way.

This is just one example of how LoRa+BLE can be used together. The true impact of this pairing of technologies will come from engineers revisiting all the times they wished they could have deployed a BLE-based network of devices in a location but ran into the obstacle of unavailable or too-costly wireless infrastructure. Geography is no longer the limit. Now the only limit is an engineer's imagination about how to put IoT to work.

10 GbE in real time

> ## Congatec

Fog and Industry 4.0 servers must provide high real-time performance on a small footprint. COM Express Type 7 server-on-modules enable space-saving servers with highly individual interfaces that can also be utilized outside server racks.

PC technology has been used for many years in machinery and plants for control systems and HMIs. Now server technology is following suit in becoming embedded as performance requirements increase in line with the challenges: Vision systems produce immense quantities of raw data that need to be processed and analyzed in parallel and in real time to realize visual and interactive robotic technologies. Connecting all this with other fog servers and Industry 4.0 machines and systems requires extremely high computing performance that can only be achieved with server technologies.

It needs real-time Ethernet, superfast process technology, and ultramodern storage to efficiently handle the entire big data from horizontal and vertical communications.

However, before server processor technology can find a foothold in the control cabinet, some challenges have to be overcome. Above all, it is imperative to provide processor technology that is designed for use in industrial environments. This means it must be energy efficient because several hundred watts of processor power would produce too much waste heat for the technology to be usable in the industrial control cabinet. In addition, it needs to be available for a long time, as machines and systems have an operating lifespan not of years but of decades. Lastly, it must also be designed to support very different interfaces in the smallest possible footprint.

All these requirements can now be fully addressed by using standardized modules. Having proven themselves for many years in customer-specific embedded computer systems, they are predestined for extremely space-constrained Industry 4.0 server designs. For this reason, the PICMG has extended the COM Express specification to include a server-on-module specification: The COM Express Type 7 pinout, drafted by congatec as an editor. The first COM Express Type 7 modules currently offer two 10 GbE interfaces for horizontal and vertical real-time communication as well as up to 32 PCIe lanes for connecting the peripherals that can be used for fast storage media, General Purpose Graphics Processing Units (GPGPUs) and all types of industrial Ethernet interfaces.

The footprint of the COM Express Basic measures only 125 x 95 mm, which makes it possible to develop highly compact, yet extremely powerful mini servers. The first processor provided for server-on-module technology is the extremely high-performance Intel® Xeon® D processor (codename
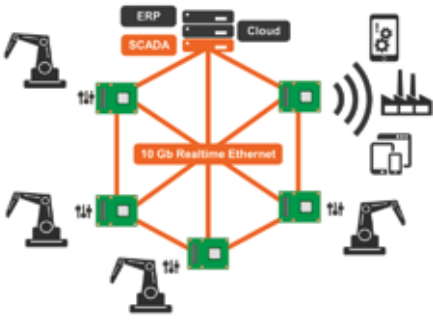
Figure 1: Industry 4.0, vision or big data servers for industrial IoT applications: congatec's COM Express Type 7 server-on-modules bring extremely compact, scalable server performance to the control cabinet

Figure 2: Developers wanting to test the 10 GbE real-time performance of the new server-on-modules can enjoy congatec's personal integration support and won't have to wait in impersonal hotlines.
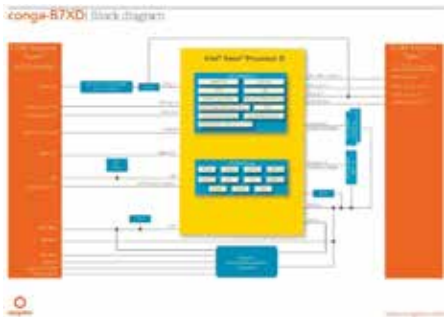

Figure 3: The conga-BX7D offer true server features on a 115 x 75 mm footprint: up to cores accessing up to 48 GByte DDR4 RAM as well as 2x 10 Gigabit Ethernet and 32 PCI Express lanes

Broadwell) with up to 16 server cores, 32 threads and up to 48 GB DDR4 ECC RAM. Application fields for the new server-on-modules are found in industrial automation as well as in industrial big data storage and network applications. In particular, these include Industry 4.0 applications in cyber-physical factories as well as modular server designs for industrial cloud, edge and fog servers.

The application-ready modular core of the long-time available congatec server-on-modules offers a standardized footprint, carrier board interfaces and cooling concept, which significantly simplify system design, so new robust server technology can be introduced more quickly to the market. They also make future performance upgrades very easy and cost-effective, since all that's required is a simple replacement of the server-on-module – even when the processor architecture has changed.

Since real-time support is key for many industrial fog and Industry 4.0 server designs, server-on-modules also support a software-definable pin for each of the 10 GbE interfaces. This physical pin can be configured as an input or output and is driven by the corresponding Ethernet controller. A typical application is the implementation of a hardware-based IEEE 1588 timing protocol for high-performance real-time applications to realize 802.1 timing and synchronization of distributed real-time systems, for instance to synchronize self-driving vehicles.

For application developers who also want to virtualize their server platforms, congatec has put together an application-ready bundle. It comprises the server-on-module, carrier board and a hypervisor from Real-Time Systems, which is particularly well-suited for industrial robotics, control systems and applications in the field of medical technology. congatec supplies this complete solution package also as a ready-to-run starter kit.

For such server designs, instead of SATA SSDs it is recommended to use SSDs that are connected via NVMe to the NVM Express or Non-Volatile Memory Host Controller Interface Specification – NVMHCI for short.

Figure 4: The new Server-on-Modul from in the COM Express Type 7 specification integrates Intel Xeon processors (Codename Broadwell DE)

Figure 5: congatec also offers corresponding cooling solutions based on heat pipes.

This interface uses native PCI Express for the connection of mass storage devices, and COM Express Type 7 specifically supports this development by providing a large number of up to 32 PCIe lanes.

Starter kits to test the new server-on-modules can be ordered from congatec now. If required, the new Cloud API for IoT Gateways can also be included in the starter kit, allowing developers to implement communication via MQTT or other optional protocol standards. Rounding out the starter pack is congatec's unique personal integration support - developers can enjoy personal contact for all needs and won't have to wait in impersonal hotlines. As congatec also offers Embedded Design & Manufacturing Services for its server-on-modules, even complete customer-specific system designs including carrier board are quickly implemented without application designers having to worry about the details of the hardware design.

TSN: Converged Network for Industrial IoT

> ## Michael Zapke & Adam Taylor

One of the major challenges to the implementation of the Industrial Internet of Things (IIoT) is the convergence of Information Technology (IT) and Operational Technology (OT) networks. Currently, these networks exist in separate domains. Limited communication in each direction is possible via dedicated gateways. Converging these networks is a key enabler for Cyber Physical Systems in which nodes interact with each other using the Industrial IoT.

The current architecture for controlling Factory Automation is hierarchical. Enterprise Resource Planning (ERP) applications at the highest level provide an integrated management and automation of business core processes, progressing down to Manufacturing Execution Systems (MES) that control the manufacturing process. Programmable Logic Controller (PLC) systems execute the automation tasks using connected industrial devices like electric drives, sensors or I/Os which reside at the lowest level of the hierarchy. This is often called the "Automation Pyramid" (Figure 1), illustrating the broad amount of devices at the bottom and high performance computers at the top. Layers of the pyramid illustrate the hierarchies.

Different layers in the Pyramid have different network requirements. While higher layers need high bandwidth and flexible network topologies, lower layers need deterministic behavior and the capability to transport samples in constant intervals with low packet delay variation. This leads to multiple networks that work side-by-side.

A converged network will address several challenges that currently exist in today's disparate network architecture:

- More transparency: All data from all hierarchies can be made accessible to every element in the factory without translation in between.
- Less network planning: More flexible topologies enable easier changes.
- Less CapEx: Reduction of cabling, reduction of gateways between networks with different protocols.
- Less OpEx: Reduction of network administration effort.
- More bandwidth: Avoid limitation to one network speed.
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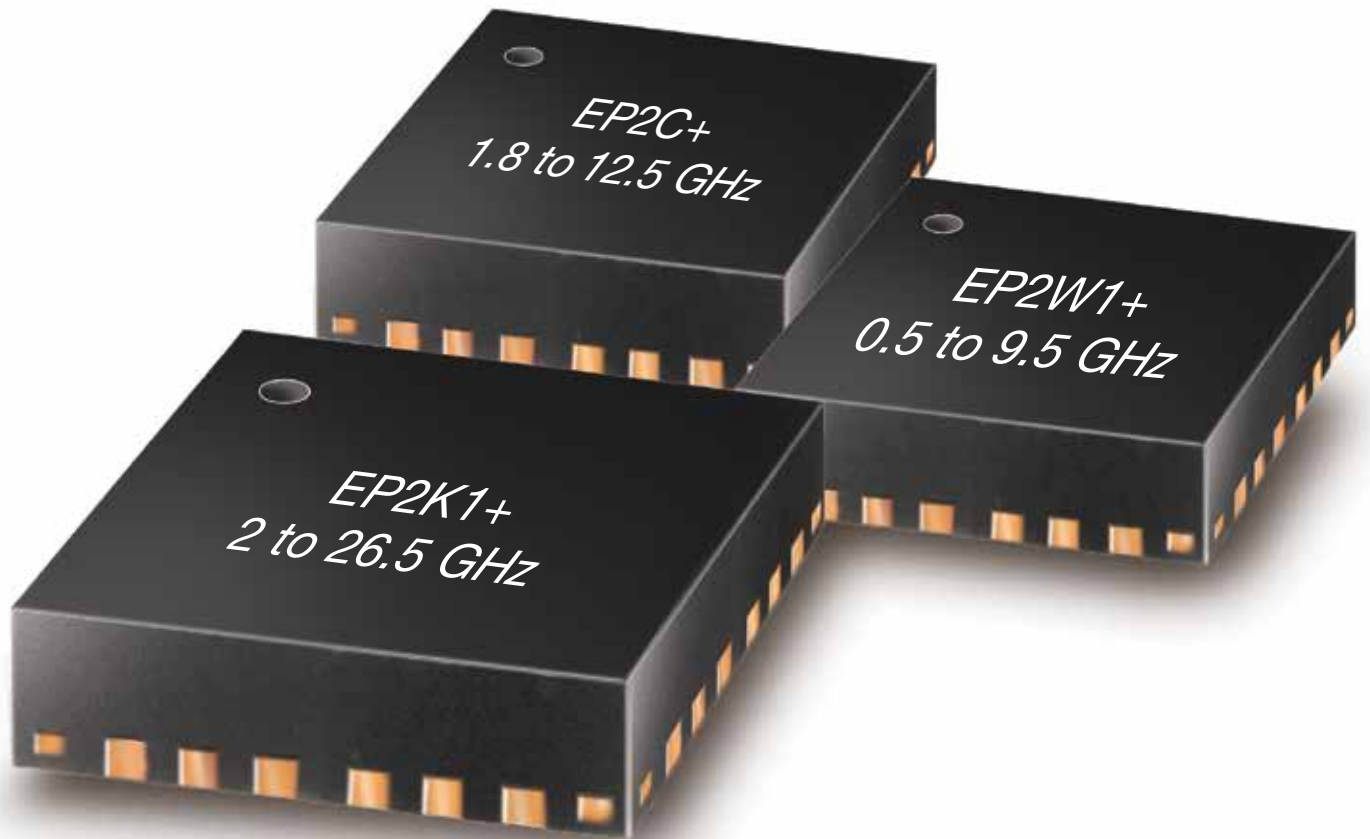
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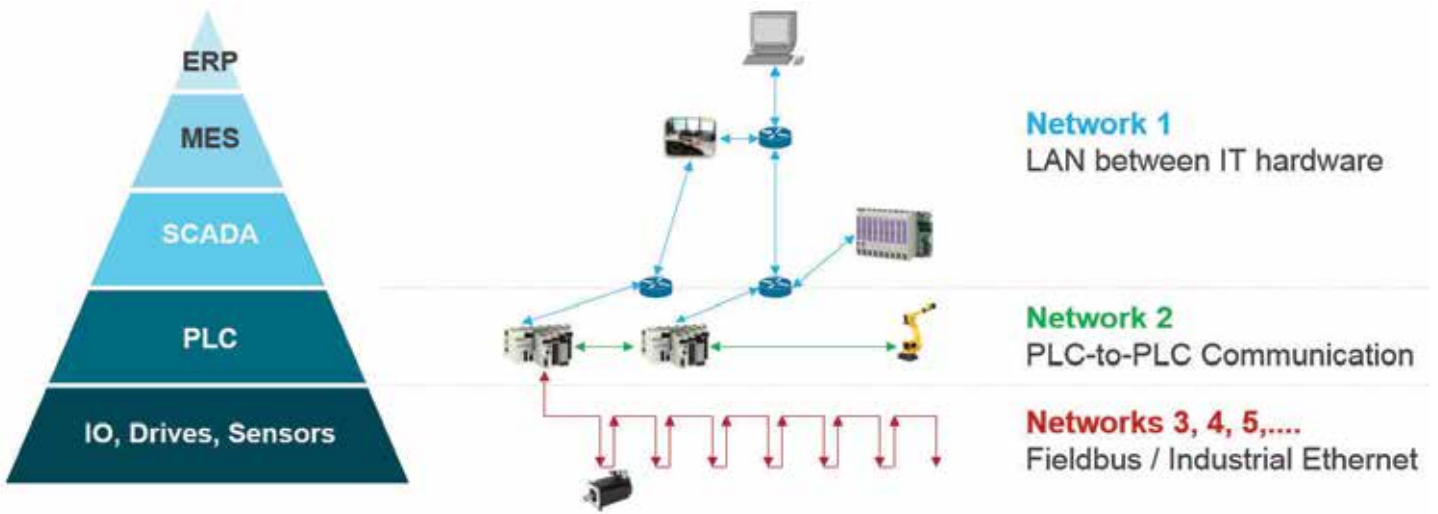
Figure 1. Automation Pyramid with typical assignment of networks to hierarchies.

This convergence is provided by Time Sensitive Networking (TSN). TSN is a set of IEEE 802 sub-standards which, when implemented, enable deterministic communication over Ethernet networks while keeping the benefits of communication in best effort manner, on that same network.

TSN introduces different traffic classes that share the same link. TSN network configuration reserves resources for streams with deterministic time characteristics. TSN, therefore, enables one common network to be implemented which supports multiple communication standards.

This introduces several improvements over standard Ethernet. Standard Ethernet communication is not time aware; it distributes the data over the entire bandwidth of the link with packets queued in order for transmission. TSN implements time awareness with scheduled traffic at configured offsets in cyclic intervals. That follows a schedule that is distributed by a network configuration controller.

Standard / IEEE Draft	Title	User's Advantage
IEEE 802.1AS (evolving to P802.1ASrev)	Network Time Synchronization	All nodes share the same time
IEEE 802.1Qbv	Scheduled Traffic	Scheduled Ethernet frames never collide
IEEE 802.1Qci	Filtering & Policing	Removes babblers from the network (Security)
P802.1CB	Seamless Redundancy	Zero Loss switch-over
P802.1Qcc	Stream Reservation	Path provisioning according to IEEE
IEEE 802.1Qbu and IEEE 802.3br	Frame Pre-emption	Maximum bandwidth without compromising real-time behavior

Figure 2. IEEE TSN Standards.

Further TSN features introduce Filtering and Policing for TSN streams, seamless redundancy and supports cyclic data transmission while also providing pre-emption for higher priority packets.

TSN is defined by a set of IEEE 802.1 standards which specify the implementation Figure 2). As of September 2017, four of these standards are adopted, while the remainder is still within the Task and Working Group stages.

These standards are implemented over Ethernet (IEEE 802.3 Physical layer) and support star, chain,

ARROW EVEREST BOARD

About PolarFire FPGAs

Microsemi's new cost-optimized PolarFire FPGAs deliver the industry's lowest power at mid-range densities with exceptional security and reliability. The product family features 12.7 Gbps Serializer/Deserializer (SerDes) transceivers at up to 50 percent lower power than competing FPGAs. Densities span from 100K to 500K logic elements (LEs) and are ideal for a wide range of applications within wireline access networks and cellular infrastructure, defense and commercial aviation markets, as well as industry 4.0 which includes the industrial automation and Internet of Things (IoT) markets.

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ring and mixed topologies and they are not limited to a specific data rate. Industrial applications will use 100Mbit and 1Gbit data rates mainly. Therefore, TSN provides the convergence between the IT and OT networks. This convergence reduces the cost of implementing the network, significantly lowering the cost of ownership and operation.

TSN Implementation

Correctly implementing TSN requires a solution which can provide a low latency and deterministic response at TSN end points and TSN bridges. Many applications solve this challenge by the combination of a processor and a FPGA connected together over a high-speed link such as PCIe. This two-chip solution not only increases occupied board space, power consumption, development time and cost but also prevents a holistic integrated solution from being developed. As the design is segmented between two devices, this also increases the complexity of verification.

Increasingly, IIoT solutions providers are using All Programmable Zynq®-7000 and Zynq® UltraScale™+ MPSoC devices to implement their solutions. These devices provide a combination of Processing System (PS) and Programmable Logic (PL) enabling the implementation of acquisition, control and processing applications by optimal use of the PS and PL thanks to:

1. Ability to interface and control a wide range of sensors, actuators, motors and other application-specific interfaces.
2. Ability to implement complex processing at the edge, for example machine learning, sensor fusion, image processing and real-time analytics.
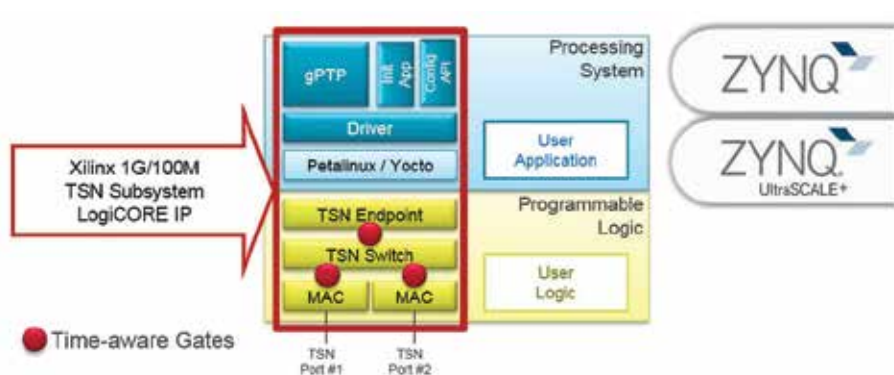
Figure 3. TSN IP in Xilinx Zynq-7000 or Zynq UltraScale+ MPSoC.

3. Scalability concerning the number of network interfaces.
4. Security and the ability for the device and system to be secure in terms of Information Assurance, Anti-Tamper, and Trust.

The support of any-to-any interfacing and the ability to couple coupled Processing System and Programmable Logic makes the Zynq-7000 and Zynq UltraScale+ MPSoC devices ideal to implement TSN next to a user application.

Xilinx's 1G/100M TSN Subsystem LogiCORE IP consists of FPGA Logic for MAC, TSN Bridge and TSN Endpoint. The TSN design with dedicated logic resources guarantees that the timing behaviour is strictly deterministic. Software which runs in the SoC's Processing System is for for network synchronization, initialization, and for the interfacing with network configuration controllers for stream reservation. The software is designed for running on Petalinux and will be published for Yocto builds.

The LogiCORE IP also comes with an optional integrated time-aware L2 switch that creates the chain or tree topology that is required in many industrial applications without

allocating another port at an external TSN switch. Seamless Redundancy (P802.1CB) also requires the additional port. The complete IP is illustrated in Figure 2, the user can freely configure before synthesis whether or not the switch shall be integrated.

Once instantiated, the TSN IP core provides individual AXI Streaming ports for each traffic class. Scheduled traffic, reserved traffic and best effort traffic are supported. The AXI Streaming ports connect to infrastructure that is introduced by Xilinx's Vivado® Design Suite. AXI Lite is used for the configuration of the TSN blocks.

Xilinx provides a ready-to-use implementation for evaluation purposes that includes Direct Memory Access separately for each of the traffic classes. This evaluation system can be used as is to test the behavior between Xilinx components as well as in combination with 3rd party equipment or with protocol analyzers. Figure 4 shows a block diagram of the evaluation system.

As Programmable Logic is flexible, it also provides the ability to update the IP Core as the TSN standards and
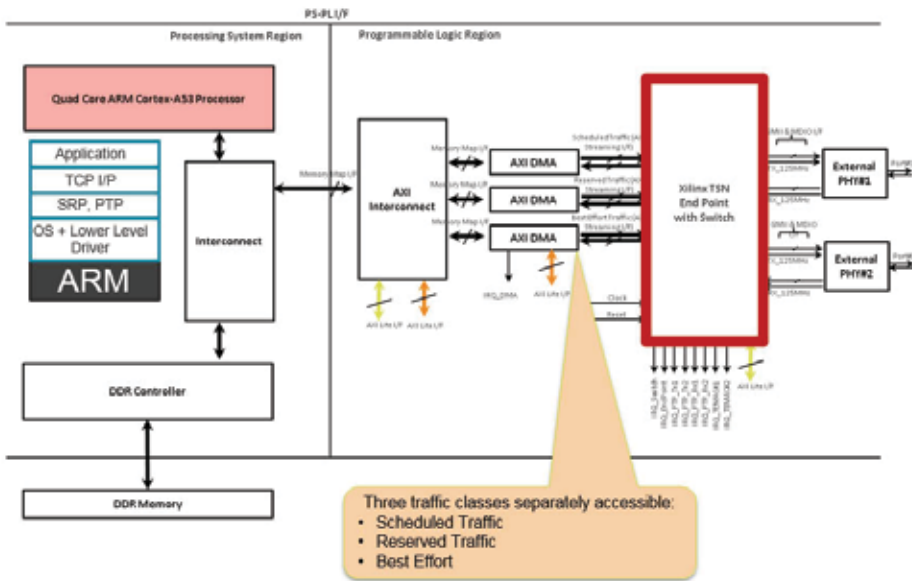
Figure 4. TSN implementation for evaluation purposes (here: Zynq UltraSale+ MPSoC).

market segment specific conformance tests progress, while devices with fixed hardware implementations (like custom ASICS and Application Specific Standard Products - ASSPs) lack the option to introduce functional changes along the TSN evolution.

To demonstrate the TSN IP core in action, Xilinx developed a demonstration application for both the ZCU102 and ZC702 development boards, featuring devices from the Zynq UltraScale+ MPSoC and Zynq-7000 families, respectively. When two of these boards are connected (Figure 5) it enables network traffic to be transmitted and received, enabling validation of TSN networking capabilities.

To further support TSN deployment and applications, Xilinx is a member of the Time Sensitive Networking testbed at the Industrial Internet Consortium (IIC). Participation within this testbed provides the ability to perform vendor interoperability testing, along with testing of high performance and latency critical applications. This testing can occur both formally on one of the two permanent testbeds located in either the USA or Europe.

Wrapping it up

To enable deployment of the cyber physical systems for Industrie 4.0 and IIoT, there needs to be convergence between IT and OT networks. TSN provides the ability to converge these networks, offering significant advantages in network connectivity, scalability and cost of deployment and ownership. Implementing TSN within an All Programmable Zynq-7000 or Zynq UltraScale+ MPSoC device provides the user with a single chip solution, which can also provide the processing capability in the PS and PL to perform the IIoT application at the edge.

Xilinx's TSN has been released with the name 1G/100M TSN Subsystem LogiCORE IP in May 2017 for early access customers and will continue the rollout in Q4/2017.

Figure 5. TSN Evaluation System (here: for Zynq UltraScale+ MPSoC).

Using Wideband IF Digitizers to Solve Challenges in Streaming and Recording RF Signals

› National Instruments

Overview

This paper describes various capabilities of wideband IF digitizers with built-in FPGA chips in the context of RF signal streaming. Topics include wideband signal streaming, variable burst signal recording, and narrowband signal monitoring.

The Challenge

Many applications in verification and validation tests, spectrum surveillance, multiconstellation GNSS, and software-defined receivers require acquisition, real-time processing, and recording of RF signals. Modern analog-to-digital converter (ADC) technology enables direct sampling receivers operating at or above 2 GHz. This simplifies the architecture of the receivers, mainly in the case of multichannel systems, which require tight synchronization between channels. That is the case in direction finding systems for spectrum surveillance, over-the-horizon and passive radar, and antenna measurements.

Furthermore, the increasing demand for faster spectrum scanning and new types of radar requires receivers with wide instantaneous bandwidth and real-time signal processing.

Normally, current RF streaming systems take two forms: high-bandwidth, lossless streaming and narrowband streaming. The first type records all available bandwidth, which in modern applications implies gigabytes per second of data for systems sampling at 2 GS/s or higher. Active radar systems typically take advantage of wideband streaming.

Often, however, most of the useful information concentrates around a particular narrower band. This is where the second type of streaming comes in. Narrowband streaming enables data reduction and inline signal processing. Such systems require streaming to HDD signals that occupy relatively narrow bands with several central frequencies.

Example narrowband signals acquired, streamed, and analyzed (or recorded) by passive radar applications can originate from Digital Video Broadcasting-Terrestrial (DVB-T) or Advanced Television Systems Committee (ATSC) transmitters that are characterized by bandwidths of 6 MHz to 8 MHz, depending on the country, and are in VHF/UHF frequency ranges.

GNSS multiconstellation receiver tests are other examples for narrowband streaming, where the requirement is to use both GPS L5/L2 and GLONASS G1 and G2 signals. Users might focus their interest in signals that are only a few megahertz wide but that can be spaced even hundreds of megahertz apart.

fter acquiring these wideband signals, these streaming systems require subsequent downconversion

(shift in frequency), decimation, equalization, and calibration. The resulting narrowband signal then gets demodulated and decoded, further filtered, amplified, and stored to HDD or any combination of these functions. At a high level, typical streaming and channelizing applications can be divided as figure 2 shows.
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Wideband Streaming

To better understand the challenges connected with wideband streaming, one must first understand the technical specifications of the IF receiver. This paper focuses on the PXIe-5624R module. IF receivers are typically part of the vector signal analyzer that comprises the mixer, IF receiver, and signal sources for LO. The architecture of the example vector signal analyzer is described in the Introduction to the PXIe-5668R—High-Performance 26.5 GHz Wideband Signal Analyzer white paper.

IF is characterized by the frequency range from 5 MHz to 2 GHz and bandwidth of 800 MHz typical (see technical specs for details). After adding a band-limited noise (dither) signal, which helps reduce the quantization effects of the ADC and improve spectral performance, the ADC samples the signal at up to 2 GSa/s with 12-bit resolution. The onboard FPGA processes these samples and transfers the data to other devices (PXI Express controller, RAID) through the PCI Express Gen 2x8, which allows for data streaming with theoretical rates of up to 4 GB/s. In the wideband streaming case, the FPGA performs only one digital downconversion (DDC) for all incoming data, as opposed to several independent downconversions in the narrowband case as mentioned later in the document.
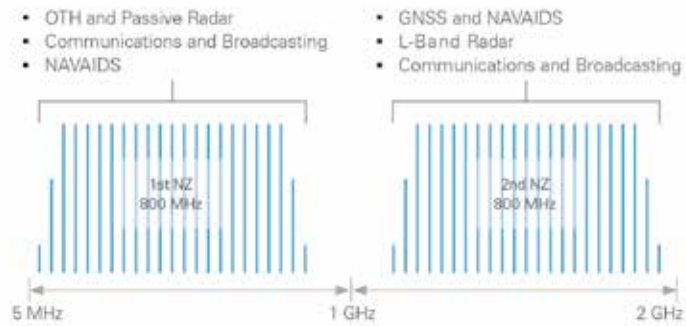
Figure 1. Example Signals in 5 MHz–2 GHz Band

Bit Packing

When talking about wideband streaming, one must consider not only the theoretical available bandwidth of the PCI Express bus but also its practical limitations (that is, control messages that travel over the same bus). The first and more simple implementation for sending data over the PCI Express bus would be to send 16-bit samples, one after another, even if data from the ADC is only 12 bit. However, this approach leads to theoretical limitations of 4 GB/s per PCI Express link available in the PXIe-5624R module (2 bytes/samples at 2 GS/s equals to 4 GB/s), which practically won't allow for continuous streaming. However, there's a clever solution: bit packing. Using bit packing, four 12-bit samples are packed into three 16-bit words. Consequently, this method reduces the data rate from 4 GB/s to 3 GB/s, enabling continuous data streaming.

Intermodules Synchronization

Often there is a need for continuous streaming from several modules of the same type. These multichannel, synchronized RF systems enable certain applications such as direction finding.
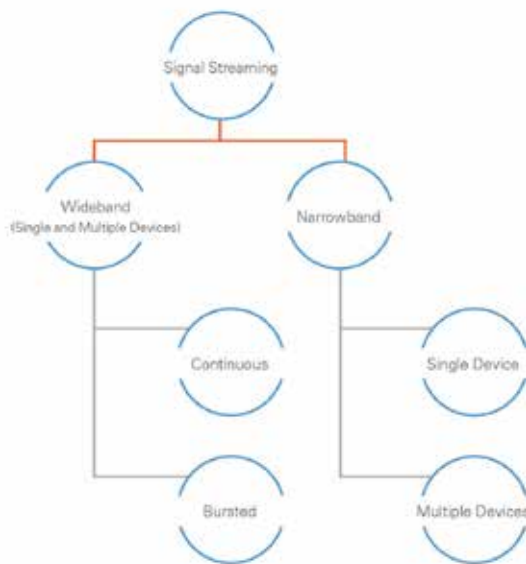
Figure 2. Classification of Streaming Applications Covered in This Document

By analyzing the incoming signal's phase difference between different channels, the system can determine the direction of the signal source.

In such case, the digitizers are locked to the same reference clock. By default, this is the 100 MHz PXI Express backplane clock. Therefore, the synchronization makes it possible to start the acquisition on multiple devices at the same time—more precisely, within a couple of 10 ps relative to each other. But, it is critical that the skew between the digitizers is the same from run to run as long as the temperature is the same, so the skew can be improved with calibration. No timing module or external cabling is required for the synchronization to work. The synchronization uses two trigger lines on the PXI Express backplane.

Burst Mode

In burst mode, the data is streamed to the host only after the trigger signal occurs. The trigger signal can be connected directly to the IF digitizer board using the PFI0 connector, or it can be software-triggered. In burst mode, users can define logic of the FPGA in a way that a few parameters can be configured:

■ Record length (Nx)
■ Record period (Mx)
■ Number of records per trigger
■ Number of pretrigger samples

Such a burst scenario can be implemented in a way that allows for variable record lengths and delays. Descriptions of scenarios can be defined on the host machine and later streamed down to the FPGA. The trigger signal, however, can produce samples with an uncertainty of around 8 ns, because the PFI0 signal being sampled at 125 MHz.

Narrowband Streaming

Narrowband streaming is often needed in GNSS validation, spectrum monitoring, passive radar, and direction finding applications. In such cases, users often are interested in multiple relatively narrowband signals that are within a defined, larger spectrum component and often coming from multiple spatially distributed antennas. The strong requirement is that the signals are acquired simultaneously, which makes it impossible to use traditional, swept vector signal analyzers. The solution for such a challenge is called a channelizer-the application that acquires a wideband signal containing all narrowband signals of interest and then separates them using DDC on an FPGA, thereby significantly reducing data rates.

Digital Downconversion

Because of its parallel structure, it is possible to implement numerous DDC logic blocks on an FPGA,

Figure 3. Block Diagram of the PXIe-5624R IF Digitizer

Figure 4. Example Burst Acquisition Scenario
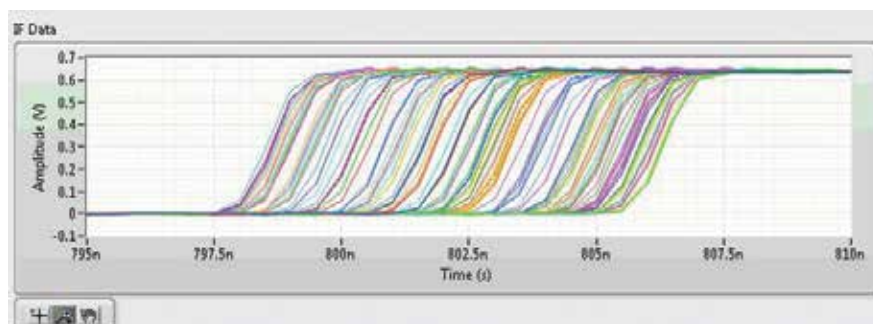
Figure 5. Trigger Uncertainty Resulting From PFI0 Being Sampled at 125 MHz

allowing for the simultaneous analysis of multiple narrowband signals. The first stage of DDC uses a digital quadrature mixer that shifts a signal to baseband from any frequency within the range of the digitizer. The next stage decimates (reduces the sample rate). Programmable digital FIR lowpass filters prior to each stage of decimation prevent aliasing when the sample rate is reduced. Users can retrieve the decimated data as in-phase and quadrature.

Additionally, users can perform digital signal processing for the digital correction of analog imperfections in the system such as:

- Digital Gain-Digitally controls the I and Q signal amplitudes
- Digital Offset-Digitally controls the I and Q signal offsets
- Equalization-Filters the I/Q data to equalize the analog response of a device
- I/Q Impairments-Modifies the I/Q data to correct or apply I/Q impairments such as gain imbalance, quadrature skew, or DC offset

One PXIe-5624R device with its Xilinx Kintex-7 XC7K410T can fit up to 12 DDCs with 37.5 MHz I/Q rates or 8 DDCs with 93.75 MHz I/Q rate (contact NI for details). Subbands can be streamed to RAID and/or analyzed online on the host machine.

Multiantenna DDC Using IF Receivers

As mentioned above, multiple PXIe-5624R devices can be synchronized for acquisition from multiple antennas, for example, for direction finding applications. In such cases, users can define up to 12 center frequencies with selected I/Q rates and multiple IF modules will downconvert signals from multiple antennas. The PXI Express solution simplifies the

synchronization of the multiple PXIe-5624R ADCs.

- The following parameters can be set in such case:
- Channels' center frequencies
- Channels' I/Q rate
- ADC clock source
- Clock out
- Burst size (for burst acquisition)
- Burst wait period in samples
- Shaping filter's parameter

Phase Noise Considerations and Improvements

The open architecture of the PXIe-5624R IF receivers allows for using external clock signals in applications where keeping the phase noise to a minimum plays a critical role. Users can choose the best way of providing clocking signals to ADC, depending on the requirement of the system and available budget. Figure 8 shows various possible configurations of clock sourcing. The PXIe-6674T module is a timing and synchronization module developed for multimodule, multichassis systems (phase noise marked with green on Figure 8), whereas PXIe-5653 is a low-phase noise LOs generator (marked with blue and purple on Figure 8). Lowest phase noise is achieved with the PXIe-5653 module, whereas PXIe-6674T is a compromise between cost and performance.

Conclusion

NI's PXI-based IF receivers (PXIe-5624R) with built-in FPGAs are powerful devices that empower some of the most demanding streaming applications such as radar test, GNSS validation, agile spectrum monitoring, and direction finding. Their open architecture in combination with the power of the PXI platform allow for easy expansion into multiple channels with guaranteed phase synchronization and coherence. Furthermore, the NI modular approach allows users to add
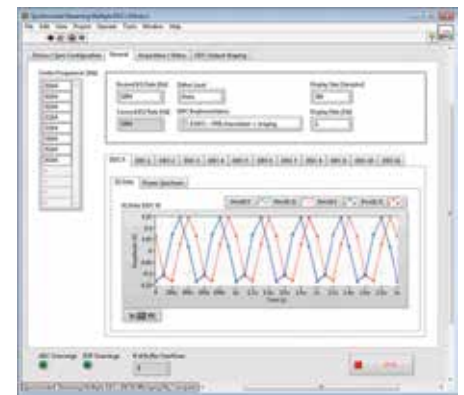

Figure 6. Example Configuration Window for a Multimodule, Multichannel Channelizer Application
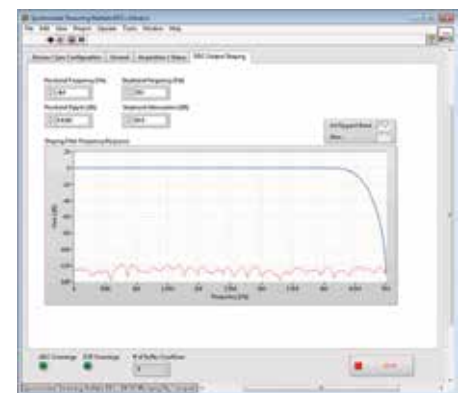

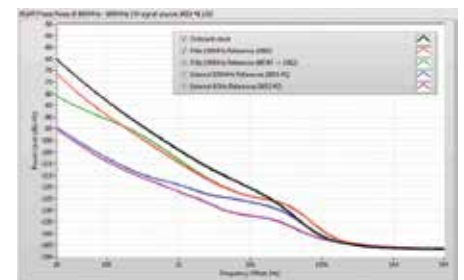**Figure 7.** Shaping Filter's Parameters

Figure 8. Various Options for Phase Noise Reductio

components such as mixers (with central frequencies up to 26.5 GHz in PXI Express form factor or 72 GHz to 76 GHz radio head), switches, power amplifiers/attenuators, and preselector modules.

First white-box testing model finds thousands of errors in self-driving cars

> Lehigh University

How do you find errors in a system that exists in a black box? That is one of the challenges behind perfecting deep learning systems like self-driving cars. Deep learning systems are based on artificial neural networks that are modeled after the human brain, with neurons connected together in layers like a web. This web-like neural structure enables machines to process data with a non-linear approach—essentially teaching itself to analyze information through what is known as training data.

When an input is presented to the system after being "trained"—like an image of a typical two-lane highway presented to a self-driving car platform—the system recognizes it by running an analysis through its complex logic system. This process largely occurs in a black box and is not fully understood by anyone, including a system's creators.

Any errors also occur in a black box, making it difficult to identify them and fix them. This opacity presents a particular challenge to identifying corner case behaviors. A corner case is an incident that occurs outside normal operating parameters. A corner case example: a self-driving car system might be programmed to recognize the curve in a two-lane highway in most instances. However, if the lighting is lower or brighter than normal, the system may not recognize it and an error could occur. One recent example is the 2016 Tesla crash which was caused in part...

Shining a light into the black box of deep learning systems is what Yinzhi Cao of Lehigh University and Junfeng Yang and Suman Jana of Columbia University—along with the Columbia Ph.D. student Kexin Pei—have achieved with DeepXplore, the first automated white-box testing of such systems. Evaluating DeepXplore on real-world datasets, the researchers were able to expose thousands of unique incorrect corner-case behaviors. They

will present their findings at the 2017 biennial ACM Symposium on Operating Systems Principles (SOSP) conference in Shanghai, China on October 29th in Session I: Bug Hunting.

"Our DeepXplore work proposes the first test coverage metric called 'neuron coverage' to empirically understand if a test input set has provided bad versus good coverage of the decision logic and behaviors of a deep neural network," says Cao, assistant professor of computer science and engineering.

In addition to introducing neuron coverage as a metric, the researchers demonstrate how a technique for detecting logic bugs in more traditional systems—called differential testing—can be applied to deep learning systems. "DeepXplore solves another difficult challenge of requiring many manually labeled test inputs. It does so by cross-checking multiple DNNs and cleverly searching for inputs that lead to inconsistent results from the deep

neural networks," says Yang, associate professor of computer science. "For instance, given an image captured by a self-driving car camera, if two networks think that the car should turn left and the third thinks that the car should turn right, then a corner-case is likely in the third deep neural network. There is no need for manual labeling to detect this inconsistency."

The team evaluated DeepXplore on real-world datasets including Udacity self-driving car challenge data, image data from ImageNet and MNIST, Android malware data from Drebin, and PDF malware data from Contagio/ VirusTotal, and production quality deep neural networks trained on these datasets, such as these ranked top in Udacity self-driving car challenge.

Their results show that DeepXplore found thousands of incorrect corner case behaviors (e.g., self-driving cars crashing into guard rails) in 15 state-of-the-art deep learning models with a total of 132, 057 neurons trained on five popular datasets containing around 162 GB of data.

The team has made their open-source software public for other researchers to use, and launched a website, DeepXplore, to let people upload their own data to see how the testing process works.

More neuron coverage

According to a paper to be published after the conference (see preliminary version here), DeepXplore is designed to generate inputs that maximize a deep learning (DL) system's neuron coverage.

The authors write: "At a high level, neuron coverage of DL systems is similar to code coverage of traditional systems, a standard metric for measuring the amount of code exercised by an input in a traditional software. However, code coverage itself is not a good metric for estimating coverage of DL systems

as most rules in DL systems, unlike traditional software, are not written manually by a programmer but rather is learned from training data."

"We found that for most of the deep learning systems we tested, even a single randomly picked test input was able to achieve 100% code coverage—however, the neuron coverage was less than 10%," adds Jana, assistant professor of computer science.

The inputs generated by DeepXplore achieved 34.4% and 33.2% higher neuron coverage on average than the same number of randomly picked inputs and adversarial inputs (inputs to machine learning models that an attacker has intentionally designed to cause the model to make a mistake) respectively.

Differential testing applied to deep learning

Cao and Yang show how multiple deep learning systems with similar functionality (e.g., self-driving cars by Google, Tesla, and Uber) can be used as cross-referencing oracles to identify erroneous corner-cases without manual checks. For example, if one self-driving

car decides to turn left while others turn right for the same input, one of them is likely to be incorrect. Such differential testing techniques have been applied successfully in the past for detecting logic bugs without manual specifications in a wide variety of traditional software. In their paper, they demonstrate how differential testing can be applied to deep learning systems.

Finally, the researchers' novel testing approach can be used to retrain systems to improve classification accuracy. During testing, they achieved up to 3% improvement in classification accuracy by retraining a deep learning model on inputs generated by DeepXplore compared to retraining on the same number of randomly picked or adversarial inputs.

"DeepXplore is able to generate numerous inputs that lead to deep neural network misclassifications automatically and efficiently," adds Yang. "These inputs can be fed back to the training process to improve accuracy."

Adds Cao: "Our ultimate goal is to be able to test a system, like self-driving cars, and tell the creators whether it is truly safe and under what conditions."

Credit: CC0 Public Domain

Lab-on-a-Chip technology - a key enabler for life science and diagnostics

> Holger Becker, Claudia Gärtner – microfluidic ChipShop GmbH

Introduction

As the microelectronic revolution changed the way how electronic components were manufactured 50 years ago, a similar development can be seen in the Life Sciences with the concept of the so-called "Lab-on-a-Chip" or microfluidics technology, which deals with the handling and manipulation of miniature amounts of liquids and was introduced almost 30 years ago [1]. After the number of scientific publications within the microfluidics area has dramatically increased between 2000 and 2010, the commercialization of microfluidics-enabled products has been picking up speed. We have seen the technology making a tremendous step from being a "technology looking for a problem" to a widely used truly enabling technology. Nowadays almost no product development in the field of diagnostics or analytical sciences takes place which does not involve elements with microfluidic functionality.

Several drivers behind the current commercial development can be named: Firstly, the fundamental scaling laws which favor miniaturization with mechanisms like diffusion and heat transport. This reduces overall time from the input of a sample to the analytical result to minutes rather than the hours or even days in larger systems. Secondly, the cost and the overall available volume of reagents in the Life Sciences is often a critical factor. By reducing these volumes, not only a cost reduction can be achieved but often this represents the only way of processing scarce material. Thirdly, many functional elements of biology, e.g. cells, blood vessels, bacteria etc. have a size which lies exactly in the range of microfabrication methods, making it an ideal fit between manufacturing technologies and applications. Fourthly, the very high geometrical accuracies of miniaturized systems together with the high surface-to-volume ratio makes the environment in which the fluids are contained extremely well controlled. Last but not least, miniaturization offers the potential to automate many laborious laboratory processes which often include many manual steps like pipetting, sample transfer etc., again reducing the cost and time of the complete analytical process and reducing the risk of procedural error. These advantages have proven to be very attractive, first spurning the very large scientific activity in the field and increasingly also in form of commercial products.
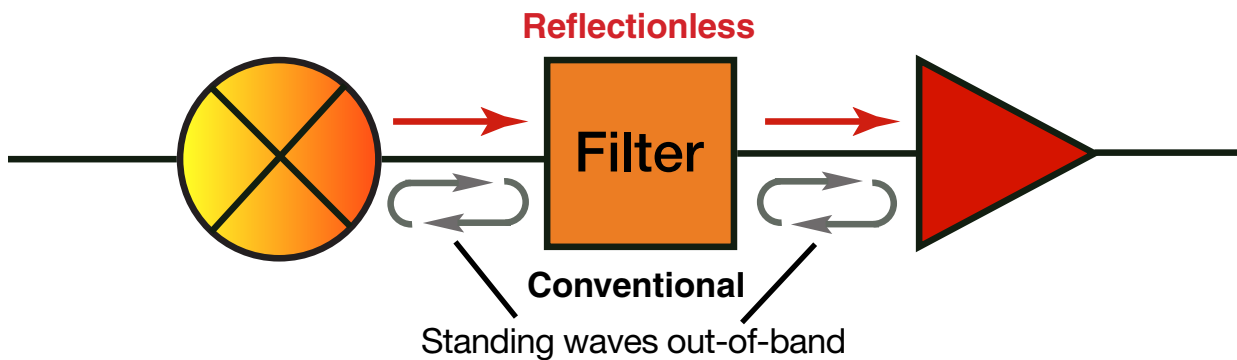
Functional integration

One of the most important advances in recent years is the ability to transfer complex analytical or diagnostic processes onto a single microfluidics device.

Figure 1 shows typical process steps which have to be realized during a

Fig 1. Schematic diagram of the typical process steps involved in a bio-analytical or diagnostic process flow in a microfluidic device.

Fig 2. Integrated microfluidic device for molecular diagnostics.

development of such an integrated microfluidic device.

In the first step, the sample has to be brought onto the device through some interface. As the type of sample can be very different (e.g. biopsy, swab, sputum, blood etc.), this interface has to be adapted to the type of sample. These "world-to-chip" interfaces still are an often over-looked item during the development.

The next step, the various sample preparation processes like liquefaction of the sample, the lysis of cells, extraction of DNA/RNA, the sample concentration etc., have so far been typically been carried out off-chip due to their complexity. Moving these steps onto the device represents the biggest challenge. Furthermore, many of these steps have to be carried out with a high precision in terms of volume, times or sequence. It is therefore a specific requirement in the development of miniaturized assays that the assay should be as robust as possible. The next process step frequently involves an amplification of target molecules, using methods like conventional or isothermal polymerase chain reaction (PCR) in order to increase the number of target molecules to achieve better detection selectivity and sensitivity.

This amplification step is then usually followed by a separation step like electrophoresis, chromatography, the use of capture probes or other filtration mechanisms in order to isolate the desired component or remove unwanted components from the mixture.

The final analytical step comprises the detection of the analyte of interest. While for many larger, lab-based systems, optical detection methods like fluorescence still act as a benchmark with respect to sensitivity, for portable systems, electrochemical analysis methods or various other sensor methods (e.g. surface acoustic waves (SAW), quartz crystal microbalance, thermal measurements) are becoming increasingly of interest. It should be noted that all the preceding process steps have to be matched to the selected detection method in order to generate the best results.

A minor but nevertheless important design step of an integrated device in diagnostics is the layout of a waste container system in order to retain all liquids used in the process on-chip. This is often necessary to avoid the contamination risk of the instrument and to prevent carry-over from one measurement to the next.

Once these individual functions

have been verified with microfluidic modules, a stepwise integration into a single device then can take place. An example for such an integrated microfluidic cartridge for molecular diagnostics is shown in Fig. 2.

Microfluidics technology has made enormous progress in the last 25 years and has proven that it is a technology which is viable in the scientific as well as the commercial arena. Although the commercial development did not happen as fast as many people predicted 20 years ago, it is evident that microfluidics has turned into a crucial enabling technology for almost any product development in the Life Sciences The big killer application is still missing, but comparison with the market uptake of other high-tech applications shows that the current time-line is nothing extraordinary. The range of applications is extremely broad and even if it has not revolutionized the Life Sciences as many had hoped for, it has and is currently changing many established practices in these disciplines.

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Boosting Cyber Security Competence: Continental Acquires Argus Cyber Security

> ## Argus Cyber Security

In order to further strengthen and enhance its capabilities in automotive cyber security, the technology company Continental is acquiring Argus Cyber Security (Argus), one of the global leaders in this domain.

Vehicles are becoming increasingly connected and software is the single biggest innovation enabler for intelligent, efficient and automated mobility. By 2020, hundreds of millions of these "computers on wheels" will drive on roads worldwide and communicate as part of the Internet of Everything. On the downside of this development, connected mobility is turning into a potential target for cyber-attacks, posing risk to human lives and property. In response, vehicle manufacturers and suppliers around the world are defining and implementing strategies and countermeasures to minimize the exposure of vehicles to such risks.

"Only secure mobility is intelligent mobility. With the acquisition of Argus Cyber Security we are enhancing our abilities to directly develop and offer solutions and services with some of the world's leading automotive cyber security experts to our customers around the globe in order to truly make mobility more intelligent and secure," says Helmut Matschi, member of the Executive Board at Continental and head of the Interior division.

Multi-layered, end-to-end security solutions and services

Founded in 2013 by Israeli cyber security experts, Argus is headquartered in Tel Aviv, Israel, has a team of more than 70 people and the most comprehensive, market-ready solution suites in the industry, based on 38 granted and pending patents.

To help vehicle manufacturers rapidly respond to the growing need for cyber security solutions, Argus has forged significant collaborations with key industry players and is successfully delivering projects to vehicle manufacturers and suppliers worldwide. Argus also has representations in Japan, Germany and North America (Detroit and West Coast).

Together, the companies will offer multi-layered, end-to-end security solutions and services including intrusion detection and prevention, attack surface protection and fleet cyber security health monitoring and management via a security

operations center (SOC) to protect vehicles in the field over their entire lifespan. The companies will also provide software updates over-the-air solutions. Argus' technology was tested by vehicle manufacturers, their suppliers and independent third parties, and has repeatedly out-performed its competitors.

"Argus was founded with a vision to protect all vehicles on the road from cyber threats. To this end we have developed the most comprehensive automotive cyber security offering in the industry and enjoy global recognition of our leadership. Joining forces with Continental and EB will enable us to further accelerate the realization of that vision," says Ofer Ben-Noon, Co-Founder and CEO of Argus Cyber Security. "With automotive cyber security regulations in the making worldwide and with already millions of connected cars on the road, I can't think of a better time, or a more exciting move, than now to become part of EB. Together we will shorten time to market and make it easier for vehicle manufacturers to protect their vehicles from cyber-attacks," Ben-Noon continues.

Boosting Security at Continental's software company Elektrobit

Argus will become a part of EB, Continental's stand-alone software company and will continue to engage in commercial relations with all automotive suppliers globally. This combination of Continental's broad automotive know-how, Argus' technology, market-ready solutions and expertise in automotive cyber security, and EB's deep automotive software knowledge, marks a unique cooperation in the automotive industry.

"As we are experiencing a world of software-defined vehicles and face unique challenges, we are taking a proactive approach in developing new ways to collaborate and interact. EB and Argus have been partners in developing cyber-security and over-the-air software update solutions since 2016. Adding Argus to our portfolio will allow us to further advance the development of our software," says Alexander Kocher, President and Managing Director, EB.

"We are now offering to the automotive industry – carmakers and suppliers alike – a complete secure solution for the development of highly automated and connected driving. This will enable them to develop safer, smarter and more efficient vehicles," Kocher continues

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Standardization as a recipe for success

› Cécile Jacquin, Cognex Germany Inc

The standardized Cognex In-Sight Explorer software platform is available across the entire range of Vision systems from low-end to high end.

In the selection of image processing systems, investment decisions are often based on the hardware technology. The current customer requirements show that the software platform of the systems are of great strategic importance. Thus in addition to the selection of image processing software, the user interfaces and their image processing tools must be included in the investment decision. Cognex offers a complete solultion in the area of Machine Vision.

Cognex has set the bar very high with regard to ease of use. In this, the world-wide leading provider of industrial image processing solutions not only concentrates on the hardware, but also covers the entire application range from low-end to mid-range to high-end with a comprehensive, user-friendly user interface. For example, the EasyBuilder configuration environent enables easy introduction to the standard applications of image processing within the Cognex In-Sight Explorer software. More challenging tasks can be undertaken using the spreadsheet view also from within the In-Sight Explorer software. The user only has to familiarise with the In-Sight Explorer software platform and can then use all of the tools they need from simple step by step setup process to powerful and flexible vision spreadsheet for more difficult applications.

As Cognex's experiences show, many users would like to expand and deepen the use of their Vision technology over time, and increase performance. This usually means that the entire Vision structure needs to be rethought, with the result that completely new, sometimes very complex systems are installed. John Keating, Director of In-Sight Product Marketing at Cognex, explains the dilemma: "For expansions of Vision applications, users want to work with their same tried and trusted software, because they have built up expertise and already work with it efficiently. New software, on the other hand, requires an increased expense in its introduction."

Therefore, Cognex has focussed on the modularity of its solutions in addition to ease of use. Cognex In-Sight Explorer software can be used with many products and is scalable in regard to the functions available. This means flexibility, above all when the Vision application needs to be expanded, from the use of the easy beginner's camera, which can be quickly and easily configured with Easybuilder, to the use of a more

challenging system based on freely configurable spreadsheets. These are tables for programming the camera for a complete image processing application.

Software is becoming strategically more important

Flexibility and user-friendliness without loss of performance capacity are important criteria for beginners in image processing, which Cognex can fulfil with its reliable In-Sight Explorer software. On the hardware side, the user has a choice of a large number of easy to use image processing sensors with the In-Sight 2000 series. John Keating comments: "The user can start with the very compact In-Sight 2000 Easy-to-Use sensor, and grow pursuant to their requirements, without leaving the trusted, reliable software platform. Thus the Vision solution always fits with the application, even when the challenges mount."

The series works perfectly with the In-Sight Explorer, overall a solution that is very easy to learn. Users have trusted the reliability of the In-Sight systems for over 20 years. This trust should not be lost during a system upgrade. For this reason, Cognex has decided on flexible standardization for the In-Sight Explorer platform: The combination of software and hardware can cover everything modularly from low-end to high-end, and thus supports nearly all applications. In addition, the software also offers sophisticated functions and configuration options for experienced users depending on the performance required, in order to efficiently and reliably master even the most difficult applications.

The Easybuilder interface, the practical and simple tool provided in the Cognex In-Sight Explorer software is designed for first time users and beginners, and offers easy step-by-step set-up of the application. With this, even

John Keating, Director of In-Sight Product Marketing at Cognex

inexperienced users can quickly achieve a reliable survey activity in nearly any production environment. Programming knowledge is not required. Thus applications can be implemented and started in the shortest period of time. John Keating says: "In contrast to our competition, we offer a seamless transition from the low-end to the high-end ranges with our flexible solution.

This flexibility is required when requirements rise, such as with more challenging image processing applications, where one uses not only partial recognition, but an immediate comparison of image data or a rapid read-out of codes and immediate verification of the data is required. In these cases, In-Sight Explorer is flexible enough to support even higher performance Cognex cameras such as the In-Sight 7000 and to offer functionalities accordingly. Thus

experienced users can also perform more complex image processing applications thanks to expanded configuration options. Advanced users can use the capacity and flexibility of spreadsheets in In-Sight Explorer to program solutions for the most difficult applications, with a much reduced number of hardware platforms.

The hardware of tomorrow must fit in with the software of today

The In-Sight 2000 series uses In-Sight Explorer for the set-up and monitoring of image processing inspections. The camera has integrated high-performance image generation with in-line changeable lenses and a patent pending LED ring light, which creates even, diffuse light over the entire image and makes expensive external lighting unnecessary. Customers can easily replace the lens and change the colour of the integrated ring light.

Even the new, recently introduced In-Sight 7000 system of the second generation (G2) uses the In-Sight Explorer platform for the set-up and monitoring of image processing platforms. In this series, the advanced user can use spreadsheet views for specific requirements. The system includes a complete set of high-performance In-Sight image processing tools, including the PatMax RedLine for reliable part location, SurfaceFX feature extraction technology for optimal image generation and OCRMax for optical

In-Sight 2000 series with Easybuilder

In-Sight 7000 series with modular equipment
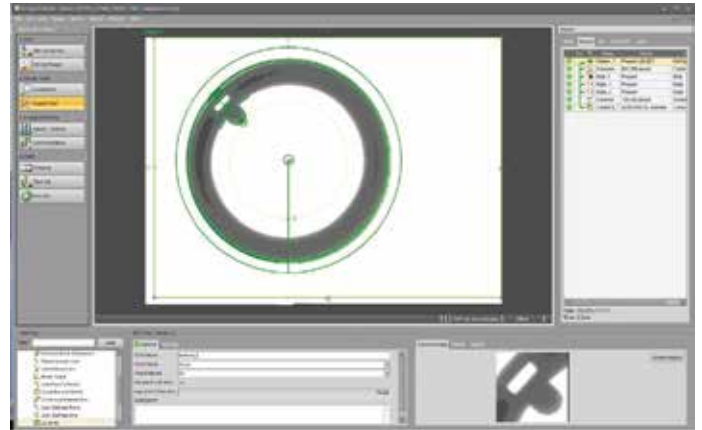
Thanks to its modular structure, the In-Sight 7000 series can be used in the most varied of industries.

The Easybuilder interface of the In-Sight Explorer software allows an easy introduction to the standard applications of image processing.
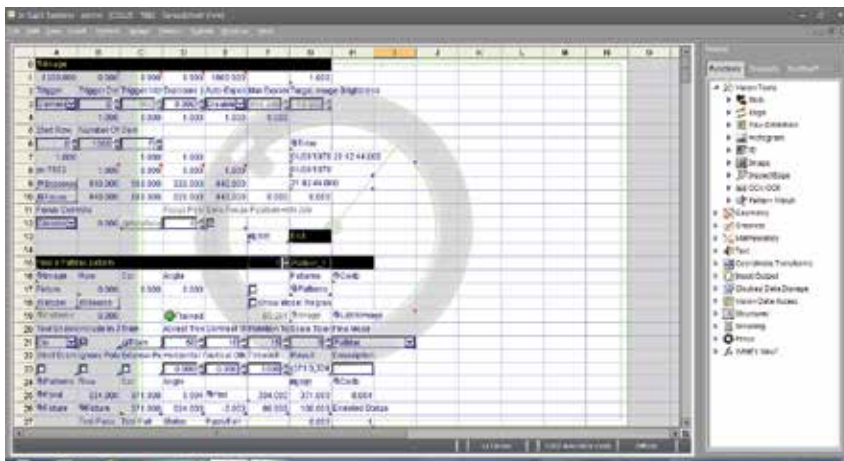
More challenging tasks can be performed by advanced users using spread-sheets in In-Sight Explorer.

character recognition. Thus In-Sight users achieve maximum performance in inspection tasks, while at the same time keeping errors to a minimum.

In-Sight 7000 (G2) is a high-performance image processing system equipped with many functions. With its versatility, it is suitable for rapid and precise inspections of the most diverse parts, regardless of industry. Thanks to its compact size, it fits in seamlessly to production lines with limited space. The improved performance keeps pace with increasing line speeds. The modular design of the In-Sight 7000 has over 400 different field configurations, and makes it the most flexible image

processing system. A large selection of illumination modules, optical filters and polarizers can be switched in and out without problems to fulfil the special requirements of an application. The broad palette of field changeable C-mount and S-mount lenses as well as industrial autofocus lens options increase the versatility.

Standardization in the Vision sector is a strategic decision.

For companies, standardization to one software platform means future-proofing technology and reliability

in production. There are hardly any down times, because the systems can be rapidly substituted for an upgrade. John Keating comments: "Now you can acquire replacement parts within 48 hours. The replacement devices can be easily exchanged and rapidly configured, because the settings are assumed from the prior system." The expense in personnel and time is reduced because the work with the same user interface enables high efficiency without a great deal of training in any stage of development. The in-house expertise in the operation of the Vision systems reduces support costs.

In terms of long-term corporate strategy, the standardization of image processing and its underlying software platform is a sensible step in automation, which many companies are already using. Cognex technology offers protection for your investment, because the industry leaders will also offer state-of-the-art hardware and software in the future. A guarantee for this is Cognex' continual investment in research and development. A total of 900 patents prove this, and establish Cognex as a technology leader. In addition, the company is represented by 500 partners in 30 countries, and thus provides established on-site support anywhere in the world.

Advanced Microwave Amplifier Models for Advanced Design System Simulations

> Larry Dunleavy, Kevin Kellogg and Eric O'Dell

Abstract:
A tutorial overview is provided of nonlinear amplifier models available from Modelithics, with a focus on the enabling features of X-parameters models.

Introduction

Mobile and wireless communication has seen phenomenal growth over the past two decades. Faster communication with higher data rates has been the driving factor. To achieve this, the RF front end components have been continuously improved to meet the linearity and power requirements and a range of wireless standards have emerged, based on variations in frequency, modulation and power level requirements. The 0.7 GHz to 6 GHz band has been the mostly widely used frequency range for mobile and wireless communications using different standards such as GSM, CDMA, WCDMA, LTE, WLAN and WiMAX. The evolving 5G standard is pushing frequency ranges for emerging commercial systems upward to mm-wave frequencies as high as 86 GHz! Still, the bulk of near term 5G developments will likely be at the proposed bands of 28GHz and below.

Amplifiers are an indispensable component of the circuitry for wireless and microwave systems. They have been used in a variety of applications including mobile communications, microwave heating, jamming and electronic warfare networks, radar systems and satellite communications. There are many vendors that manufacture low noise amplifiers, power amplifiers, gain blocks and variable gain amplifiers for microwave wireless frequency bands below 6 GHz. An increasing number of products are now also being offered at higher frequencies, including many GaN MMIC based amplifiers, which offer higher power densities and higher frequencies than possible with Silicon and GaAs power transistor technologies.

When it comes to modeling, among the most advanced models available for nonlinear simulations is the X-parameter* model. This is conveniently supported within Keysight Advanced Design System (ADS) and Genesys. Another model that is available and predates X-parameters is the P2D model. Both are behavioral models that are particularly useful for modeling productized die and packaged integrated circuit amplifiers, for

which internal schematic details may not be available to the modeler. In the following treatment, examples of both models are discussed with an emphasis on the more powerful and accurate X-parameter model. X-parameter models can be generated either from an ADS nonlinear circuit simulation or from measurements taken on a suitably equipped test bench, such as one equipped with a nonlinear vector network analyzer (NVNA) like the Keysight PNA-X. Our focus in this article will be on measurement-generated models.

Available Models

Table 1 shows a list of currently available amplifier models included in the Modelithics® COMPLETE Library for ADS. These models are setup to enable both broad-band linear as well as nonlinear simulations of internally matched and unmatched amplifiers. Many of the models include noise parameter prediction and all allow some level of nonlinear simulations with the X-parameter model being most flexible and accurate. Several of these models are also available for immediate free use thanks to sponsorship from Mini-Circuits. Unique model features test conditions and simulation results along with measurement validations, are detailed in each models' data sheet. The columns to the right of the product listing in Table 1 indicate various features of these models that use either the X-parameters or the P2D model. Note one Modelithics model, for the Qorvo RF2878, includes both X-Parameter and P2D model formats7, that can be selected by

Vendor	Part Number	Modelithics Model Number	Body Style	Max Freq. (GHz)	P1dB (dBm)	Non-Linear	X-Parameters Model	P2D Model	Substrate Scalable	Noise Parameters	Broadband S-Parameters	Temperature Dependent	Load Pull	TOI	Free Downloads
Avago	MGA-635P8	AMPXP-AVA-MGA635P8-001	2x2mm QFN	13	22										
Avago	MGA86576	AMP-AVA-MGA86576-001	Package	10	7										
Freescale	MWE6IC9100NR1	AMPXP-FRS-MWE6IC9100NR1-001	TO-270	0.96	50										
Guerrilla RF	GRF2070D5	AMPSP-GUR-GRF2070-001	2x2mm DFN	8	20.1		*								
Guerrilla RF	GRF2071D5	AMPSP-GUR-GRF2071-001	2x2mm DFN	8	21		*								
Guerrilla RF	GRF2072D5	AMPSP-GUR-GRF2072-001	2x2mm DFN	8	19.7		*								
Guerrilla RF	GRF2073D5	AMPSP-GUR-GRF2073-001	2x2mm DFN	8	18		*								
Guerrilla RF	GRF2501D5R	AMPSP-GUR-GRF2501-001	1.5x1.5mm DFN	8	-8		*								
Maxim	MAX2371	AMP-MAX-2371-001	QFN	2.5	-3										
Maxim	MAX2373	AMP-MAX-2373-001	QFN	2.5	-3										
Mini-Circuits	GVA-62+	AMPXP-MCL-GVA62+-001	SOT-89	18	19.8										
Mini-Circuits	GVA-63+	AMPXP-MCL-GVA63+-001	SOT-89	18	19										
Mini-Circuits	GVA-84+	AMPXP-MCL-GVA84+-001	SOT-89	12	20.5										
Mini-Circuits	PGA-102+	AMPXP-MCL-PGA102+-001	SOT-89	12	17.5										
Mini-Circuits	PGA-103+	AMPXP-MCL-PGA103+-001	SOT-89	12	22.5										
Mini-Circuits	PGA-105+	AMPXP-MCL-PGA105+-001	SOT-89	12	19.3										
Mini-Circuits	PHA-1+	AMPXP-MCL-PHA1+-001	SOT-89	18	22										
Mini-Circuits	PHA-22+	AMPXP-MCL-PHA22+-001	DL1020	12	22										
Mini-Circuits	PSA4-5043+	AMPXP-MCL-PSA4-5043+-001	SOT-343	12	21										
Mini-Circuits	ZFL-1000LN+	AMP-MCL-ZFL-1000LN+-001	Coaxial	1	3		*								
NEC	uPC8179TK-E2-A	AMP-NEC-UPC8179TK-001	1151 Minimold	2.4	2										
Qorvo	AH101	AMPXP-TQT-AH101-001	SOT-89	15	26.5										
Qorvo	RF2132	AMP-RFMD-RF2132-001	Package	3	29										
Qorvo	RF2878	AMPXP-RFMD-RF2878-001	Package	3	14.4										
Qorvo	RF5110G	AMPXP-RFMD-RF5110G-001	3x3mm QFN	3	36										
Qorvo	TGA8344-SCC	AMP-TRI-TGA8344-001	MMIC	26	16										
Qorvo	TGA8399B-SCC	AMP-TRI-TGA8399B-001	MMIC	10	11										
Qorvo	TGA8B10-SCC	AMP-TRI-TGA8B10-001	MMIC	13	17										

*In development, available for pre-release ordering.

Table 1. Currently Available Models as Included in Modelithics COMPLETE Library for ADS

setting the user-defined parameter to 0 for P2D and 1 for X-Parameters. This model is available in Modelithics SELECT+ free sample library for ADS. While the focus in this article will be on models for ADS, X-parameters-based models are also available from Modelithics for Keysight Genesys.

Understanding X-Parameters (In Brief)

X-Parameters are analogous to S-Parameters. They are both behavioral or "black box" models, in that there is no need for knowledge of internal circuitry, design or device type. However, whereas S-parameters provide for linear input/output relationships, X-parameters enable multi-harmonic nonlinear simulations. X-parameters can be easily ported to multiple EDA platforms, but like S-parameters

performance one must be very careful about any extrapolations in frequency, power, or bias outside of the data range used to build the model. Modelithics X-parameter model datasheets give power, frequency, bias, and additional guidelines for model users.

As Figure 1 suggests a behavioral model provides a nonlinear mapping between a time domain (or multi-harmonic frequency domain) input signal x(t) and output signal y(t). Shown also is the Modelithics X-parameters-based model representation for a specific example amplifier model from Mini-Circuits. The available input parameters will vary with the model. The "model_mode" parameter is set to "1" for nonlinear X-parameter analyses and to "0" for small-signal S-parameter analyses. For practical reasons, it is easier to provide a broader-band
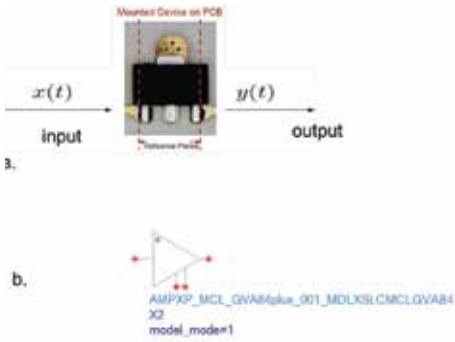
Figure 1. Amplifier representation is a "black box" model: a. packaged amplifier shown with desired mapping between output y(t) and input x(t), b. Modelithics ADS model for GVA84+ amplifier from Mini-Circuits.

small-signal (S-parameter-based) model to include out of band frequencies that may be of interest for stability and other purposes. The nonlinear model will generally be applicable to a narrower frequency band, including the main operating band of interest, since it is more "expensive" to develop in terms of test time and measurement complexity. This is especially true when measuring X-parameters of high power devices and circuits.

Whereas a deep dive on the mathematical formulation of -parameters is beyond our scope here it may be helpful to review in brief one of the main defining equations shown below in Eq.. 1.

Equation 1

$$B_{ij} = X_{ij}^{(F)}(|A_{11}|)P_j + \sum_{k,l \neq (1,1)}(X_{ij,kl}^{(S)}(|A_{11}|)P^{j-l}a_{kl} + X_{ij,kl}^{(T)}(|A_{11}|)P^{j+l}a_{kl}^*)$$

Equation 2

$$b_1 = S_{11}a_1 + S_{12}a_2$$
$$b_2 = S_{21}a_1 + S_{22}a_2$$
or

Equation 3

$$b_i = \sum_{k=1}^{2} S_{ik}a_k \quad \text{for } i = 1, 2$$

$$B_{11}(|A_{11}|) = X_{11}^{(F)}(|A_{11}|)P + X_{11,21}^{(S)}(|A_{11}|)A_{21} + X_{11,21}^{(T)}(|A_{11}|)P^2 A_{21}^*$$

$$B_{21}(|A_{11}|) = X_{21}^{(F)}(|A_{11}|)P + X_{21,21}^{(S)}(|A_{11}|)A_{21} + X_{21,21}^{(T)}(|A_{11}|)P^2 A_{21}^*$$

X-parameters reduce to (linear) S-parameters in the appropriate limit

$$X_{11}^{(F)}/|A_{11}| \underset{|A_{11}| \to 0}{\to} S_{11}$$
$$X_{21}^{(F)}/|A_{11}| \underset{|A_{11}| \to 0}{\to} S_{21}$$
$$X_{11,21}^{(S)}(|A_{11}|) \underset{|A_{11}| \to 0}{\to} S_{12}$$
$$X_{21,21}^{(S)}(|A_{11}|) \underset{|A_{11}| \to 0}{\to} S_{22}$$
$$X_{11,21}^{(T)}(|A_{11}|) \underset{|A_{11}| \to 0}{\to} 0$$
$$X_{21,21}^{(T)}(|A_{11}|) \underset{|A_{11}| \to 0}{\to} 0$$

X-parameters are a superset of S-parameters
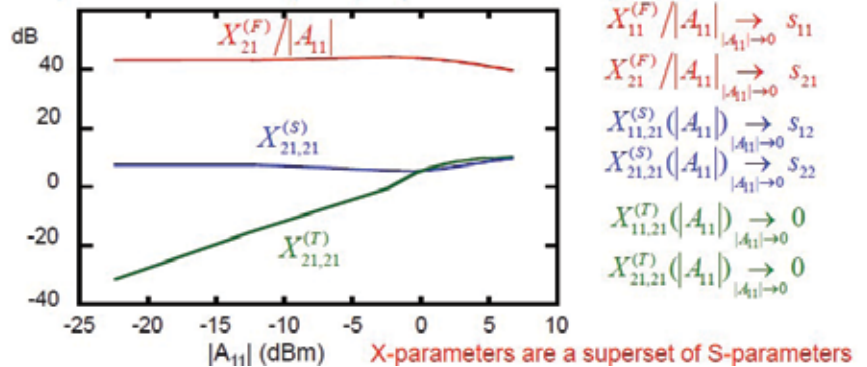
Figure 2 a. X-parameters enable accurate analysis of multi-stage or cascaded nonlinearities, not just worst-case analysis
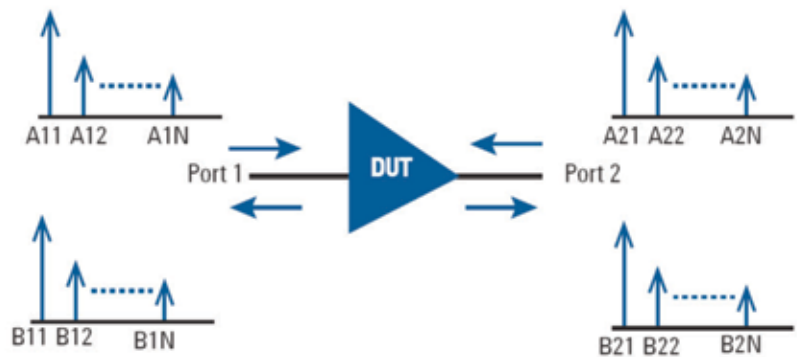
Figure 2 b. Graphical views to assist with understanding X-parameters for an amplifier: a. in terms of linear extrapolation to S-parameters and b. representation of the multi-port/multi-harmonic frequency mapping the X-parameters enable. (Graphics provided courtesy of Keysight Technologies.)

Starting with Eq. 2, b1 and b2 are the "reflected" voltage waves flowing out of ports 1 and 2, respectively, from a 2-port device, defined in terms of the S-parameters and the incident voltage waves a1 and a2. The indices 1 and 2 are port indices and all parameters are frequency dependent. This is a linear equation set and no new frequencies are generated and the "mapping" is assumed to be amplitude independent. The S-parameters are measured as ratios between reflected and incident waves, typically using a vector network analyzer, with no need to know the exact absolute power level of any of the waves. Eq. 3 is equivalent to Eq. 2 with i and j being the input and output port indices, respectively. S-parameters models obey superposition, that the combination of multiple small signal

stimuli presented to the model will output the same response as the sum of the individual responses would. As such, S-parameters are easily and conveniently cascaded in a linear mode of operation.

Turning our attention to Eq. 1, in this case we have a nonlinear mapping between "reflected" or outgoing "b" waves, linear superposition does not apply and we have new periodic frequencies generated, cross frequency phase dependency, and the mapping is amplitude and frequency dependent at a single operating point. For this reason, there are four subscript indices used in the equation: i is the output port index, j is the output frequency (or harmonic number) index, k is the input port index and l is the input frequency (or harmonic number) index. This formulation is setup to accurately represent amplitude dependence under the variance of port 1 power as represented by the notation $|A_{11}|$, which is the amplitude of the incident wave on port 1 at the fundamental frequency. The X-parameters are the functions that have superscripts (F), (S) and (T) and depend nonlinearly on $|A_{11}|$. P is a phase term that, along with the magnitude-only dependence on $|A_{11}|$ of the X(S) and X(T) functions, is a necessary consequence of the assumed time invariance of the underlying system[5]. When measuring X-parameters with a modern nonlinear vector network analyzer, such as a suitably optioned Keysight PNA-X, we need to calibrate for and accurately measure absolute powers and the phase relationship at fundamental and all harmonic frequencies to be recorded. Moreover, for high efficiency amplifiers or when PAE is important, drain efficiency data can be included in the X-parameter model by carefully
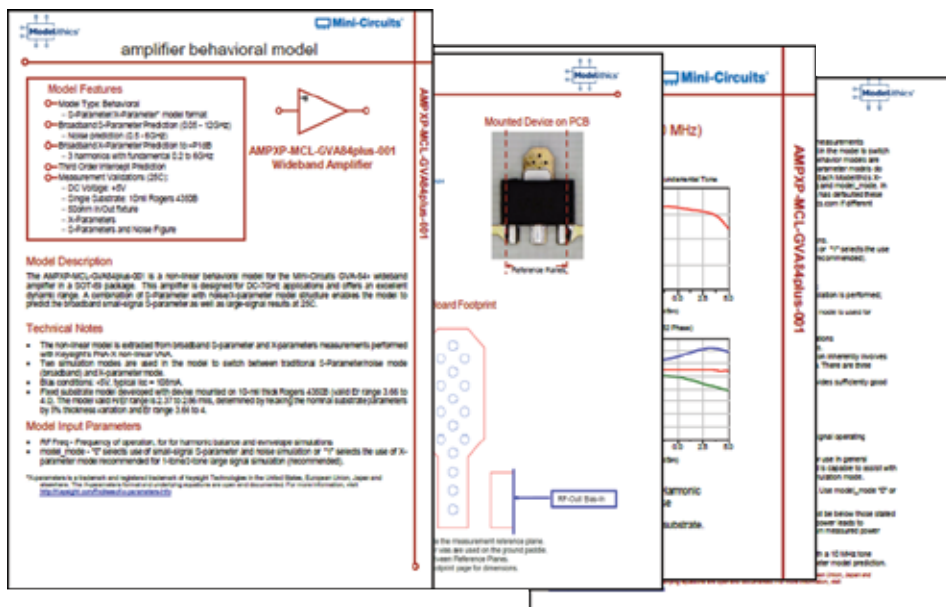
Figure 3. As an example, Modelithics information data sheet for GVA84+ model contains 15 pages of information on model use, validations and detailed technical information.

setting up the bias in the NVNA menu to establish communication between instruments and guaranteeing that the model is set up properly with measurement variables.

The motivated and mathematically inclined reader is referred to the cited references to dig deeper into understanding Eq. 1; however, some graphical insight is offered in Figure 2. For engineers who have a lot of familiarity looking at S-parameters for amplifiers, a first look at X-parameters plotted can be far from intuitive! Nevertheless, when we consider that X-parameters are a superset of S-parameters, we can start getting some comfort level by examining Figure 2a. Note how some of the functions can be presented in a way that directly correlates with the more familiar S11 and S21 parameters at low power. Figure 2b, illustrates the multi-frequency, multi-port mapping

that X-parameters enable between the nonlinear a and b waves. One of the key advantages to X-parameters is the way that harmonic signals with accurate harmonic amplitude and phase information are captured. This enables time domain waveform transformations as well as accurate analysis of cascaded nonlinearities. This contrasts with the worst-case system analysis performed by engineers for many years, using traditional spread-sheet methods.

Example Amplifier Models and Simulation Results

We now turn to presenting a few examples of X-parameters models selected from Table 1. We will start with the GVA84+ model. Figure 3 illustrates some Modelithics data sheet information for this amplifier model.

Linear Simulations (model_mode = 0) - The model, which is setup the

Figure 4. S-parameters (a.) and noise parameters (b.) simulation and measured results for GVA84+ model using model_mode=0 setting and appropriate linear ADS simulation schematics.

manufacturer recommended bias point of 5V and low power current of 108mA, has two model modes. Starting with linear mode, this model enables accurate S-parameter simulation over 0.05 to 12 GHz usin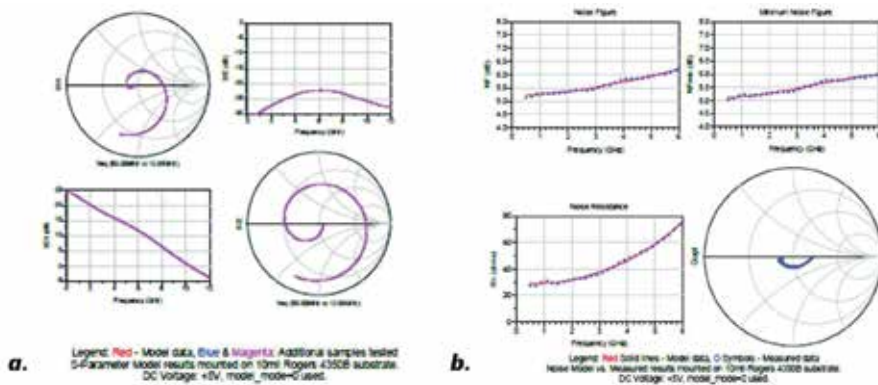g "model_mode=0". Noise parameter prediction is also provided for over 0.5 to 6 GHz, using the same mode. Figure 4 shows simulated and measured S-parameter and noise parameter results for the GVA84+ amplifier model. One of the advantages of data-based behavioral models like S-parameters and X-parameters models, is that agreement to measured data can be exact "on grid" (that is when the simulation corresponds to measured data conditions used in generating the model.)

Nonlinear HB Simulations (model_model =1) - Switching to nonlinear analysis, Figure 5 shows simulation results for a single-tone power swept harmonic balance analysis setup for the same amplifier model. According to the model data sheet, nonlinear analysis is provided for over the 0.2 to 6 GHz frequency range. As can be seen, from Figure 5 in the high-power region the fundamental power compresses as expected and harmonic power levels can be analyzed. Because we also get the phase information at multi-harmonics the nonlinear phase behavior (e.g. AM/PM) in the compression region can also be assessed. The results of using a somewhat more involved simulation setup for P1dB calculate across a range of frequencies are shown in Figure 6, with excellent correlation to the independently measured manufacturer's P1dB data for this part. Another interesting example of the advantage of an X-parameter model over than that of an S-parameter model is one where superposition breaks down, such as two amplifiers cascaded as depicted in the schematic in Figure 7a with simulated results shown below in Figure 7b. In this example, two X-parameter models of different Mini-Circuits XFL-1000LN+ amplifier units are cascaded back to back (AMP1 and AMP2). The results are then compared to a third X-parameter model (AMP3) where the cascaded amplifiers were treated as a single gain block and modeled together. AMP1 overdrives AMP2 at higher power levels, but unlike S-parameters, these X-parameter models are able to accurately predict the fundamental and harmonic spectra of the incoming and outgoing waves. This can be seen by observing the close correlation of the simulated results, verifying the accuracy of X-parameters with for proper calculation of cascaded non-linearities in both amplitude and phase.

Nonlinear Envelope Domain Simulations (model_mode=1) Another common amplifier figure of merit of interest is two-tone third order intermodulation (IM3) and third order intercept point
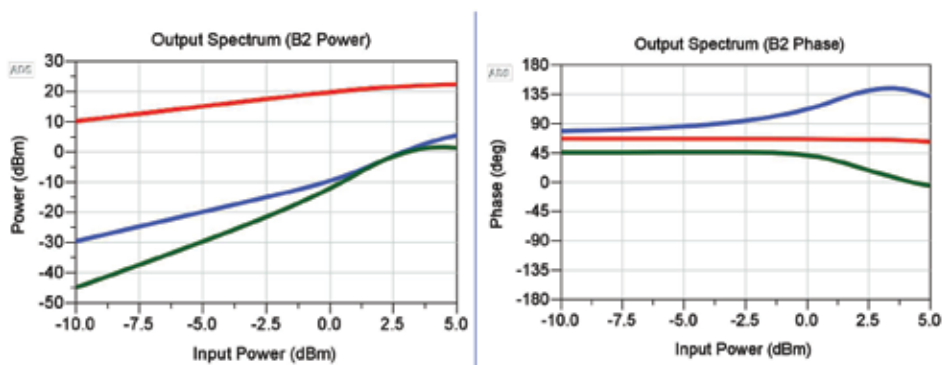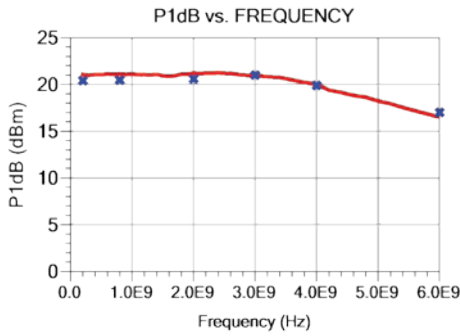

Figure 5. Multi-harmonic power sweep simulation for GVA84+ amplifier example showing amplitude and phase at 2GHz for the b2j (amplifier output signal) wave at j= 1, 2 and 3, corresponding to fundamental (red), second (blue) and third (green) harmonic.

Legend: Red: Fundamental Output Power at P1dB, Blue X: Mini-Circuits: Measured Typical Data
Plot shows P1dB vs. Frequency X-Parameter Model results mounted on 10mil Rogers 4350B substrate. DC Voltage: +5V, model_mode=1 used.

Figure 6. Figure 6 Simulated results for cross-frequency 1dB compression power simulations compared to manufacturers data.
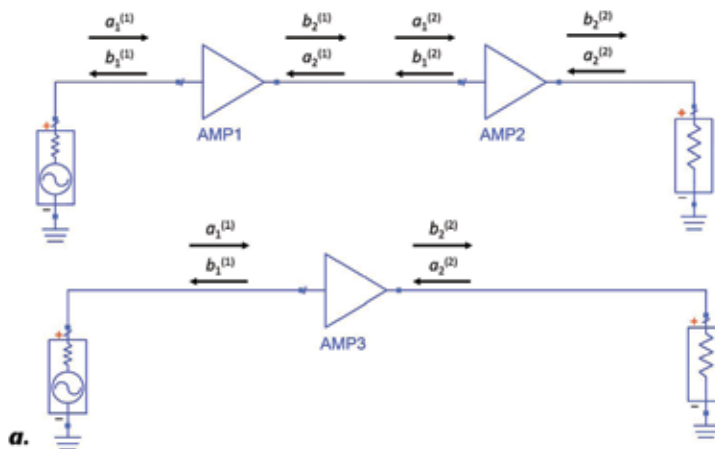

Figure 7. a. Schematic block diagrams of AMP1 and AMP2 discrete X-parameter models cascaded in simulation (upper schematic) and the AMP3, which is the X-parameter model of the two amplifiers measured and modeled together as a discrete gain block.
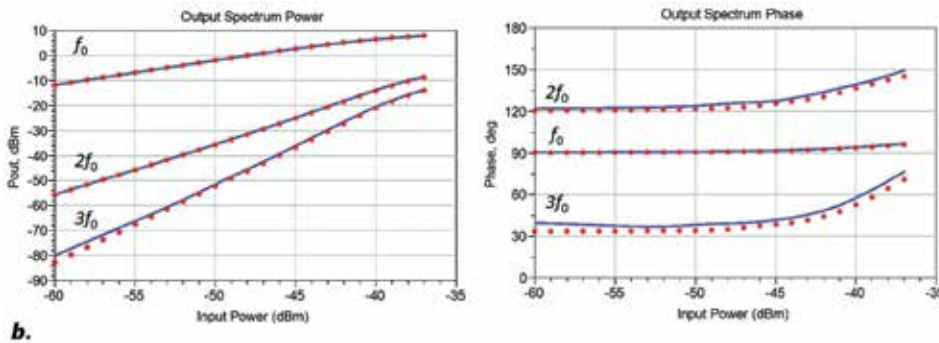
Figure 7. b. Comparison of simulated results of an X-parameter model of cascaded amplifiers (red) to the result of a combination of the amplifiers when measured and modeled as individual X-parameter models (blue), and cascaded in simulation. Left plot shows simulated output power of the fundamental, 2nd and 3rd harmonics vs. input power. Right plot shows simulated phase of the fundamental, 2nd and 3rd harmonics. 1 Ghz is the frequency of simulation.

Figure 7 Schematic (a.) and simulated results (b.) for output power and phase of the fundamental, 2nd and 3rd harmonics when two X-parameter amplifier models are cascaded together as measured and in simulation.

(IP3) simulations. While there is a methodology for measuring X-parameters under 2-tone simulation , our scope here will be limited to X-parameters generated from more conventional 1-tone X-parameters test setups. That said, our experience in validations done so far is that quite good results can be obtained for 2-tone IM3 and IP3 simulations using 1-tone X-parameters models, with certain caveats also observed . Figure 8 shows that excellent results were obtained for this comparison between simulated and measured third order distortion. In this case, the measurements were made at Modelithics using a separate test setup from that used to generate the X-parameters model. The envelope domain can also be used along with the same X-parameters model type to simulate more complex digital modulations, such as CDMA.

Load-Pull X-parameters Models - For the remaining examples we will switch go a different model. The GVA84+ is a pre-matched amplifier that is matched in the vicinity of 50 ohms. Keysight recommends that X-parameters models are generally valid for a VSWR range of 2:1 as compared to the model extraction impedance. A solution for amplifiers requiring matching far removed from 50 ohms is "load-dependent" X-parameters8,9. On the test bench, this means we must vary the load impedance in some manner. We may add a passive load-pull tuner, prepare an active load pull measurement bench, or even a hybrid active approach. Within the test bench, we must be prepared in the simulator to also setup suitable matching impedances, that are different from 50 ohms. This was the
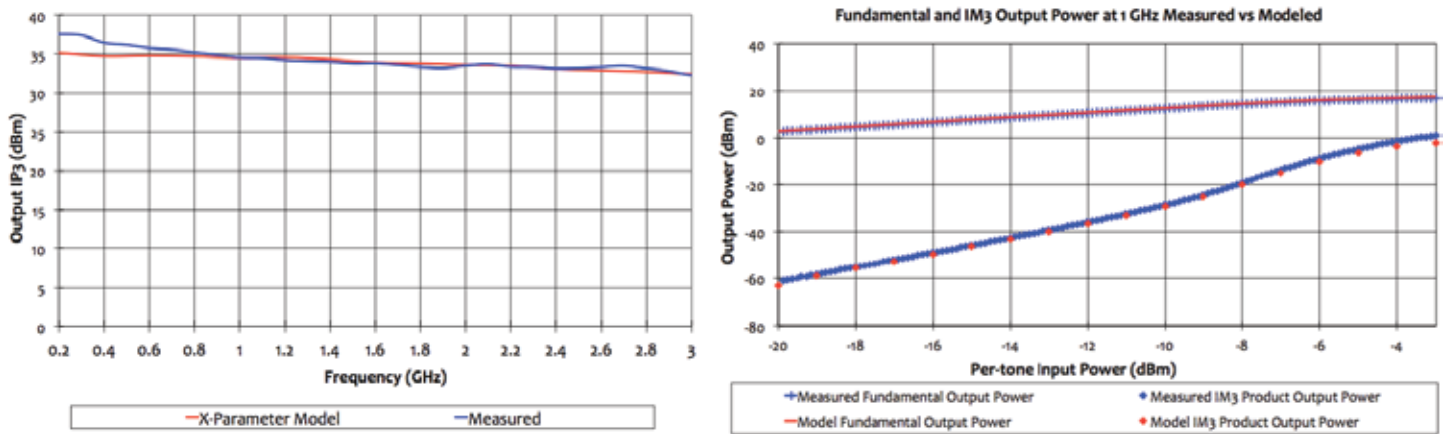
Figure 8 Simulation results compared to independently measured IP3/IM3 data. Left plot shows simulated IP3 vs. frequency over 0.2 to 3 GHz. Right plot shows power swept fundamental and IM3 data at 1 GHz fundamental for GVA84+ model.
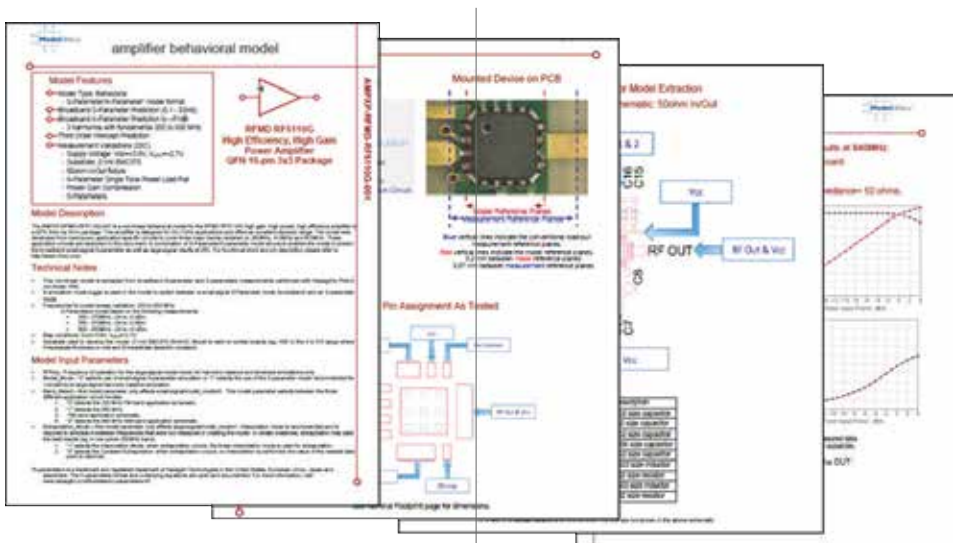
Figure 9. As an example, Modelithics information data sheet for RF5110G model contains 16 pages of information on model use, validations and detailed technical information.

case for the model to be described next. In addition to a load- tuner this bench had to be configured to handle higher powers than the unprotected PNA-X can handle and also be setup to capture bias current information in order to enable the model to simulate power-added-efficiency properly.

A few pages from the model information data sheet for the RFMD (now Qorvo) RF5110G amplifier are shown in Figure 9. As compared to the GVA84+ amplfier described above, this part is a high efficiency, high gain power amplifier capable of over 3W of output power. The output is left unmatched so that the designer can optimize for his chosen bandwidth. The Modelithics model for this part can accurately simulate S-parameters over 0.1 to 3GHz (model_mode =0), while the nonlinear model (model_mode=1), operates at a subset of

these frequencies. The model is actually extracted for applications in three bands, selected with a band select pull down menu. A manufacturer suggested application circuit was implemented for each band on custom test boards manufactured along with on-board calibration standards to de-embed the 50 ohm input/output transmission lines to the package edge. Excellent agreement is seen between simulated and measured results for load-pull countours and power swept gain, power and PAE are shown in Figure 10.

Summary

A library of advanced nonlinear models for a range of amplifier products is available for use in Keysight ADS. Advanced features include accurate de-embedding to device or package terminals with the same model being usable for broad-band linear and noise (where applicable) simulations as well as harmonic balance and envelope domain simulations enabled primarily by X-parameters technology. X-parameters are an excellent model solution for amplifier modeling. Among other reasons it requires little or no detailed internal

Figure 10. Load-pull (left) and power swept nonlinear data (right) for RF5110G amplifier

device information and allows the amplifier to be treated as a black box. When extracted properly, the result is a model that can be used for multi-stage nonlinear analyses and design optimizations of individual amplifier output or inter-stage matching circuits. Information and simulations from example models were used to illustrate the type of documentation provided for each model along with a range of measurement validations showing excellent correlations are possible with nonlinear test data, even if derived from completely independent test benches and verifying test data not used as part of the model development data set.

Acknowledgements and Additional Information

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MEMS Sensors Set to Revolutionise Healthcare Sector

> **Mark Patrick, Mouser**

Micro electro-mechanical system (or MEMS) technology has been with us for several decades, but in terms of its true potential some would argue that it has barely arrived. The integration of electrical circuits and mechanical structures on a single substrate, at the micron scale, is the enabling technology behind most wearable devices and fundamental to many smartphone functions.

MEMS is also having a massive impact on the development of biotechnology, providing researchers the ability to search for, locate and influence biological and chemical compounds in the body and its many complex subsystems. This will undoubtedly lead to new ways to identify and prevent illnesses and debilitating conditions. For example,

the use of MEMS technology in nerve prosthesis is now being explored, research that could help the blind see or return some mobility to the disabled - clearly real life enhancing developments.

MEMS has been a disruptive innovation within the medical sector for diagnosis and health care, and been very successfully applied in pressure sensors. Today MEMS-based pressure sensors that communicate using RF can be implanted into the body, providing a valuable insight into the condition of organs and arteries. Recent advancements in the packaging of MEMS has been instrumental here.

Outside of the body, the small and unobtrusive form factor of MEMS pressure sensors means that they

can be used to reduce the size of equipment, making it more portable, while their relatively low cost means the prospect of disposable sensors becomes feasible. The scope of their use includes measuring the blood pressure and respiration of patients in hospitals and ambulances. Their application in dialysis machines and infusion pumps has also been ground breaking.

The incorporation of MEMS inertial sensors in consumer devices is also influencing the way health providers are addressing the care of vulnerable patients who may be susceptible to falls. Monitoring the movement of patients can provide an early warning system for carers, alerting them to the need for attention. The same technology is now being
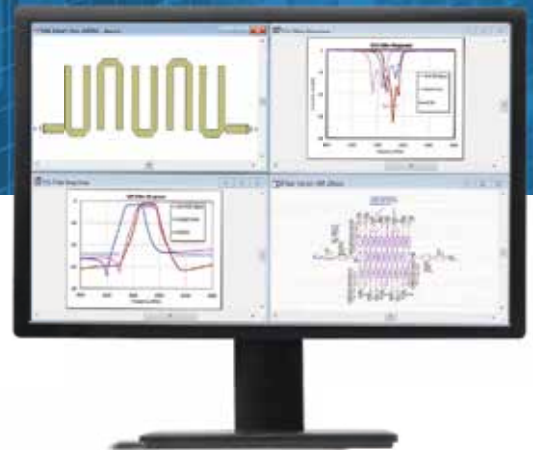
applied to the treatment of scoliosis, by measuring how often and how tightly braces are being worn by patients, in a bid to overcome the barriers that can impede progress.

A Body in Motion

As MEMS are manufactured via the same techniques used in conventional semiconductor production, some integrated device manufacturers are well positioned to develop and supply MEMS sensors. A presentation at the Medical MEMS and Sensors Conference 2017 (Santa Clara, November, 2017) given be Analog Devices' Engineering Manager of High Performance Sensors, Mark da Silva PhD, entitled 'Ultra Low Power Implantable Inertial MEMS Sensors', shows the direction some semiconductor manufacturers are moving. Implantable inertial MEMS sensors could be used to monitor the movement of limbs in real-time, while similar sensors implanted in the back could be used for spinal cord stimulation for the treatment of pain.

Ultra low power MEMS accelerometers, such as the ADX362 series from Analog Devices, are already available and being used in a wide array of applications, including hearing aids and home healthcare. This 3-axis accelerometer can measure both dynamic and static acceleration (for detecting shock, for example) and consumes just 10nA in sleep mode and as little as 270nA when in a motion triggered mode. Because it doesn't use under-sampling, as some MEMS sensors do, the sensor's full bandwidth is

sampled for both 8-bit and 12-bit output resolutions. This can be as low as 1mg/LSB at a ±2 g range and the family has a standard noise level of 500µg/√Hz, which can be further reduced to 175µg/√Hz through a lower noise mode. As shown in Figure 1, the ADXL362 also integrates antialiasing filters and a temperature sensor, as well as an analogue-to-digital converter (ADC), SPI interface and digital logic.

All of the features of the ADXL362 can be evaluated using the Arduino-compatible EVAL-ADXL362-ARDZ shield, which features an LCD for displaying the tilt and temperature data provided by the sensor. The board is also compatible with Analog Devices' EVAL-ADICUP360 development board, which includes both Arduino and Pmod interfaces.

Taking sensor integration to a higher level, the ICM-20948 from TDK InvenSense is a 9-axis motion tracking device which integrates a 3-axis gyroscope, 3-axis accelerometer and 3-axis magnetometer with a digital motion processor in a multi-chip module measuring just 3mm x 3mm x 1mm. Each sensor features a self-test mode, while the integrated motion processor handles calibration as well as the motion processing algorithms, reducing the workload on the host processor.

Under Pressure

As mentioned above, one of the biggest applications for MEMS in medical applications is pressure sensors. They can be used in ventilators to monitor respiration rates, in dialysis equipment to measure the inlet and outlet blood pressure for flow regulation, and even in eye surgery. MEMS pressure sensors can be used for the detection of oxygen, carbon dioxide, calcium, potassium and glucose in blood, as
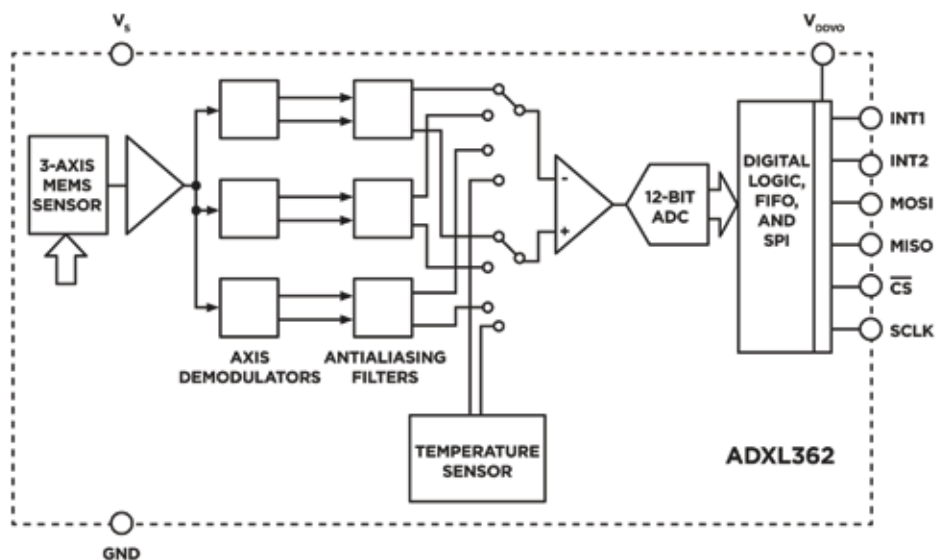
Figure 1: The ADXL362 from Analog Devices is an ultra-low power 3-axis accelerometer ideal for healthcare applications
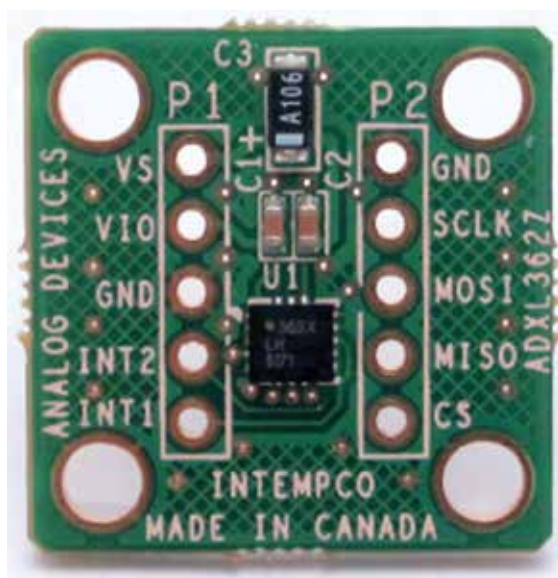
Figure 2: The EVAL-ADXL362-ARDZ
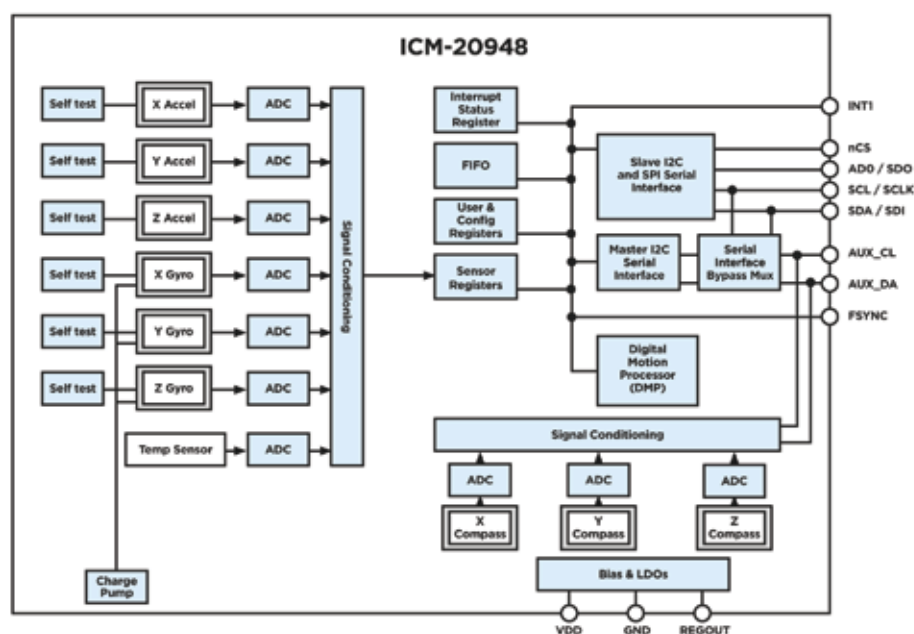
Figure 3: A block diagram of the ICM-20948 9-axis MEMS motion tracking multi chip module

well as drug infusion pumps. They are also instrumental in continuous positive airway pressure devices for treating sleep apnea, and in negative pressure wound therapy.

Non-invasive blood pressure monitoring is used to measure a patient's systolic and diastolic blood pressure via the largely familiar inflating arm cuff. Pressure is applied to the arm until the artery is occluded, at which point the blood stops flowing. Pressure is released until blood starts flowing (normally detected audibly), giving the systolic pressure. As the cuff's pressure reduces the medical professional will no longer be able to detect audibly the flow of blood in the artery; the diastolic pressure. Using MEMS-based sensors, non-invasive blood pressure monitoring can be largely automated and it is one of the biggest applications by volume for MEMS pressure sensors. Silicon Microstructures is a leader in the design and manufacture of MEMS pressure sensors and the SM4421 is a good example of such a pressure sensor used in this application. Housed in a SOIC-16 package it integrates a MEMS sensing element and signal conditioning ASIC to provide a 14-bit temperature-compensated output through an I2C interface. Available in gauge, differential and asymmetric configurations, the devices that make up SM4x21 series can operate across a pressure range from 2.5PSI to 14.9PSI and can be used in a range of different medical applications.

The Future of MEMS in the Medical Sector

MEMS has the potential to transform many aspects of medical care; the concept of a lab-on-a-chip will lead to fast and low cost diagnosis in remote locations and developing countries becoming a reality. The technologies used to manufacture MEMS devices are also employed in the development of nanotechnology and the two are closely related. This will see the sciences of microfluidics further merging with microelectronics, while the introduction of new materials such as carbon nanotubes and graphene offers even greater potential.

Protecting man and machine against damaging residual currents

› Peter-Lukas Genowitz, Eaton

How the correct choice of the residual current device ensures operator safety, machine uptime and profitability

Introduction

Technology continues to rapidly evolve, and machine builders are faced with designing products to enable their customers to produce faster, and more efficiently, at a lower cost. Product lifecycles are becoming shorter, placing demands on machine builders to design and develop highly customized machines. Exporting equipment remains complex, as electrical standards often differ from country to country.

Manufacturers and their end users are looking more towards their suppliers for support, due in part to in-house engineering team size reductions. One aspect of this is electrical circuit protection, which can impact both safety and machine up-time. Electrical faults can have devastating effects on the human body causing injury, and lead to machine failure and fire – affecting productivity.

The function of a residual current device

Residual currents in electrical systems are caused by either fault conditions or generated by system components such as frequency converters. The role of a residual current device (RCD) is to automatically disconnect the power supply if the fault can pose a risk.

Residual currents can arise for many reasons and take many forms. The biggest challenge is being able to differentiate between all the possible forms of residual current, while protecting people and equipment, but on the other hand avoiding nuisance tripping related to system caused earth leakage currents. The solution is to recognise the different forms of earth leakage current that can occur, and design in the appropriate RCD.

Types of protection

Devices have to shield operators and technicians from the dangers of electric current, both during normal use and fault conditions. Potentially life-threatening accidents can result from either direct or indirect contact.

Direct contact refers to when a person touches a live electrical part that is intended to be live during normal operation. Indirect contact is a fault when a conductive, non-live exposed and touchable part becomes live due to an electrical fault.

There are multiple types of protection required; basic, fault, additional and fire. Basic prevents contact with live parts through insulation or a cover. Fault protection includes situations where an insulator (basic protection) fails and the RCD switches off before dangerous voltages can occur on

conductive, non-live exposed parts e.g. housings. Additional protection safeguards against dangerous electrical shock and situations in which basic and fault protections fails. Fire protection uses RCDs to prevent electrical fires caused by insulation faults.

Types of RCDs

RCDs are characterised by the residual current waveforms they can detect and respond to, if they are dependent or independent to the voltage, and whether their trip response is instant or delayed.

The ability to respond to various current waveforms is important, and the chosen RCD has to be suitable for each waveform type. It is also very important to note the different tripping level for each waveform.

Several types of RCDs are available, each for use with differing current waveforms.

Type AC only detects sinusoidal fault currents, but these are not permitted in many EU countries. Type A detects both sinusoidal and pulsating DC residual currents. Type F RCDs are primarily used for single phase frequency inverter applications to handle the residual currents with frequency mixture up to 1kHz which typically occur on the output of a single phase frequency converter. They can also detect sinusoidal AC currents as well as pulsating DC currents.

Type B devices can detect sinusoidal AC and pulsating DC as well as smooth DC fault currents. RCDs of this type are designed for use in three-phase systems. Type Bfq comply with Type B requirements while being designed for use in circuits that include powerful frequency converters for speed-controlled drives. Type B+ have a frequency tripping response defined up to 20 kHz and provide superior protection from fire risk caused by

ground fault currents in applications with electronic drives.

In addition to the above, Type G, "Li" and S RCDs have a trip delay and hence a surge-withstand capability to avoid nuisance tripping.

Classification of RCDs

RCD is the general term for all types of residual current protective devices. A standard residual current circuit breaker is called an RCCB and some further types of RCD exist; these are described below.

RCD relays are devices with a separate current transformer and contactor to handle higher current ranges up to 400 A. However, RCD relays combined with moulded case circuit breakers (MCCB) offer a solution up to 1800A.

A residual current operated circuit breaker with overcurrent protection (RCBO) is a combination of an RCCB with a miniature circuit breaker (MCB). It provides overload, short circuit, shock protection and fire prevention from a single device.

Many different combinations can be made from available RCD add-on

blocks and MCBs without having to stock a large number of products. This gives a high degree of application flexibility and makes it easy to customize the combination of RCD and MCB devices.

RCD add-on blocks are also available for MCCBs to cover applications up to 250A.

Digital RCDs

Digital RCDs combine protection functionality with a set of digital features, working together to provide maximum circuit status information and increase the protected system or machine's availability. The digital technology is applied to both RCCBs and RCBOs. Local pre-warning LEDs and remote pre-warning potential-free outputs can be provided in the RCCB. These pre-warnings allow maintenance staff to resolve creeping problems before they lead to interruptions or failures. Cost savings accrue due to the reduction in unscheduled service callouts and further savings arise because test intervals can be extended to once a year only.
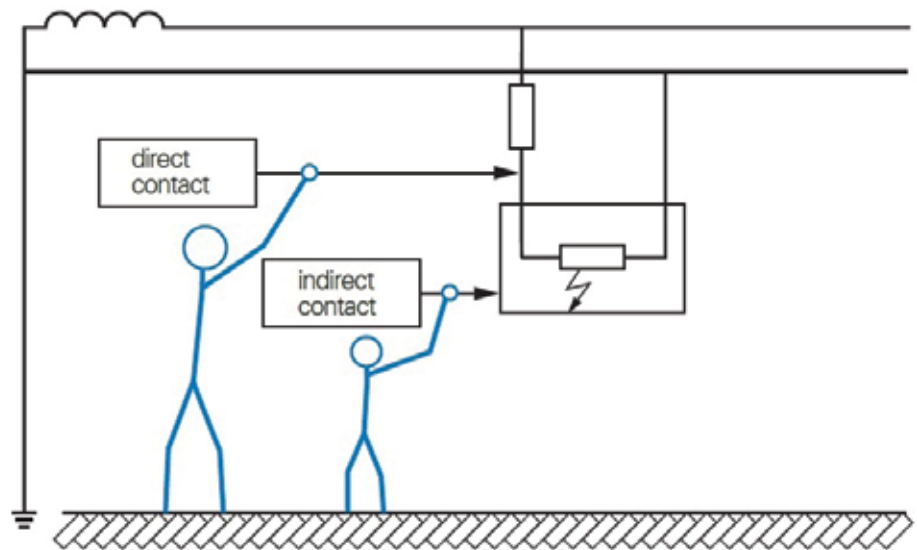

Image 1: Direct and indirect contact risks

Kind of current	Current profile	Correct use/application filed of RCCB types				Tripping current
		AC	A (U)	F	B/Bfq/B+	
Sinusoidal AC residual current		•	•	•	•	0.5 to 1.0 $I_{\Delta n}$
Pulsating DC residual current (pos. or neg. half-wave)		–	•	•	•	0.35 to 1.4 $I_{\Delta n}$
Cut halve-wave current Lead angle 90º Lead angle 135º		–	•	•	•	Lead angel 90° 0.25 to 1.4 $I_{\Delta n}$ Lead angel 135° 0.11 to 1.4 $I_{\Delta n}$
Halve-wave current with smooth DC current of 6mA		–	•	•	•	max. 1.4 $I_{\Delta n}$ + 6 mA
Halve-wave current with smooth DC current of 10mA		–	–	•	•	max. 1.4 $I_{\Delta n}$ + 10 mA
Smooth DC current		–	–	–	•	0.5 to 2.0 $I_{\Delta n}$

Image 2: Different Residual current waveforms and appropriate RCCB (Residual Circuit Current Breakers) devices

Global standards

Protection and trouble-free operation depends on paying attention to compliance with all relevant local and global standards and guidelines.

Standard IEC/EN RCDs can be used worldwide except in the USA and Canada. In the North American market, UL standards are used instead of international IEC standards, and so for export to this region RCDs must be available in special UL approved versions. Country specific approval is also required in a number of other countries.

Ensuring that the RCDs conform to international standards, such as IEC/EN 61008 or UL1053, and that they carry the corresponding marks, as Eaton's do, is essential for guaranteeing safety. By specifying one product that is a world market product and can be used globally will ultimately save time and associated costs when exporting.

Electrical interference problems and solutions

There are various electrical interface problems that can occur and machine builders need to consider when specifying RCDs.

Leakage currents are currents that conduct to ground during normal operation without any insulation fault. RCDs though cannot distinguish between leakage currents and fault currents, and will trip if the currents' sum exceeds their tripping value.

Type F, U or Bfq RCDs have tripping curves that are set to be insensitive to system caused earth leakage currents. This prevents nuisance tripping errors in industrial applications with powerful frequency inverter controllers.

Dynamic leakage currents are transient currents to the ground conductor. To prevent this unwanted tripping, the use of short-time delayed RCDs Type G or Li are recommended. Nuisance tripping in RCDs can also be caused by high currents from inductive loads. According to the product standard RCDs must tolerate up to six times their rated current to provide resistance to nuisance tripping.

Over-voltages created by thunderstorms can lead to nuisance tripping of the RCD. Eaton offers the Type G RCD specified according to ÖVE E 8601 to avoid this problem.

Summary

RCDs can protect both man machine from harm, eliminate the risk of fire and reduce machine downtime by detecting and reacting to residual currents. As these currents can arise for many reasons and take many forms, and it is essential to choose RCDs with tripping characteristics that ensure protection from genuine fault conditions, while avoiding lost production time due to nuisance tripping.

Machine builders must consider the relevant international legislation and installation aspects of power protection systems; including the type of earthing system being used, installation standards, and electrical interference problems and solutions.

It is part of Eaton's commitment to providing circuit protection solutions, from initial design steps through to installation, maintenance and spares holding. Eaton's global organisation and portfolio of internationally approved, innovative components and technologies is complemented by local production facilities, expertise and support.

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

> **AT&T**

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
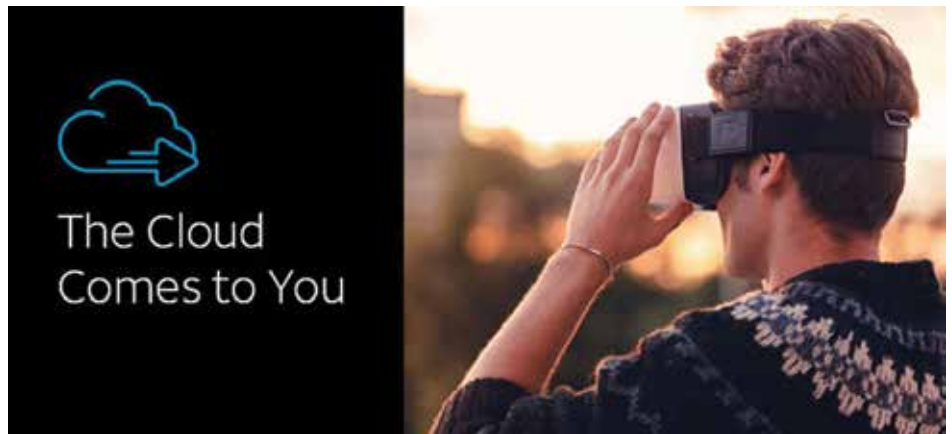
super-slim device in your pocket. Doctors would be able to view and share and adjust complex medical images without having to invest in expensive imaging systems.

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.

Material could bring optical communication onto silicon chips
Ultrathin films of a semiconductor that emits and detects light can be stacked on top of silicon wafers.

> ## Helen Knight, MIT news

The huge increase in computing performance in recent decades has been achieved by squeezing ever more transistors into a tighter space on microchips.

However, this downsizing has also meant packing the wiring within microprocessors ever more tightly together, leading to effects such as signal leakage between components, which can slow down communication between different parts of the chip. This delay, known as the "interconnect bottleneck," is becoming an increasing problem in high-speed computing systems.

One way to tackle the interconnect bottleneck is to use light rather than wires to communicate between different parts of a microchip. This is no easy task, however, as silicon, the material used to build chips, does not emit light easily, according to Pablo Jarillo-Herrero, an associate professor of physics at MIT.

Now, in a paper published today in the journal Nature Nanotechnology, researchers describe a light emitter and detector that can be integrated into silicon CMOS chips. The paper's first author is MIT postdoc Ya-Qing Bie, who is joined by Jarillo-Herrero and an interdisciplinary team including Dirk Englund, an associate professor of electrical engineering and computer science at MIT.

The device is built from a semiconductor material called molybdenum ditelluride. This ultrathin semiconductor belongs to an emerging group of materials known as two-dimensional transition-metal dichalcogenides.

Unlike conventional semiconductors, the material can be stacked on top of silicon wafers, Jarillo-Herrero says.

"Researchers have been trying to find materials that are compatible with silicon, in order to bring optoelectronics and optical communication on-chip, but so far this has proven very difficult," Jarillo-Herrero says. "For example, gallium arsenide is very good for optics, but it cannot be grown on silicon very easily because the two semiconductors are incompatible."

In contrast, the 2-D molybdenum ditelluride can be mechanically attached to any material, Jarillo-Herrero says.

Another difficulty with integrating other semiconductors with silicon is that the materials typically emit light in the visible range, but light at these wavelengths is simply absorbed by silicon.

Molybdenum ditelluride emits light in the infrared range, which is not absorbed by silicon, meaning it can be used for on-chip communication.

To use the material as a light emitter, the researchers first had to convert it into a P-N junction diode, a device in which one side, the P side, is positively charged, while the other, N side, is negatively charged. In conventional semiconductors, this is typically done by introducing chemical impurities into the material. With the new class of 2-D materials, however, it can be done by simply applying a voltage across metallic gate electrodes placed side-by-side on top of the material.

"That is a significant breakthrough, because it means we do not need to introduce chemical impurities into the material [to create the diode]. We can do it electrically," Jarillo-Herrero says.

Once the diode is produced, the researchers run a current through the device, causing it to emit light.

"So by using diodes made of molybdenum ditelluride, we are able to fabricate light-emitting diodes (LEDs) compatible with silicon chips," Jarillo-Herrero says.

The device can also be switched to operate as a photodetector, by reversing the polarity of the voltage applied to the device. This causes it to stop conducting electricity until a light shines on it, when the current restarts.

In this way, the devices are able to both transmit and receive optical signals.

The device is a proof of concept, and a great deal of work still needs to be done before the technology can be developed into a commercial product, Jarillo-Herrero says.

This paper fills an important gap in integrated photonics, by realizing a high-performance silicon-CMOS-compatible light source, says Frank Koppens, a professor of quantum nano-optoelectronics at the Institute of Photonic Sciences in Barcelona,

Spain, who was not involved in the research.

"This work shows that 2-D materials and Si-CMOS and silicon photonics are a natural match, and we will surely see many more applications coming out of this [area] in the years to come," Koppens says.

The researchers are now investigating other materials that could be used for on-chip optical communication.

Most telecommunication systems, for example, operate using light with a wavelength of 1.3 or 1.5 micrometers, Jarillo-Herrero says.

However, molybdenum ditelluride emits light at 1.1 micrometers. This makes it suitable for use in the silicon chips found in computers, but unsuitable for telecommunications systems.

"It would be highly desirable if we could develop a similar material, which could emit and detect light at

1.3 or 1.5 micrometers in wavelength, where telecommunication through optical fiber operates," he says.

To this end, the researchers are exploring another ultrathin material called black phosphorus, which can be tuned to emit light at different wavelengths by altering the number of layers used. They hope to develop devices with the necessary number of layers to allow them to emit light at the two wavelengths while remaining compatible with silicon.

"The hope is that if we are able to communicate on-chip via optical signals instead of electronic signals, we will be able to do so more quickly, and while consuming less power," Jarillo-Herrero says.
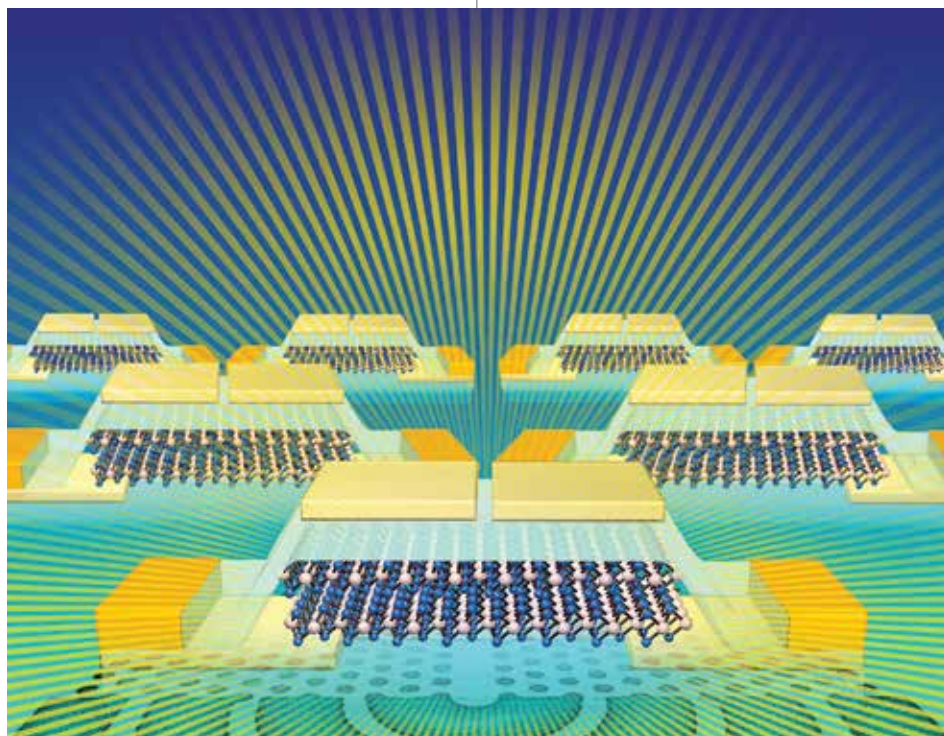
image: Researchers have designed a light-emitter and detector that can be integrated into silicon CMOS chips. This illustration shows a molybdenum ditelluride light source for silicon photonics. **Credits:** Sampson Wilcox

BLOODHOUND successful first public runs

BLOODHOUND SSC made its first public runs at Cornwall Airport Newquay today, hitting a peak speed of 210mph in front of an estimated 3,500 spectators, including VIPs and members of the BLOODHOUND's 1K supporters club. The successful test was live streamed around the world and came 20 years after driver Wing Commander Andy Green set the current World Land Speed Record of 763.035mph.

BLOODHOUND SSC made two runs along the 9,000ft (2.7km) runway, accelerating at a rate of 1.5G and reaching 210mph from a standing start in just 8 seconds. The runs were an unqualified success and atmosphere among the crowd was euphoric. Andy Green was equally thrilled: "The Car is already working faster and better than we expected. I cannot wait to go faster!"

Powering down the runway

For these runs, power was provided by a Rolls-Royce EJ200 jet engine, normally found in a Eurofighter Typhoon. This produced a peak thrust of 20,000lbs (90 kilonewtons), equivalent to 54,000 thrust horsepower, or the combined output of 360 family cars.

On completing the test, Andy Green added: "The design and engineering team has done an incredible job with BLOODHOUND SSC. There is development work still to do, of course, but straight out of the box it feels responsive, stable and, above all, tremendously fast.

"Although 210mph is far below the Car's ultimate target of 1,000mph, today was a proper workout for the vehicle. The Car is designed for high speed on a desert rather than sprint performance off the line, but it still accelerated from zero to 210mph in less than 8 seconds. It's also notable for being the longest period that we've run the

Car for, at around 21.5 minutes – and remember it's designed to run for just 2 minutes at a time in the desert."

Final stage of Newquay tests

The runway trials came at the end of a month of testing at Cornwall Airport Newquay where the Team has been checking the integration of the EJ200 jet engine as well as the Car's steering, brakes, suspension, data systems and other functions. It's also given the Team the opportunity to develop operating procedures and safety protocols, and practice radio communications.

The Car was fitted with its runway wheels, originally from an English Electric Lightning fighter. Specially reconditioned by Dunlop, these wheels have pneumatic tyres, which have around one-third of the grip of regular car tyres.

"Stopping a slippery, 5 tonne car, running on low-grip aircraft tyres, is a challenge within the relatively limited length of the 2.7km runway here, particularly as the Car continues accelerating after I lift off the throttle. I discovered during the initial dynamic tests that to get the Car to 200mph, I would have to take my foot off the throttle at 130mph as it then carries on accelerating for another 2 seconds. And then to slow down, I need to apply gentle pressure to the brakes for 2 seconds to 'warm up' the carbon fibre disk brakes before applying full force on the brakes to stop the Car."

The brakes heated up to nearly 1,000°C and Andy noted that there was even a flicker of flame on one of them: "It's a proper race car!"

Out Of the box

Astonishing performance

"We have built up to this over the past few weeks, but the performance today was still astonishing. BLOODHOUND SSC is already performing like a thoroughbred racing car, supported by a brilliant engineering team. Nevertheless, with this combination of runway length and what I have to do slow the Car down, these two runs represent one of the most difficult run profiles I will ever do in BLOODHOUND. "When we run on the dry lake bed at Hakskeen Pan, South Africa, BLOODHOUND SSC will be running on solid aluminium wheels with even less grip than we had here. Data from today's tests, including jet engine performance, aerodynamic stability and the braking distances, will help us plan our World Land Speed Record campaign."

BLOODHOUND'S Chief Engineer Mark Chapman said, "The Newquay tests have gone better than anyone dared hope and that is testament to the many years of research and design invested in BLOODHOUND SSC. It is a one-off prototype with over 3,500 bespoke parts, so to see it performing so well today is a hugely satisfying experience. It's like a greyhound, not a bloodhound!"

Next stages of development

Next year, BLOODHOUND SSC will be run at even higher speeds. "This is as fast as we can run the Car in the UK," confirmed Chapman. "We will run it faster next year. The rocket won't be in the Car then, but those runs will be to develop the Car further in conjunction with developing the rocket programme."

Endre Lunde, Senior Vice President Communications at Nammo, BLOODHOUND's rocket provider, said: "Today is a tremendous achievement and we are really looking forward to working with BLOODHOUND next year to help the Car go even faster."

A.S. Ramchander, Vice-President Marketing at Castrol, said: "We are delighted to see BLOODHOUND SSC complete its first public runs. This partnership gives us the chance to showcase how our high-performance products such as Castrol EDGE SUPERCAR push the boundaries of performance and we have our sights firmly set on partnering on a 22nd World Land Speed Record."

An inspiring day

Although today's event focused on the Car, the BLOODHOUND Project is all about inspiring young people to enjoy, explore and get involved in science, technology, engineering and mathematics.

Rolls-Royce engineer Jess Herbert said, "I was inspired to take up a career in engineering by the BLOODHOUND Project after the team visited my school and I then took up an apprenticeship at Rolls-Royce. I was lucky enough to have been at the unveiling of BLOODHOUND back in 2015 and I'm hugely excited and proud to have the opportunity to witness the test runs. Being a BLOODHOUND Ambassador has given me the chance to share the story with the engineers of tomorrow and I hope that seeing the Car in action will really help to bring the whole thing to life for them too."

Richard Noble, Project Director, added, "These trials at Newquay take us one step closer to setting the next World Land Speed Record. The BLOODHOUND Project is now being followed by a huge number of people in Britain and we are thrilled that 3,500 people came today and around the same amount are paying to come to see us on Saturday.

"With Oracle Corporation now on board as our Cloud Partner we can inspire millions by exporting large volumes of BLOODHOUND performance data around the world to 220 countries. We have delivered real results already, with our university partners reporting substantial increases in the number of young people taking up engineering as a direct result of the BLOODHOUND Project. That is our primary objective and we're delighted that we have 3,500 students coming to see the Car run on Monday 30th October – I know this will inspire a lot more!"

The Team will now start to analyse the data, as well as checking the Car and preparing it for the Public Day on Saturday and the Education Day on Monday when around 3,500 children and young people are expected to attend.

NXP Introduces Industry's First Automotive-Qualified Bluetooth 5-Ready Wireless Microcontrollers with integrated CAN-FD

NXP Semiconductors N.V. (NASDAQ: NXPI) today announced its Kinetis KW35/36 MCU family, the industry's first automotive-qualified Bluetooth 5-ready wireless MCU family with integrated CAN-FD connectivity. Its AEC Q100-Grade 2 temperature range qualification paired with the latest Bluetooth technology enables this new MCU family to offer superior durability and performance in automotive applications.

The Kinetis KW35/36 Bluetooth technology is designed to simplify integration of Bluetooth connectivity in cars, enabling automotive manufacturers to deliver added convenience for consumers to control many features using their smartphones, for example unlocking a car, remotely sharing keys with a friend or relative, personalizing seat positions as well as temperature and infotainment settings and controlling interior and/or exterior lighting. As a market leader in automotive and security solutions, the new Kinetis KW35/36 wireless MCU family complements the company's automotive secure access portfolio as it can be used to add a smartphone car access option next to the current passive entry and start system. Emerging BLE smartphone car access systems typically come with an NFC backup option to cover low battery situations. The MCU's Bluetooth connectivity can also be used to communicate car diagnostics such as tire pressure monitoring systems (TPMS) as well as battery and fuel levels.

"With our deep customer intimacy and leadership in automotive, the Kinetis KW35/36 wireless MCU family represents our commitment to deliver innovative solutions that drive better experiences for drivers around the world. This family is the industry's first automotive-qualified BLE family of MCUs with CAN-FD allowing for easy integration into an auto in-vehicle communication network," said Emmanuel Sambuis, Vice President of Microcontrollers and Connectivity at NXP. "Our goal has always been to provide more secure, connected experiences for drivers. Combining our connectivity technology with automotive grade expectations opens up new opportunities for car manufacturers and drivers."

Kinetis KW35/36 MCU Family Features:

■ Eight concurrent secure connections for multiple authorized users.

■ Hardware and software features for smartphone-to-car connectivity.

■ Low power consumption to extend battery life

■ Bluetooth 5 certified software stack

■ CAN and LIN drivers to enable easy integration into auto in-vehicle communication networks

■ 6 mm x 6 mm QFN package with wettable flanks package technology to facilitate optical inspection of the soldering, reducing cost and increasing reliability

■ MCUXpresso software and tools for ease of development

■ FRDM-KW36 development board for Kinetis KW35/36 MCUs with 2.4 GHz BLE and generic FSK wireless connectivity and CAN/LIN wired connectivity solutions

■ USB-KW41Z USB dongle for sniffer operations
Availability

The new Kinetis KW35/KW36 MCU family is sampling now and will be available in volume production in Q2 2018.

Intel Enables 5G, NFV and Data Centers with High-Performance, High-Density ARM-based Intel Stratix 10 FPGA

MAX14883E delivers ±60V fault protection, selectable Intel today announced it has begun shipping its Intel® Stratix® 10 SX FPGA – the only high-end FPGA family with an integrated quad-core ARM* Cortex*-A53 processor. With densities greater than 1 million logic elements (MLE), Intel Stratix 10 SX FPGAs provide the flexibility and low latency benefit of integrating an ARM processor with a high-performance, high-density FPGA needed to tackle the design challenges of next-generation, high-performance systems.

By integrating the FPGA and the ARM processor, Intel Stratix 10 SX FPGAs provide an ideal solution for 5G wireless communication, software defined

radios, secure computing for military applications, network function virtualization (NFV) and data center acceleration.

For NFV applications that consolidate and deliver the networking components needed to support a fully virtualized infrastructure, Intel Stratix 10 SX FPGAs can handle the high-speed data path while integrated processors enable the low latency transactions needed to manage flow tables for control plane processing. With hardware acceleration, Intel Stratix 10 SX FPGAs provide a heterogeneous computing environment to create optimized, low latency accelerators. In secure computing applications, integrated processors make it much more difficult to snoop software operations thereby helping keep data secure. These devices also enable general purpose utility processing to extend convenience and form factor reduction in high-end systems.

"With Intel Stratix 10 SX FPGAs, Intel reaffirms its 'all in' commitment to SoC FPGA devices combining integrated, flexible ARM cores with high-performance FPGAs," said Reynette Au, vice president of marketing, Intel Programmable Solutions Group. "We now provide a wide set of options for customers needing processors and FPGAs, with device offerings across the low-end, mid-range and now, high-end FPGA families, to enable their system designs."

Customers can implement their designs today with the Intel Stratix® 10 SX FPGA, using the Intel SoC FPGA Embedded Development Suite (Intel® SoC FPGA EDS), a comprehensive tool suite for embedded software development. It comprises development tools, utility programs, and design examples to jump-start firmware and application software development.

The Intel® SoC FPGA EDS also enables customers to utilize the ARM* Development Studio 5* (DS-5*) Intel SoC FPGA Edition to code, build, debug and optimize their applications.

Manufactured on the Intel 14-nanometer process technology, the Intel Stratix® 10 SX FPGA combines an ARM hard processor system with the Intel HyperFlex™ core fabric architecture to create a high-performance and power-efficient SoC FPGA.

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ON Semiconductor Introduces World's First Highly Scalable Family of Next-Generation Automotive Image Sensors

ON Semiconductor, driving energy efficient innovations and the market leader in automotive imaging, today announced a CMOS image sensor platform that brings new levels of performance and image quality to automotive applications such as ADAS, mirror replacement, rear and surround view systems and autonomous driving. The Hayabusa™ platform features a ground-breaking 3.0-micron backside illuminated pixel design that delivers a charge capacity of 100,000 electrons, the highest in the industry, with other key automotive features such as simultaneous on-chip high dynamic range (HDR) with LED flicker mitigation (LFM), plus real-time functional safety and automotive grade qualification.

"The Hayabusa family enables automakers to meet the evolving standards for ADAS such as European NCAP 2020, and offer next-generation features such as electronic mirrors and high-resolution surround view systems with anti-flicker technology. The scalable approach of the sensors from ½" to ¼" optical sizes reduces customer development time and effort for multiple car platforms, giving them a time-to-market advantage." said Ross Jatou, VP and GM of the Automotive Solutions Division at ON Semiconductor. "ON Semiconductor has been shipping image sensors with this pixel architecture in high-end digital cameras for cinematography and television. We are now putting this proven architecture into new sensors developed from the ground up for automotive standards."

The high charge capacity of this pixel design enables every device in the Hayabusa family to deliver Super-Exposure capability, which results in 120-decibel (dB) HDR images with LFM for high image fidelity in the most challenging scenes without sacrificing low-light

sensitivity. The simultaneous HDR and LFM capability is especially important in enhancing safety as it ensures that all objects and potential hazards can be identified in both very dark and very bright areas of the scene. With the widespread use of LEDs for front and rear lighting as well as traffic signs, the LFM capability of the platform makes certain that pulsed light sources do not appear to flicker, which can lead to driver distraction or, in the case of front facing ADAS, the misinterpretation of a scene by machine vision algorithms.

The Hayabusa product family also features real-time, ISO26262-compliant functional safety capabilities to alert the system processor if the sensor has any issues or potential errors. These features enable system designs rated up to ASIL-C. The real-time capability enables errors to be identified immediately rather than waiting for the full image to be transferred to the processor and then waiting for image analysis. This faster response time means the system processor can take immediate action to remedy the issue, which is crucial when considering that a vehicle moving on a freeway easily covers 100 feet in less than one second. The first product in this family, the 2.6 megapixel (MP) AR0233 CMOS image sensor, is capable of running at 60 fps while simultaneously delivering ultra-high dynamic range and LED flicker mitigation along with all of the Hayabusa platform features. Samples are available now to early access customers. Contact your ON Semiconductor sales representative for more information.

STMicroelectronics' Advanced Automotive Processors with Built-In Security Set to Protect Connected Cars against Cyber Threats

STMicroelectronics, a global semiconductor leader serving customers across the spectrum of electronics applications, is leading the race to protect connected cars against cyber threats with its latest automotive processors that feature a dedicated, built-in security module.

Millions of connected cars are already on the road, and industry analysts predict there will be more than 250 million by 2020[1]. Connected services supported by on-board telematics units, Wi-Fi hotspots, Bluetooth® devices – and aftermarket equipment such as on-board diagnostics (OBD) dongles - enable drivers and passengers to be safer, more productive, socially connected, and better entertained on their journeys. Unfortunately, all this connectivity builds a real surface of attack for hackers.

Automotive groups are quickly addressing security measures to support growth in valuable markets for connected services such as content streaming, location-based assistance, intelligent emergency support, and remote software updates over the air of in-car electronic control units (ECU), while preventing hackers exploiting the connections for their own ends. Experts recommend manufacturers employ a range of techniques, including establishing trust in connected devices and securing all connections, to provide multiple layers of defense throughout the vehicle's circuitry and software.

ST is helping the industry meet these challenges by combining its expertise in security chips – proven in financial and government applications worldwide — and automotive semiconductors that meet important industry safety and quality standards. The new Telemaco3Ptelematics and connectivity processors (STA1385 and its variants) are the first automotive microprocessors to integrate a powerful, dedicated, isolated Hardware Security Module (HSM), which acts like an independent security guard to watch data exchanges and encrypt and authenticate messages. The HSM securely checks the authenticity of received messages and any external devices that try to connect and protects against eavesdropping.

With this HSM on-chip, Telemaco3P devices are ahead of the general-purpose application processors typically found in current connected-car systems, which lack dedicated hardware-based security. ST's new chips are also extremely robust, with a 105°C maximum temperature rating for use in locations that can become extremely hot, such as on top or directly beneath the roof in a smart antenna.

"Realizing the benefits of connected cars requires strong

protection against cyber-attacks," said Antonio Radaelli, Infotainment Business Unit Director, Automotive and Discrete Product Group, STMicroelectronics. "Our new Telemaco3P processors combine ST's proven expertise in hardware security and knowledge of the automotive industry's standards and requirements to lay solid ground for safe and enjoyable connected motoring."

The new automotive processors are part of a comprehensive ST strategy to offer products with embedded security functions that include stand-alone Secure Elements (ST33) and embedded Flash microcontrollers (SPC5).

ST is providing engineering samples of the STA1385 to lead partners now and full production is scheduled for mid-2018.
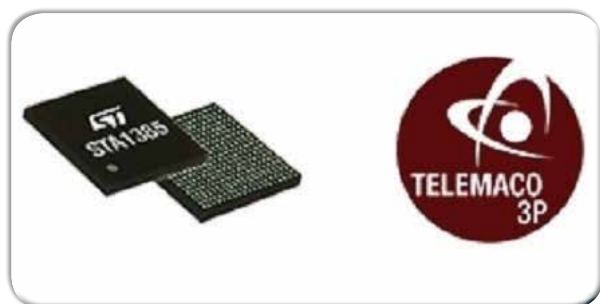
Cypress Enables Dynamic 3D Graphics in Hybrid Instrument Clusters and Head-Up Displays with New Automotive MCU Solution

Cypress Enables Dynamic 3D Graphics in Hybrid Instrument Clusters and Head-Up Displays with New Automotive MCU Solution

Cypress Semiconductor Corp. today announced a new series in its Traveo™ automotive microcontroller (MCU) family with more memory to support a hybrid instrument cluster with 3D graphics and up to 6 traditional gauges, as well as a head-up display. The highly integrated, single-chip devices in the S6J32xEK series include an advanced 3D and 2.5D graphics engine and provide scalability with Cypress' low-pin-count HyperBus™ memory interface. The series continues Cypress' expansion of its broad automotive portfolio with differentiated system performance via its MCUs, wireless radios, capacitive-touch solutions, memories and Power Management ICs (PMICs). "Our automotive customers are looking to integrate increasingly more dynamic 3D graphics in their hybrid

instrument cluster and head-up displays to appeal to consumers," said Mathias Braeuer, product marketing director of the Automotive Business Unit at Cypress. "Cypress developed our new Traveo MCU series specifically to provide a scalable, cost-effective, single-chip solution to address these applications, and we are pleased to having some of the world's leading automotive suppliers designing in this solution."

The Traveo S6J32xEK series integrates up to 4MB of high-density embedded flash, 512 KB RAM and 2MB of Video RAM, an Arm® Cortex®-R5 core at 240-MHz performance, a Low-Voltage Differential Signaling (LVDS) video output, a Low-Voltage Transistor-Transistor Logic (LVTTL) video output and a 6x stepper motor control. This combination enables the devices to serve as single-chip solutions to drive two displays. The devices have up to two 12-pin HyperBus memory interfaces that dramatically improve read and write performance of graphical data and other data or code. A single HyperBus interface can be used to connect to two memories for Firmware Over-The-Air (FOTA) updates, which enable end-users to get software fixes and new features and applications for their vehicles on-the-go. The devices support all in-vehicle networking standards required for instrument clusters, including Controller Area Network-Flexible Data (CAN-FD) and Ethernet AVB. Additionally, the series provides robust security with integrated enhanced secure hardware extension (eSHE) support.

The Traveo S6J32xEK series include 50 channels of 12-bit Analog to Digital Converters (ADC), 12 channels of multi-function serial interfaces and I2S interfaces with an AUDIO DAC to output the complex, high-quality sounds required in today's instrument clusters. The devices' support for Ethernet AVB delivers increased bandwidth in multimedia applications and reduced programming time. The S6J32xEK series offers functional safety features to support Automotive Safety Integrity Level (ASIL) B, and the devices feature a wide ambient temperature range of -40˚C to +105˚C. The Traveo family is backed by a comprehensive tools and software ecosystem that simplifies system integration, including AUTOSAR MCAL 4.0.3 support.

Availability

The Traveo S6J32xEK series is sampling now and will be in production in the first quarter of 2018. The

MCUs are available in a 208-pin and 216-pin thermally enhanced quad flat package (TEQFP).

Cypress Enables Leading-Edge Automotive Systems

Cypress works with the world's top automotive companies to bring leading-edge automotive systems typical of luxury models to mainstream vehicles, including Advanced Driver Assistance Systems (ADAS), 3-D graphics displays, wireless connectivity, full-featured touchscreens and superior body electronics. Cypress' automotive portfolio includes the Traveo MCU family, power-management ICs (PMICs), PSoC® programmable system-on-chip solutions, CapSense® capacitive-sensing solutions, TrueTouch® touchscreens, NOR flash, F-RAM™ and SRAM memories, and USB, Wi-Fi® and Bluetooth® connectivity solutions. The portfolio is backed by Cypress' commitment to zero defects, excellent service and adherence to the most stringent industry standards, such as the ISO/TS 16949 quality management system, the Automotive Electronics Council (AEC) guidelines for ICs and the Production Part Approval Process (PPAP).

Rugged 50Ohm Multiport Coaxial Connectors & Pre-Assembled Cables

Harwin continues to strengthen its portfolio of interconnect solutions designed for implementation in harsh application environments with new additions to its flagship Datamate high reliability connector (Hi-Rel) product family. With the objective of addressing space-constrained RF/wireless designs, each member of the Datamate Coax series comprises multiple (ganged) coaxial contacts in a compact housing. As they provide access to numerous coaxial lines through a single connection point, these components present engineers with a highly convenient, space efficient and cost effective way to address diverse connectivity requirements.

Featuring 2, 4, 6 and 8 contact options, the contacts contained within each Datamate Coax connector are arranged into single or double ended jack formats with 4.00mm pitch. They deliver strong RF performance characteristics up to frequencies of 6GHz. The connectors inherently robust construction means that they can cope with high levels of shock (100G) and vibration (10G/200Hz), plus extreme temperatures (-55$°$C to +125$°$C).

Among the key application areas for the space-saving, heavy duty Datamate Coax connector series are avionics, radar, robotics, industrial automation, military and medical, as well as general wireless communications. Benefitting from the technical expertise of Harwin's engineering team and the companys proven track record in a broad range of challenging Hi-Rel application scenarios, the accompanying cable assemblies ensure long term operational integrity while mitigating the related tooling costs that OEMs face when carrying out this work in house. The cable lengths available are 150mm, 300mm and 450mm.

"In most cases OEM engineers simply don't have the time or resources to create their own bespoke cable assemblies for the new products they are developing. Sourcing tooling and putting it in place for small prototype batches is not always convenient in the early stages of the project. Also coax cables tend to be time consuming, and such activities need a great deal of care and attention, states Scott Flower, Product Strategy Manager for High-Rel products at Harwin. "As Harwin maintains a high degree of vertical integration, we are able to address these issues directly – providing superior quality, ready-to-use cabling solutions that enable our customers to get through the prototyping phase much quicker and thus move on to full scale production."

Mini-IO adopted as an International Electrotechnical Commission standard

TE Connectivity (TE), a world leader in connectivity and

sensors, announced the Mini-IO connector has been adopted as an international standard (IEC 61076-3-122) by the International Electrotechnical Commission (IEC). IEC 61076-3-122 provides the minimum requirements for a miniaturized connector for industrial applications and thus ensures safety through consistent performance and interoperability. Connector requirements for industrial applications are high as they typically run in harsh environments with high mechanical demands from vibrations and rapid movements, environmental stress through dust and humidity, and possible exposure to radiated electromagnetic fields.

"TE is pleased that with the completion and publication of IEC 61076-3-122, the Mini-IO is the first standardized miniaturized industrial communication connector for an IP20 environment. Beyond its advantages for industrial applications in harsh environments, the small dimensions of the connector enable smaller devices and therefore higher packing densities inside cabinets," said Guenter Feldmeier, global standardization & consortia leader of TE's Industrial business unit. "TE Connectivity is pleased that the mini- i/O Standard was based on our technology."

Referring to its current use in industrial automation systems such as MECHATROLINK and VARAN, Feldmeier adds: "The reliability of the Mini-IO in harsh environments is already demonstrated by industry users. The standard now offers an exciting opportunity to accelerate the adoption by further eco-systems."

Metal Backshells with Built-In Shielding Ensure Ongoing Electrical & Mechanical Integrity

To complement its widely-used Datamate wire-to-board connector offering, Harwin now supplies a comprehensive range of backshells with a rugged aluminium alloy construction and electroless nickel plating. Through these accessories, which can be applied to new installations or alternatively for carrying

out mid production modifications, engineers are able to add increased levels of mechanical robustness, as well as providing the necessary EMI/RFI protection. As a result, prolonged operational lifespans can be benefitted from even in the most uncompromising of application conditions.

Incorporated into the female cable versions is a highly convenient attachment feature via which braid screening can be achieved with maximum effectiveness. There is a large elliptical entry hole for braid placement, along with a choice of slotted or hexagonal jackscrews on either side for securing the connection (as well as providing strain relief). The male backshell is designed for panel mount applications, and is compatible with both cable or vertical PCB connector styles. Full 360 degree EMI/RFI shielding is delivered once the male/female mating process has been completed. A working temperature range spanning from -55°C to +125°C is supported.

The new Harwin backshells can be used in conjunction with both the company's J-Tek and its Mix-Tek Datamate connector product lines – with signal, power and coax cabling all being accommodated. The combined Datamate/backshell assemblies are significantly lower in overall cost than equivalent Micro-D/backshell arrangements. Made to order, only low minimum volumes are required and there are very short turnaround times involved. Among the key areas where these items will be employed are aerospace, motorsport, industrial drives/controls, military communication, satellite systems, robotics and renewable energy infrastructure.

OMC launches new small-footprint SMA Tx/Rx housings

OMC, the pioneer in optoelectronics manufacturing,

has launched two new high density PCB-mounting SMA (H22) style housings for its wide range of fibre optic transmitters and receivers which save board space and ensure long-term performance.

The company has released two new space-saving housing styles: High Density SMA (HDSMA) which is designed to be edge-to-edge stackable while offering enhanced board density, and Vertical SMA (VSMA) which offers an even smaller PCB footprint for applications where devices are used singly on a PCB.

The new high-density HDSMA housing has PCB footprint of 10mm x 7mm, offering a potential increase in device density over the traditional SMA (H22) PCB mount housing of between 22 and 50 percent depending on the amount of board edge available. The package is designed for systems requiring multiple Tx/Rx channels per PCB and features an all-metal, bolt-down design. OMC's full range of fibre-optic emitter and receiver diodes can be supplied aligned and mounted in the new HDSMA receptacle.

The company's new Vertical SMA (VSMA) package has a PCB footprint of only 8mm x 7mm which OMC believe makes it the world's smallest PCB footprint SMA fibre-optic housing. With a modern, slimline design and all-metal body, the VSMA device bolts in place with a single screw and features a locating lip which slots into a groove in the PCB edge to securely fix the device in place. The VSMA package is designed to allow a fibre-optic transmitter or receiver to be incorporated into a PCB design while occupying the minimum possible PCB space. It is available with a wide range of visible and infrared emitters and fibre-optic receivers aligned and mounted within.

The new housings still permit the use of a standard SMA connector with secure hexagonal locking nut. Both have been designed to meet the demand for space-saving fibre-optic devices in the modern age of miniaturisation in which PCB area is at a premium.

Explains OMC's Commercial Director, William Heath: "The VSMA device takes up minimum possible space if a designer is incorporating single devices onto their PCB, while the HDSMA edge-stacking receptacle allows many more devices to fit into the same amount of space where multiple channels are required. For example, in 100mm of board edge a designer can fit 10 HDSMA receptacles whereas with the traditional PCB mount SMA package they would be restricted to 7 devices."

"SMA is a secure connector system, as once the connector nut is tightened the fibre is locked in place - unlike, for example, sprung connectors whereby even when the connection is made any tension on the cable will allow the fibre to move and change the attenuation of the link, as you create an air gap. Our new packages retain all the benefits of a traditional SMA (H22 style) housing, such as its rugged, all-metal design and secure bolt fixing to the PCB, but enables designers to reduce the size of their designs, saving cost and offering an environmental advantage – or to include extra channels in the same space for added functionality, while ensuring secure and reliable long-term performance."

The new packages suit industrial applications where a fit-and-forget approach is desired or in applications subject to high vibration, and as with their standard SMA connector, a small hex spanner is used to gently tighten the lock nut after installation. As well as securing the link, this reduces the likelihood of casual tampering or unintentional demating.

Earlier this year, OMC expanded into a new purpose-built manufacturing facility specifically designed and constructed by the company to suit its complex production and testing requirements. The new factory has dedicated development and assembly departments, as well as specialist test areas and a machine shop capable of both prototyping and mass component production. As part of this expansion, the company has invested in brand new, state-of-the-art CNC machining capabilities to facilitate the cost-effective manufacture their new range of advanced fibre optic connector systems and components.

Amphenol Aerospace Secures License to Supply VITA-46 Connectors

Amphenol Aerospace is announcing the availability of

its R-VPX connectors, which are intermateable and intermountable with VITA 46 connectors supplied by TE Connectivity. Amphenol and TE have signed a cross-licensing agreement, providing the industry with at least two qualified suppliers for these high-speed, board-to-board connectors.

mphenol's R-VPX Ruggedized VITA 46 connectors offer data exchange rates in excess to 10Gbps, which meet and exceed the VITA 46 standards while offering modularity, flexibility and customized wafer-loading patterns. The R-VPX connectors support Ethernet, Fiber Channel, InfiniBand, and other high-speed protocols. The connectors can be combined side-by-side on boards with high power modules, RF modules and optical modules, also available through Amphenol Aerospace.

"We're very excited to be able to offer this high-speed product as it allows us to continue our long history of being at the forefront of board level and high speed interconnect technology for the military and aerospace industries," said Jeremy Williams, Amphenol Aerospace's Product Line Manager for Board Level Products.

Belden Extends Reach and Reliability of Genius Bus and Modbus Plus Networks

New Rugged, Robust Fiber Optic Repeaters Protect Network Integrity in Harsh, Automated or Decentralized Industrial Environments.

a global leader in signal transmission solutions for mission-critical applications, has released two new fiber optic repeaters – the OZD Genius G12 and OZD Modbus Plus G12. These robust devices help industrial applications leverage fiber optic cables to achieve the reliable, high-performing connectivity required by the Industrial Internet of Things (IIoT).

"As systems become more automated and decentralized, fiber optic cables can offer significant advantages over traditional copper cabling. Whether it's lower installation costs or reliable data transmission over long distances, these benefits are compelling reasons to migrate quickly to fiber," said Rolf-Dieter Sommer, product manager at Belden. "Our new fiber optic repeaters are ruggedized and robust, giving customers an immediate path to get more value from their investment in fiber optic technology."

The OZD Genius G12 and OZD Modbus Plus G12 repeaters are designed for mission-critical and harsh industrial environments, such as manufacturing, transportation and traffic control systems, water and wastewater treatment plants and power generation facilities.

For Modbus Plus and Genius Bus networks, these devices can:

Offer increased value by expanding the range of data transmission (up to 22,000m)

Be used with all kinds of fiber optic cables (vendor agnostic)

Support data transmission rates of up to 1 Mbit/s with seamless redundancy against fiber breaks

Lower the risk of damage and downtime in harsh conditions, including corrosive gases and electromagnetic interference (EMI).

"As the IIoT expands, the ability to extend the reach of the network becomes increasingly important and these devices give engineers and integrators an efficient and elegant way to achieve that objective," adds Sommer.

ON Semiconductor brings 5 Megapixel CMOS backside illuminated image sensor at high speed for Surveillance

The new ON Semiconductor AR0521 is a 1/2.5" image sensor with a 5 Megapixel resolution, offering 60 fps for excellent video performance. The 2.2 µm Back Side Illuminated pixel technology enables clear, sharp

digital pictures while the sensor's ability to capture both continuous video and single frames makes it the perfect choice for security applications. A demo kit is available for the AR0521 along with additional services provided by the global imaging experts at FRAMOS.

The AR0521 captures images in either linear or high dynamic range modes with rolling shutter readouts and includes additional functions such as binning and subwindowing in both video and single frame modes. It is designed for both low light and high dynamic range performance, with line interleaved T1/T2 readout that support off chip HDR algorithms in an ISP chip.

Sibel Yorulmaz-Cokugur, sensor expert at FRAMOS, explains the advantages of ON Semiconductors AR0521: "The new AR0521 is a fast surveillance sensor with high sensitivity and an excellent image quality for precise recognition and analysis. In comparison to its predecessor, the MT9P006 sensor, it provides an 18% increase in Quantum Efficiency (QE) at 550nm along with 33% in the NIR region, which is important for most of our surveillance customers. The AR0521 makes surveillance more secure by providing better images under challenging conditions while its small form factor eases the integration in OEM and embedded vision projects."

In addition, the excellent image quality is supplemented by several digital processing functions, including digital gain, dynamic defect correction and a digital shading correction block that compensates for color/brightness shading that is introduced by the lens and the sensor's chief ray angle (CRA) curve mismatch. The full resolution image can be outputted at 60 frames per second (fps) in linear mode and 30 fps in line interleaved high dynamic range (HDR) mode output through either the MIPI or HiSPi ports. The maximum data rate for MIPI is 1.2 Gb/second and 1.0 Gb/second for HiSPi. The AR0521 is designed to operate over a wide ambient temperature range of -30°C to +85°C which aligns with a wide range of applications in rough environments. It also supports advanced line synchronization controls for multi-camera (stereo) support. Evaluation samples of color sensors are now available.

Industry and product experts at FRAMOS are available to support customers with the integration of these new sensors in their applications and projects. In addition, FRAMOS provides services like development support, customization, and logistics that speed development and improve time to market for all vision products.

Reduce Risk and Time to Market with Microchip's MPLAB® Mindi™ Analog Simulator with SPICE and SIMPLIS Environments

MPLAB® Mindi™ analog simulation software, which was updated to include more models and features, is now available from Microchip Technology Inc. The MPLAB Mindi Analog Simulator is a circuit simulation tool that now supports more than 300 Microchip analog products, with SIMetrix's enhanced SPICE (Simulation Program with Integrated Circuit Emphasis) and SIMPLIS Technologies' SIMPLIS (SIMulation of Piecewise LInear Systems) simulation environments. The updated Mindi analog simulation software is available as a free download by visiting: http://www.microchip.com/mindi.

Analog simulation is often a crucial step for circuit design, where complicated device interactions can be difficult to refine and debug in hardware. The proper simulation tools can help designers avoid significant risk—decreasing time to market and saving costly hardware revisions. The MPLAB Mindi Analog Simulator can test a circuit or sub-circuit, including transient and stability analyses, providing valuable estimation for the target circuit operation. Many applications require simulation before production. In the past, larger companies were often reliant on third-party providers or internal development for their analog component models, while many smaller companies wanted to run simulations but were not able to afford tool licenses for a full software package. The features and affordability of the MPLAB Mindi Analog Simulator make it an excellent option for customers of all sizes.

The MPLAB Mindi Analog Simulator allows for fast simulation of a wide variety of circuits, including closed-loop control systems like filters, power supplies and motor drive applications. Powered by SIMetrix/SIMPLIS

simulation engines, and pre-loaded with Microchip's analog device models, this analog simulation package allows for more accurate and faster simulation.

The updated software package now includes support for additional Digitally Enhanced Power Analog (DEPA) controllers, linear regulators, MOSFET drivers and LED drivers not present in previous software releases. In addition, it is based on the SIMetrix/SIMPLIS 8.1 software package, with added support for file-defined piecewise linear sources, Laplace transform transfer functions, arbitrary filters, Fourier analysis plots, transmission line modeling and improved convergence in the SIMetrix environment. The update also added convergence reporting to help with debug issues in the SIMetrix environment.

"Customers want a full solution, including software tools," said Keith Pazul, director of marketing for Microchip's Analog, Power and Interface Division. "The MPLAB Mindi Analog Simulator complements the compiler and integrated development environment Microchip is famous for, adding analog simulation capabilities. Now people can get the same industry-leading level of software support for analog and digital designs with Microchip's full suite of design tools."

▨ New congatec modules with 10 GbE bandwidth raise the bar for embedded edge computing

congatec - a leading technology company for embedded computer modules, single board computers and embedded design and manufacturing services – announces the launch of the conga-B7AC, a new Intel Atom C3000 processor based COM Express Type 7 Server-on-Module that raises the bar for embedded edge computing through 10 GbE bandwidth support. With a power consumption starting at only 11 Watt, the new low-power multicore Server-on-Modules with up to 16 cores offer up to 4x 10 GbE real-time capable

network performance. The feature set is designed for modular industrial micro servers as well as rugged telecom and network equipment – such as small cells, factory gateways and storage systems – and is deployable even in the extended temperature range from -40°C to +85°C. The conga-B7AC is based on the new PICMG COM Express 3.0 specification and, as a commercially off-the-shelf available, standardized building block, perfectly suited for efficient custom designs of very small sized, solely passively cooled embedded edge devices.

"Distributed embedded edge devices supporting 10 GbE bandwidth can be utilized as small cells for next generation LTE networks, device nodes for cyber-virtual factories, or local micro data centers for sensor networks. For these tasks, they need to handle massive TCP/IP communication and storage bandwidths in real-time. These edge data centers have to offer high multi core capabilities, as they generally have to handle smaller package sizes in parallel. This is the application area, where the new server-grade Intel Atom C3000 processors are a perfect addition to our Intel Xeon D processor based Server-on-Module portfolio. Thanks to their reduced cost and power consumption we are now able to bring massive network bandwidth and storage capabilities deeply into the industrial field," explains Martin Danzer, Director of Product Management at congatec.

The new COM Express Type 7 Server-on-Modules from congatec are application ready for redundancy, real-time communication and virtualization technologies to maximize uptime and resilience, minimize latency and to get the most out of each processing core. Their cloud API for distributed embedded edge servers further provides all the capabilities that data center managers need to remotely monitor system health, power consumption and environmental conditions. With the support of up to 20 PCI Express (PCIe) lanes, the new Intel Atom C3000 processor based COM Express Type 7 Server-on-Modules also offer minimum latency for storage devices as well as very fast access lanes to all the various sensor networks, field busses and industrial Ethernets.

The feature set in detail

The new conga-B7AC COM Express Type 7 Server-on-Modules are available with 8 different Intel Atom server processors, from the 16-core Intel Atom C3958 processor to the quad-core C3508 for the extended

temperature range (-40°C to +85°C). All modules provide up to 48 GB of fast 2400 DDR4 memory with or without error correction code (ECC) depending on customers' requirements. They offer very high network capabilities with up to 4x 10 GbE and the Network Controller Sideband Interface (NC-SI) for connecting a baseboard management controller (BMC) allowing out-of-band remote manageability. Flexible system extensions including NVMe flash storage can be connected via up to 12x PCIe Gen 3.0 lanes and 8x PCIe Gen 2.0 lanes. 2x SATA 6G ports are available for conventional storage media. Further I/O interfaces include 2x USB 3.0, 4x USB 2.0, LPC, SPI, I2C Bus and 2x UART. Additionally, the module hosts a trusted platform module (TPM) for security sensitive network appliances.

congatec offers comprehensive board support packages for all current 64 bit Microsoft Windows variants as well as Red Hat Enterprise Linux Server. An extensive range of accessories, such as cooling solutions and the new COM Express Type 7 carrier board for evaluation, simplifies the design-in even further.

congatec virtualizes robust COM Express Type 7 Server-on-Module

congatec presents virtualized fog server installation
congatec – a leading technology company for embedded computer modules, single board computers and embedded design and manufacturing services – will be presenting its first robust, fanless, virtualized edge server platform for the extended temperature range at Embedded Conference Scandinavia (ECS) to be held in Stockholm from 7-9 November. The platform supports redundancy as well as real-time collaboration and consists of COM Express Type 7 modules with Intel® Atom™ processors (codename Denverton) and a real-time hypervisor from Real-Time Systems.

The aim of this edge/fog server demo installation is to highlight the advantages of function virtualization and software defined services for IoT and Industry 4.0 connected rugged embedded server systems.

OEMs benefit from application-ready, virtualized, fanless embedded server platforms with up to 16 cores, giving them the ability to provide highly flexible real-time capable carrier-grade edge services as well as all kinds of shop floor based Industry 4.0 and M2M/IoT services. In addition, dedicated infrastructure components such as firewalls, load balancers and routing systems can be standardized with software-based solutions and consolidated on the fog servers themselves. All this helps OEMs increase the agility and cost-effectiveness of their communications infrastructures.

The installation in detail
The virtualized Server-on-Module platforms support redundant edge/fog server configurations that are connected via redundant 10 GbE interfaces, and can be used to install and manage any number of applications and services. There are also redundant core configurations for real-time support of machine controllers in which the individual cores and device resources can be prioritized or assigned exclusively. Thanks to the hardware independence of virtualized platforms, it is possible to develop multi-tenant nodes for faster implementation of heterogeneous machines, systems and sensor networks in Industry 4.0 environments, making these virtualized, real-time installations more agile, flexible and scalable. The installation is also suitable for high availability cloudlets and small cells at the edge of carrier infrastructures.

Application-ready Industry 4.0 and IoT platforms
The presented virtualized edge server platform is a flagship project of congatec's extended services for Industry 4.0 and IoT ready Computer-on-Modules that come application-ready to use – including all required embedded software and hardware services. congatec provided design-in services, BIOS customization, driver and OS support including virtualization as well as all relevant hardware oriented services for this individually designed platform. These services include but are not limited to PCB checks of customers' layouts, debugging, signal integrity simulation and testing; testing of EMC, power consumption and compliance; as well as thermal design and thermal adaptation

Renesas Synergy™ Platform Strengthens Security and Expands IoT Device-to-Cloud Connectivity

Synergy Software Package v1.3.0 includes NetX Secure TLS, MQTT connectivity, Wi-Fi/Cellular/BLE Frameworks, and Support for New Synergy Microcontrollers

Renesas Electronics Corporation, a premier supplier of advanced semiconductor solutions, today announced the latest update of its Renesas Synergyג„¢ Platform, the first qualified, maintained and fully supported software/hardware platform that accelerates time to market, reduces total cost of ownership and removes the obstacles engineers face designing Internet of Things (IoT) products. The Renesas Synergy Platform consists of fully integrated software, development tools and a family of scalable microcontrollers (MCUs) with no upfront fees or back-end royalties " everything is included in the purchase price of the MCU device.

The Synergy Platform's new release includes the Synergy Software Package (SSP) version 1.3.0, which integrates Express Logic's NetX Secure Transport Layer Security (TLS) and Message Queue Telemetry Transport (MQTT) for NetX Duo¢. SSP v1.3.0 also adds Wi-Fi, LTE cellular and Bluetooth® low energy (BLE) wireless application frameworks that simplify adding or exchanging radio frequency (RF) modules in IoT devices. Low power management is enhanced by adding the Power Profile application framework to make it easy to use the Synergy MCUs' complex low-power modes. The Synergy Platform also includes software and development tool support for three additional MCU groups" S5D5, S3A6, and S128. New low-cost S5D5 and S3A6 target board kits and S128 development kit further reduce development cost barriers.

SSP v1.3.0 integrates NetX Secure to safeguard connected IoT device communications over public networks and the Internet. Developers can easily deploy NetX Secure to authenticate the senders and receivers identity, and prevent eavesdropping and tampering with data sent across the network. NetX Secure uses the TLS protocol to achieve socket layer security while using the NetX Duo TCP/IP network stack. TLS provides security three ways: by establishing secret keys between the client and server, applying hashing algorithms to detect alteration or forgery of packet content, and remote host identity using digital certificates. The MQTT protocol enables lightweight machine-to-machine (M2M) communication across small IoT edge devices powered by MCUs. This combination of TLS and MQTT protocols ensures secure and efficient communication from edge to cloud. "The functionality of the Synergy Platform continues to grow in value, serving embedded IoT developers with greater security, simple to integrate RF modules, and an ever-expanding full service software/hardware platform that accelerates time to market like never before, "said Peter Carbone, Vice President of Synergy IoT Platform Business Division, Renesas Electronics Corporation. Each new SSP release enables our customers to innovate and differentiate, while tackling the most complex IoT applications."

"With edge nodes and connected devices rapidly populating the IoT landscape, the need to put an end to security breaches of sensitive and confidential information has never been more critical,"said William E. Lamie, President, Express Logic, Inc. We are thrilled to see Express Logic's NetX Secure TLS and MQTT for NetX Duo inside Renesas' Synergy Software. We believe that Synergy customers have the essential tools needed to quickly develop secure IoT device-to-cloud solutions."

Wireless Application Framework Additions

The wireless application frameworks in SSP v1.3.0 enable developers to easily add, or swap RF modules from various suppliers into their projects by providing a set of uniform APIs that abstract low-level hardware details. This makes it easy for Synergy Platform customers to evaluate popular RF modules and quickly adapt to changes in availability of specific RF modules with minimum impact to application code. SSP v1.3.0 also makes the Wi-Fi application framework native to the SSP and adds new frameworks for cellular and BLE connectivity to cover the three key wireless IoT protocols. Synergy Tools simplify selecting RF module functions, configurations, and connections to the ThreadX® real-

time-operating system (RTOS). Customers can access the Synergy wireless application frameworks and supported device drivers on the Synergy Gallery.

Synergy S5D5 Group MCUs

The S5D5 Group, Renesas' eighth group of Synergy MCUs, increases the Synergy Platform's scalability with six new software-compatible MCUs. Each MCU delivers cost-effective performance, a large SRAM to flash memory ratio, and robust security features to address IoT applications. The S5D5 MCUs include a 120 MHz ARM® Cortex®-M4 CPU core, 512KB or 1MB on-chip flash memory, 384KB of SRAM, precision analog acquisition functions, Ethernet interface, and high-speed USB. Specialized on-chip security features include the ability to generate and safely store private keys using symmetric and asymmetric cryptography, a true random number generator (TRNG), and special memory protection functions.

Availability

SSP v1.3.0 is available now for download at https://synergygallery.renesas.com. The Synergy S5D5 MCU Group is available now from Renesas Electronics' worldwide distributors, along with a low-cost TB-S5D5 Target Board Kit that enables customers to evaluate and quickly start their design.

Qualified Bluetooth® Low Energy Application Processor Module from STMicroelectronics Accelerates Time-to-Market for Connected Smart Objects

To help product innovators streamline prototyping and development of connected smart objects, STMicroelectronics has created the SPBTLE-1S ready-to-use Bluetooth® Low Energy (BLE) module that integrates all the components needed to complete the radio subsystem. The new BLE module integrates ST's proven BlueNRG-1 application-processor System-on-Chip (SoC) and balun, high-frequency oscillators, and

a chip antenna among others.

Developers can use this module to bypass hardware-design and RF-circuit layout challenges. The SPBTLE-1S is BQE[1]-approved, and FCC, IC, and CE-RED (Radio Equipment Directive) certified to simplify end-product approval for North America and EU markets. ST's Bluetooth 4.2 certified BLE protocol stack is included, and the supporting Software-Development Kit (SDK) contains a wide range of Bluetooth profiles and sample application code.

Coming in a space-efficient 11.5mm x 13.5mm outline, and with a wide supply-voltage range of 1.7V-3.6V, the SPBTLE-1S module is ideal for small, battery-operated objects powered by various types of sources such as a primary button cell or rechargeable Li-ion battery. High RF output power of +5dBm and good receiver sensitivity help to maximize communication range and reliability.

The BlueNRG-1 SoC at the heart of the SPBTLE-1S implements the complete BLE physical layer (PHY), link layer, and network/application-processing engine comprising a low-power ARM® Cortex®-M0 core with 160KB Flash, 24KB RAM with data retention, and a security co-processor. The SoC also implements smart power management, with a DC/DC converter capable of powering the SPBTLE-1S module to ensure optimum energy efficiency. Users can leverage an extensive set of interfaces, including a UART, two I²C ports, SPI port, single-wire debug, and 14 GPIOs, as well as peripherals including two multifunction timers, a 10-bit ADC, watchdog timer and real-time clock, a DMA controller, and a PDM stream processor interface, which is ideal for developing voice-controlled applications.

The SPBTLE-1S module is in production and available now, priced $6.65 for orders of 1000 pieces.

Evaluationkits containing the SPBTLE-1S are also available, which streamline development of various types of smart objects. The STEVAL-IDB007V1M combines the module with MEMS pressure and temperature sensors, LEDs, push-buttons, and programming interface to run the provided demonstration software out-of-the-box. An Arduino-compatible connector is also featured on-board, which allows development of more complex applications by adding extra expansion boards. This eval board is firmware, software and hardware compatible with the existing STEVAL-IDB007V1 platform based on the BlueNRG-1 SoC.

The STEVAL-BLUEMIC-1 small form factor evaluation

board features a MEMS microphone and an inertial module containing a MEMS 3D accelerometer and gyroscope.

AMS launches NFC Sensor Interface for Industrial IoT

AMS, a leading worldwide supplier of high performance sensor solutions, today released the AS3956, a dynamic NFC tag IC which meets industrial-grade quality standards and provides very high reliability in mission-critical applications and in products with a long operating lifetime. The AS3956 dynamic tag acts as a contactless bridge between sensors and any NFC reader, such as a smartphone, through a host microcontroller. It supports the NDEF messaging protocol in full compliance with NFC Forum recommendations, guaranteeing interoperability with any NFC phones, including Apple® iOS devices

In designing the robust AS3956, ams drew on close interaction with customers that manufacture products for industrial applications and the Internet of Things (IoT). Intensive testing in real-world applications has validated the performance and reliability of the chip in a wide range of demanding operating conditions.

Unlike the consumer-grade dynamic NFC tags on the market today, the AS3956 is ideally suited to:

■ industrial and Internet of Things (IoT) applications exposed to harsh operating conditions, including extreme temperatures ranging from -40°C to 125°C;

■ products requiring an extended operating lifetime, such as HVAC equipment, hearing aids, and wireless sensors for infrastructure such as roads, bridges and utilities. The AS3956's internal EEPROM memory is rated for a minimum 100,000 program/erase cycles, and offers 10 years' data retention at 125°C;

■ mission-critical products that require a zero failure rate; The AS3956 includes various features that give the designer flexibility in implementing NFC-based applications. These include the provision of both an I2C and an SPI interface to a host microcontroller, and

a wide supply voltage range of 1.65V-5.5V.

In basic operation, the AS3956 acts as a stand-alone Type 2 tag conforming to the NFC Forum standards and supporting NFC communication with a reader. In addition, either of two data-transfer modes for host controller communication can be selected:

■ Extended Mode, a self-timed data transfer mechanism using standard Type 2 tag commands, thus minimizing software overhead on the host controller

■ Tunneling Mode to implement ISO14443A Level 4 PICC emulation in line with EMVCo requirements or custom protocols

The AS3956 includes an energy-harvesting capability, drawing energy from the incoming RF field generated by an NFC reader, and supplying up to 5mA to an external device. Energy harvesting is particularly useful as a cost effective, small footprint alternative to standard wireless charging, to extend battery lifetime in biometric smart cards, or to implement fully passive wireless sensing solutions, as required for example in smart insulin pens.

"Previous generations of general purpose NFC dynamic tags have not offered the reliability and flexibility that many applications require. The AS3956 offers far superior lifetime performance. The rigorous quality processes and numerous validation tests put in place by ams will give customers confidence that the AS3956 can cope with operation in harsh or extreme conditions and still maintain unimpaired RF, interface and memory functions," said Giancarlo Cutrignelli, Head of Marketing for Wireless Sensor Nodes at ams.

ams provides the AS3956 in a miniature chip-scale package (CSP) just 0.3mm high, and with a 1.8mm x 1.4mm footprint as well as in a 3mm x 3mm MLPD package. It is available for sampling now. Unit pricing is $0.53 in an order quantity of 1,000 units.

A demonstration kit is available from the ams ICdirect online store. For sample requests or for more technical information, go to www.ams.com/Sensor-Tags/AS3956.

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