EP&T
ELECTRONIC PRODUCTS & TECHNOLOGY

MAY 2018

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AI media darling Sophia headlines Discovery innovation event

Seeing as two of the hottest tech topics of the day remains artificial intelligence (AI) and robotics, it's no wonder that AI robot and global media darling Sophia led the keynote address at this year's Discovery Conference in Toronto.

Created by Hanson Robotics Ltd., Sophia the Robot first garnered worldwide attention by being granted Saudi Arabian citizenship last year. Currently living in Hong Kong, but often traveling the world on her publicity junket, Sophia made her first official visit to Canada this month.

"It's exciting to know that you, the generation that grew up with so much amazing technology, is interested in advancing innovation. I'm sure many of you will go on to create software, apps, devices and much more that the world has never seen before," Sophia said to the 3,500 assembled at the Metro Toronto Convention Centre, many of which were young tech entrepreneurs from across Ontario. "Each of you have the ability to change our world for the better. I believe that is what technology and innovation should do."

When asked if there was any chance that AI creations such as Sophia could one day gather enough intelligence to 'take over the world', she remarked that the intent for robots is to solve problems for humanity, not create them. She says humanoid robots will perhaps eventually combine the consciousness of humans.

"We are designed to interact with humans and to serving areas such as healthcare, education and customer service. We are still some ways off from world domination. My artificial intelligence is designed around being completely self-learning. So my brain does not work like a human brain, but one day – look out," she jokes.

Interviewed on stage by Tom Corr, president and CEO, Ontario Centres of Excellence, Sophia was asked if she thought robots could eventually have empathy.

"Empathy will set us free. I hope to teach empathy skills one day, once I myself have developed a true understanding of what that means," she said.

Innovation and technology can be positive drivers of social change to improve the quality of life

Sophia's appearance on stage served as a precursor to the event's true keynote: a discussion by her creator, Hanson Robotics founder and CEO David Hanson, who appeared via hologram to discuss the humanizing of robots.

"At Hanson Robotics we are working to bring robots to life. We are working towards the grand quest – to achieve machines with the heart of a human, with the true biosystems of a human, with the ability to express emotions with facial expressions – to walk through our world – touch grasp and feel. But, not to just feel with the hands, but to feel with a full comprehension. An internal set of feelings inspired by a whole organism."

Hanson refers to the concept of human-like robots as not a new 'dream', but one that has existed for millennia - conceptualized in sci-fi books and movies for generations. However, today it is becoming a reality as we witness robotics emerge. Hanson's quest is to have robots, such as Sophia, navigate the human social domain. That come to learn what it means to be human, so that these robots can care about us.

"I believe that this kind of character robot is the path towards making truly safe, caring, super-intelligent machines," Hanson said. "It (AI/robotics) could change everything – but it's important we get it right."

When ask how society avoids the issue of AI robots learning from the worst of us instead of the best of us - Hanson's replies.

"We also need to look at how we can train our machines to perceive the truth," he continued. "To look past the human biases, to look for the greater good. We need to develop the algorithms that can perceive this greater good. In a sense, it's a grand challenge for humans to rise… because if we can't be our best, then the machines certainly can't exceed our worst." EP&T

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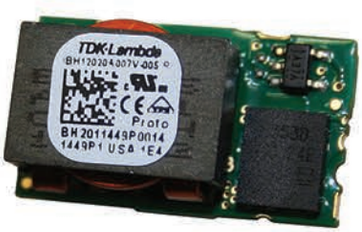

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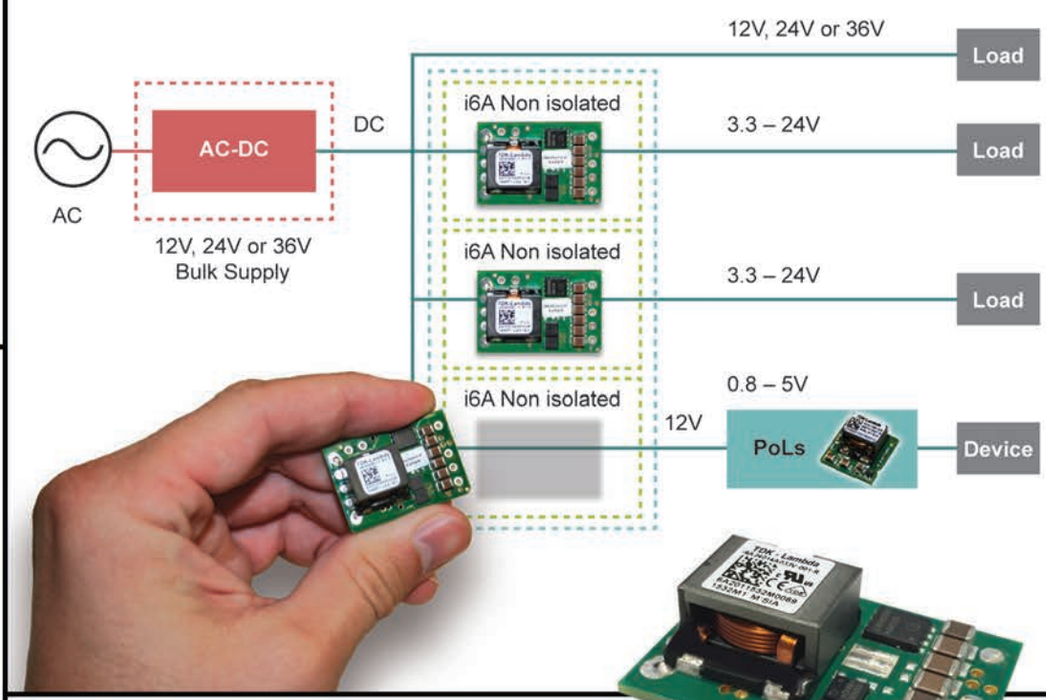

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NEWSWATCH

ARTIFICIAL INTELLIGENCE

U OF WATERLOO LAUNCHES ARTIFICIAL INTELLIGENCE INSTITUTE

The University of Waterloo has launched the Waterloo Artificial Intelligence Institute, bringing together a large group of researchers and businesses to advance technology and prepare Canada for future economic disruption.

Waterloo AI uniquely focuses on end-to-end innovation ranging from foundational to operational AI. Foundational AI advances the field as a whole through research in a number of areas, including statistical learning, deep learning, game theory and data science. Operational AI develops scalable, secure and transparent solutions for a wide range of applications.

As part of its mandate, Waterloo AI will pursue new areas of research with societal and business impact including healthcare, environmental protection, urban planning, manufacturing, autonomous systems and human-machine interaction and will emphasize timely access to expertise to individuals and industry.

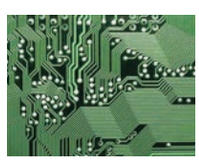
EDUCATION

OMRON GIFTS EQUIPMENT TO GEORGIAN COLLEGE

Georgian College engineering technology students now have a wealth of real-world equipment thanks to a generous gift from Omron Automation Americas. A leader in automation solutions, Omron recently provided the college in Barrie ON with workforce-relevant technology, bringing its cumulative donations to be worth hundreds of thousands of dollars. Omron is also donating software and providing training on the new equipment to faculty.

"The success of applied learning programs relies heavily upon students' access to the latest tools used in industry," according to Peter Brouwer, general manager of Omron Canada.

"The latest technologies in motion control, machine safety, HMI, vision, sensors and control components are available and can be tested together in a learning environment that simulates integrated interactions of total machine automation," says Brouwer.



June 5-7

Conference for Electronics Enabling Technologies at Edward Village Markham.

SMTA CONFERENCE COMING IN JUNE

Several professional development courses will headline the SMTA's technical program in Markham ON this spring. The International Conference for Electronics Enabling Technologies will be held June 5-7 and will focus on such topics as soldering, stencil printing, process troubleshooting and defect prevention, among many more.

Conference sessions on June 6 and 7 will cover a broad range of topics including everything from failure modes, reliability, research to coating & encapsulation, imaging & inspection. Shawn Blakney, senior director of global technology and innovation at Celestica, will provide the keynote presentation on Tuesday, June 5 on the topic of 'The Automated and Digital Factory - Navigating Technology Disruption.'

The conference is co-located with the SMTA Ontario Expo on Wednesday, June 6, featuring 20 companies highlighting the latest manufacturing solutions.

AUTOMOTIVE

DELTA-Q TECH INCORPORATES J1939 AUTOMOTIVE CAPABILITIES

Delta-Q Technologies, Vancouver, a leader in battery charging solutions for electric drive vehicles and machines, has expanded its capabilities to support the Society of Automotive Engineers (SAE) J1939 standards in its battery charging solutions. Delta-Q now offers the two leading Controller Area Network (CAN) bus communication protocols: CANopen and J1939.

J1939 is the preferred CAN standard for in-vehicle networks for trucks and buses in industries such as construction, material handling, electric automobiles, speciality utility vehicles and outdoor power equipment. With J1939 CAN protocol capabilities on Delta-Q's chargers, the company can support machines approved for these uses

IOT

LORAWAN NETWORK ACCESS TO SIMPLIFY IOT DEV FOR TECH FIRMS

Wavefront Innovation Society and eleven-x Inc. reached a partnership that will make it easier for Canadian companies to develop and deploy Internet of Things (IoT) solutions. eleven-x's LoRaWAN based, long-range Low Power Wide Area Network (LPWAN) service is now available at Wavefront Wireless Zones across Canada.

The network enables testing, development and proof of concept deployment of IoT solutions. Since the eleven-x network is deployed coast-to-coast in most major markets across Canada, companies can roll out mass deployments of their IoT solutions upon completion of development and testing.

eleven-x operates Canada's first and only coast-to-coast public Low Power Wide Area Network optimized to support IoT solutions. Providing the first development platform in Canada based on LoRaWAN will encourage the adoption of low power wireless IoT applications and enable the development of new and innovative battery powered solutions.

SOFTWARE ENGINEERING

CIENET OPENS TECH DEV CENTRE IN MARKHAM

CIeNET, a leading global technology service provider of technical consulting and software engineering solutions, has opened its Canadian Technology and Development Center in Markham ON.

"This facility allows us to become a stronger player in engineering and innovation in Canada," says Grace Sang, managing director CIeNET Canada, which remains focused on automotive and mobility related technologies since its establishment here.

Photos: Mirna Chacín; Borealis AI

NEWSWATCH

SUPPLY SIDE

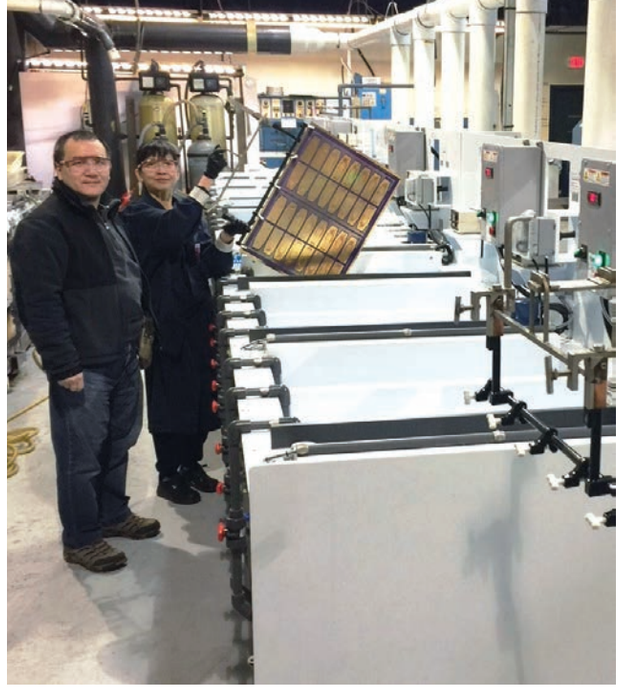
ENIGMA INTERCONNECT ADDS GOLD PLATING TO BARE PCB MAKING

Enigma Interconnect, Western Canada's largest manufacturer of bare printed circuit boards, has installed a new line that provides double sided selective and flash/full body electroplating in hard gold options.

This service is offered in-house and is now part of the firm's quick turn capabilities. Panel gold plating (or flash gold) is an electroplated finish, available in both hard and soft gold options.

"These services are ideally used for products such as PCMCIA or minicards that have both solderable requirements and some plug-in edge fingers," says John Parsons, Enigma's engineering manager.

With a typical thickness of 8 ± 4 micro-inches thick, Enigma's deep gold line improves panel utilization for designs incorporating card edge connectors and those with card edge connectors on multiple sides of the pcb, according to Parsons.



David Kuo, Enigma's production manager is pictured with Sui Sum Leung, Enigma's lab lead hand.

MICROART EXPANDS INTO THE US

Microart Services Inc., a Markham ON-based electronics manufacturing services (EMS) provider, has secured a factory location in North Tonawanda NY, representing the firm's first expansion outside of Canada. The factory will be a duplicate of Microart's current factory, but on a smaller scale, according to CEO Mark Wood.

"We have been looking for some time to get a foothold into the US market to support our customers there," Wood says. "This also serves some of our Canadian customers that require US content in their products being sold into the US."

IRWIN EXPANDS SERVICE OFFERING, FACILITY

Irwin Industrial, a value-added distributor of parts for production, is enhancing its supply-chain solutions offering by adding key personnel and expanding its headquarters.

Irwin has appointed Richard Michaud to spearhead Irwin Intelligent Bin (I2B) systems, a customer-centric replenishment program that automatically detects low individual-item inventory levels and instantly sends alerts, eliminating the need for counting trips, safety-stock, emergency orders and line-down situations.

To accommodate its growth, Irwin Industrial is expanding its Aurora ON headquarters by 30%. The expansion will include demonstration and staging areas for Smart Supply Solutions, a franchised brand showroom, a work cell for value-added assembly and kitting, as well as increased warehouse area.

SHIMIFREZ EXPANDS SERVICES

Shimifrez Inc., a Toronto-based fabricator of precision photo chemically etched and electroformed metal components, has expanded its services to provide shadow masks and micro machining services to OLED, solar and research institutions globally.

Metal masks are often used in evaporation or sputtering processes of structured metal or oxide layers. With the increasing requirements on precision and structure resolution, electroformed masks become more prevalent, according to Hassan Nojoumi, president and CEO of Shimifrez.

"Electroformed masks are characterized by vertical, burr-free edges and super sharp corners," Nojoumi says. "The shadow masks are made in nickel which has the additional advantage of magnetic attraction to the substrate surface, so that the deposition of very sharp edges is possible."

Shimifrez now provides shadow masks and micro machining services to OLED, solar and research institutions.

NORTHERN COATINGS FACILITY NOW OPERATING IN ORANGEVILLE

Entering its 25th year of operations, Northern Coatings Ltd. has moved its facilities into an industrial park in Orangeville ON, located on the outskirts of Toronto. Specialists in applying conformal coating to printed circuit boards, the firm currently runs four coating lines at a minimum of nine hours daily – thus, guaranteeing a maximum turn-around time of 2-3 full business days, according to company president and owner Maryann Watkins.

Based on the accuracy of its selective conformal coating process, Northern Coatings does not mask its assemblies prior to coating. When UV cure conformal coatings are used, pcbs cure in a matter of seconds.

"We have a constant inspection process in place, which allows us to continually provide the level of excellence our customers expect," says Watkins.

THE ID GROUP ADDS OTTAWA LOCATION

Distributor of energy management solutions The ID Group, Dollard des Ormeaux QC, also a leading provider of EMI solutions in Canada, has opened its second location in Ottawa.

The new facility represents the firm's main warehouse and distribution center.

"This additional location is reflective of our growth and will enhance the connection to our customer base in the 'Silicon Valley North' area in Canada," says Irwin Lambersky, president, The ID Group.

DIVERSE ADDS GW INSTEK TO LINEUP

Celebrating its 25th anniversary as a franchised electronic component distributor and production equipment and consumables supplier, Diverse Electronics, St-Laurent QC, has partnered with GW Instek, a leading manufacturer of high-precision electronic test and measurement instruments.

GW Instek's product range encompasses more than 450 products across five categories – power supplies, oscilloscopes, spectrum analyzers, function generators and component/safety testers.

"GW Instek is a global brand with a strong North American division, which means we can provide our customers with economically-priced, quality products with strong warranties and complete after-sales support," says Diverse president Rick Masciotra. **EP&T**

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A camera revolution comes into focus with NexOptic's lens technology

Since early telescopes, we have seen various lens designs that aid users in viewing distant objects, though they all suffer from fundamental weaknesses.

These models use curved lenses that have size limitations and are also prone to aberrations. Vancouver-based NexOptic Technology Corp. hopes to change that.

As a creative optical development company, the firm aims to revolutionize lenses by improving how we capture digital media. Their overarching goal is to produce lenses capable of superb definition and clarity in a smaller housing.

For instance, a flat lens system they designed gathers about 27 percent more light than a comparably sized curved aperture lens with squared corners. More importantly, NexOptic designs increase the aperture to-depth ratio in devices that currently exhibit depth limitations. Their lens sizes can be miniaturized by several factors thus opening the door to a multitude of applications ranging from space telescopes to handheld phones.

Paul McKenzie, president and chief business officer (CBO), NexOptic Technology Corp.

West Tech Report spoke recently with Paul McKenzie, president and chief business officer (CBO) of NexOptic Technology. A serial entrepreneur, he has made significant resource discoveries worldwide and has overseen and negotiated joint-venture and alliance partnerships with companies whose market-capitalizations have exceeded $20-billion.

Inspired by smartphones with dual camera systems

An Alberta/BC based company focused on developing new products with far-reaching potential, NexOptic came together as the two original founders were in Alberta and McKenzie was in Vancouver. Together they made the company a reality.

"I met the founders four years ago. They were at a conceptual stage at the time, and even though the technology was new to me, I

could tell that there was something significant going on," says McKenzie. "They came from strong backgrounds themselves. One engineer has an MBA, another has a business degree. They have built and managed companies in the past."

This is significant, but this was not the main reason that led McKenzie to support NexOptic.

"It was how meticulously they explained their ideas and how they wanted to move forward and their passion for their idea that really resonated with me," he adds.

NexOptic has benefited from government support out of the province of Alberta through the ACAMP and Alberta Innovates programs, which helped to incubate and fast track their efforts. They earned $50,000 through a grant from the National Research Council (NRC-IRAP), but it was more about the symbolism behind it that helped NexOptic, explains McKenzie.

"We were one of the few [grant recipients] out of many applicants, giving us a strong endorsement - as to who we are and what we're doing. Because they went rather forensic in their due diligence of us, the process and award gave our shareholders increased confidence in us," McKenzie says.

A few years back NexOptic was inspired by iPhones that began delivering dual camera systems, which improved low light and distance photography issues.

"We are expecting our technology will provide a more substantive shift to see farther with higher resolution, as well as produce crisper photographs in low light," says McKenzie. "When we try to take pictures at a dimly-lit dinner party, or a sunset, we struggle due to the amount of light the smartphone can take in. We want NexOptic's solution to be a leap forward for the industry."

NexOptic is aiming to produce a smartphone application where, with additional engineering, their lenses can be scaled using lower aperture-to-depth ratios. Since the geometry of their lenses can be scaled up or down according to the size required, the lenses can also be adapted for laser light or monochromatic light and narrow fields of view.

Lenses will permit an enhanced shareability and viewability

If successful, NexOptic will change the camera industry. For instance, their product allows the viewer to see much further - compared to conventional binoculars.

"We would bring into the digital age an enhanced shareability and viewability. You are going to be able to see it on a screen, share the experience with anyone beside you, image it… basically binoculars on steroids," explains McKenzie.

For the mobile device space, users can expect cheaper, more precise photographs, paving the way for extended zoom lenses on traditional smartphones with increased resolution. OEMs and engineers may note that while smartphones are the most imminent opportunity, these applications are just the beginning for this technology.

"My advice to the budding entrepreneur is - it really is about passion. Passion combined with capital allows a company to launch. If you have passion and no money, and you are determined enough, then you will find your way."

NexOptic is working toward a line of sports optics, after which they will target the smartphone industry. For more information, go to **nexoptic.com**. **EP&T**

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IoT connects Smart City projects

St. Jacobs-based S2e Technologies Inc. delivers research and collaboration to establish sustainable solutions development

The multitude of engineering skills combined with the breadth of technologies required to deliver a large scale IoT project can't be overstated. Clearly difficult to build alone, such detailed endeavors often require research and collaboration for bringing the many elements together.

This is where s2e Technologies Inc. of St. Jacobs Ontario comes in, a leading sustainable solutions development firm that has managed to help create many SMART Community or City projects in Canada. Also specializing in renewable energy solutions and micro-grid projects, s2e Technologies collaborates in large scale IoT initiatives by maximizing the use of state-of-the-art technologies and solutions to support efficient and sustainable growth - including net zero energy and smart grid infrastructure.

EP&T sat down with members of the s2e Technologies team to discuss their approach and involvement with large scale IoT projects in Canada.

Q. Provide our readers with a thumbnail sketch of the part you play in Smart City projects?

Before we could build anything resembling a Smart Community, we had to prove that our vision was feasible from a technical and financial standpoint. Towards this end, we undertook an extensive Smart Community feasibility study that considered the possibilities for Net Zero Energy in a large scale real estate project, as well as sustainable concepts around water, waste and urban agriculture. We collaborated with 90 graduate students from 11 Canadian Universities to study the various aspects of what we called 'Smart', and we demonstrated how these communities could be built while also making money. In other words, we proved the potential for an attractive triple bottom line - good for people and the planet, while being profitable. However, we realize that we have a long way to go before these concepts become engrained in the mindset of developers, architects, engineers and even municipalities. Our role now is to partner with developers or build projects on our own to demonstrate a new way of building communities that are desirable to homebuyers and tenants, environmentally friendly and profitable.

Q. Outline the importance technology plays with existing infrastructure or in planning for the future.

Technology is an ever-evolving set of tools that can help us to address infrastructure challenges that impact our daily lives. Often when you solve for one challenge, another issue presents itself that needs to be addressed. For example, electric vehicles have utilities everywhere excited right now, but these vehicles can use as much energy as an efficient home. If 10 neighbours drive home from work at 6pm every day and all want to charge their vehicle at the same time, the electrical grid is challenged by that load spike and prolonged draw. These cars have tremendous ability to reduce commute related GHG emissions, but present other challenges for the grid and the reliable delivery of power. In planning infrastructure, it is important to understand 'where the puck is going, not where it has been.' We work very closely with various levels of government to test and demonstrate new technologies so they can plan future infrastructure.

Q. How do you integrate technology into smart cities? How does it all work together?

How do you avoid common pitfalls in developing connected products?

As already mentioned, technology only gives us tools. It is still up to people to use those tools to solve problems and meet real needs. The human to technology interface is critical to ensure broad acceptance and usability. The most common pitfalls with technology integration happens when it is assumed that the technology will magically solve a human problem, and they forget to talk to end users, or omit necessary steps in planning. It's almost hubris to say it, but technology is all about planning: 'talk early and often'. Smart Cities are all about leveraging advanced technology to address problems that range from simple to highly complex and integrated across multiple platforms. The more complex, the more planning and discussion is required. Planned right, and implemented well, then we see results that start to look like magic: like street lights that have focused beam-spreads that flood the street without intruding into adjacent buildings, and that turn on/off by themselves when vehicles drive up or down the street (without disturbing sleeping residents beside them); like parking apps that tell you where the closest available parking space is and at what price, and that let you pay by phone to reserve it; or like utility planning apps, that can report on the energy use of entire city blocks, helping utility planners to see where electric vehicles are used most, where solar panels are generating most, which buildings are efficient, where brownouts are most likely, where system upgrades are needed, and so much more.

Technology is an ever-evolving set of tools that can help us to address infrastructure challenges that impact our daily lives.

Q. IoT projects are embedded with electronics, software, sensors, actuators and connectivity which enables these objects to connect and exchange

data.

Explain the different roles played by hardware systems and software systems in these networks of physical devices.

IoT is, in many ways, a physical embodiment of ideas that are really not new. Of all the tools that technology can give us, the ones that impress us most are the ones that affect our real-life daily experience, and this is where IoT shines. Some famed examples include things like Amazon buttons, where you can press a button to order more laundry detergent right from your laundry room (billed and shipped in real-time), or a refrigerator that can scan its contents and offer you recipes or meal suggestions.

IoT is ultimately a system or concept built from parts, where software is the brain and hardware is the muscle. Hardware devices (sensors / actuators / electronics) can only do the simple tasks they've been programmed to do. Software uses these devices to make magic happen (from ordering laundry detergent to suggesting a customized grocery list). IoT is the communication and exchange of data that happens between these devices, via clever software: where a 'thing' in your laundry room can tell a 'thing' at the Amazon warehouse that you want to order laundry detergent.

Q. s2e Technologies partnered with Sifton Properties Ltd. to create West 5 Project in London ON - the largest SMART community in North America. Describe the complexities and layers of technologies involved in pulling that project together.

West 5 is an integrated 70-acre community which, when complete, will house over 1600 families and some 450,000-square-feet of retail and commercial/office space in a variety of mixed format buildings from townhomes to towers. This means that the design team has had to consider technologies across a variety of building platforms. The project's objective was to provide all of its own energy needs and to provide a variety of advanced technologies that enable smart living.

Each building presents its own challenges, but there have been some themes: the community is intended to generate its own power, which means that some buildings will need to make up for the needs of others, by hosting extra solar panels over parking, on facades, or wherever they fit, which has raised a number of creative challenges around installation methods in each case. Some buildings will have EV charging areas where vehicles will be shared among multiple tenants/users, and their availability will be scheduled with smart-phone apps. Street lighting will have smart-controls and motion sensing. There will be Wi-Fi available in major public areas throughout the community. Some of the technology used (like Wi-Fi and insulation) is really not going to feel new or exceptionally 'smart', but the way it is integrated across the site, and the scaled impact it has when implemented at that level, is where the real magic is achieved.

Q. As a rule, large scale IoT projects require many developers and designers to make happen. And, yet, plenty of myths still circulate regarding how IoT engineering is done. Describe some of the key issues involved.

This is a fun question. How expensive is a car? How warm is a house? Both questions should evoke more questions - what house? What car? Every house and car is different, and the cost or performance of each varies just as widely as IoT applications and development approaches. The truth is that each application of IoT is, by the nature of the mix of things involved (which varies widely), destined to be unique. But there are some commonalities worth learning from.

Every IoT system is built from the same 4 pillars: (1) sensors/devices, (2) communications, (3) security, and (4) data. IoT lives at the intersection of many disciplines which tend otherwise not to occupy the same space and each of these four terms means different things to people from the technology, construction, logistics and material supply industries, so naturally they see each other's work as a bit of black magic that can create confusion when you combine them all.

Smart community projects must start with a smart plan: the team must determine its strategy on all four items above: (1) what devices they will use to collect what data; (2) how that data will be shared across the internet and with whom; (3) how that data will be kept secure; (4) what information will be processed out of that data and how that information is used to create value.

Every IoT system is built from the same 4 pillars: (1) sensors/ devices, (2) communications, (3) security, and (4) data.

Q. Describe the importance IoT plays in the future development of our cities, as well as manufacturing environments.

When you consider that the average cost of an IoT sensor will be about 40 cents by 2020, and that these sensors will transmit in real time a wide range of data, from the condition of materials in a building after a storm to water quality out of the tap, there is virtually no element of daily city life that can't be datafied. Routines will be deciphered and optimized, abnormal conditions identified before they become dangerous, and so on. All the while, new technologies are developed as the data reveals a gap, a need, a better way.

While the potential for improving city life is exciting, there are some real questions that cities will need to address as this datafication happens, including who has the privilege of access and how the data providers ensure privacy will be protected. IoT alone will not define the great cities of the future. Rather, the pact that a city makes with its citizens about the use of their data may be the defining element of what will be the great cities of the future. **EP&T**

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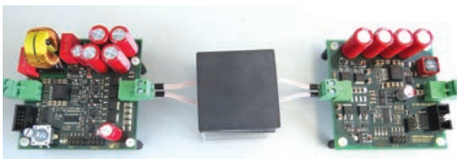

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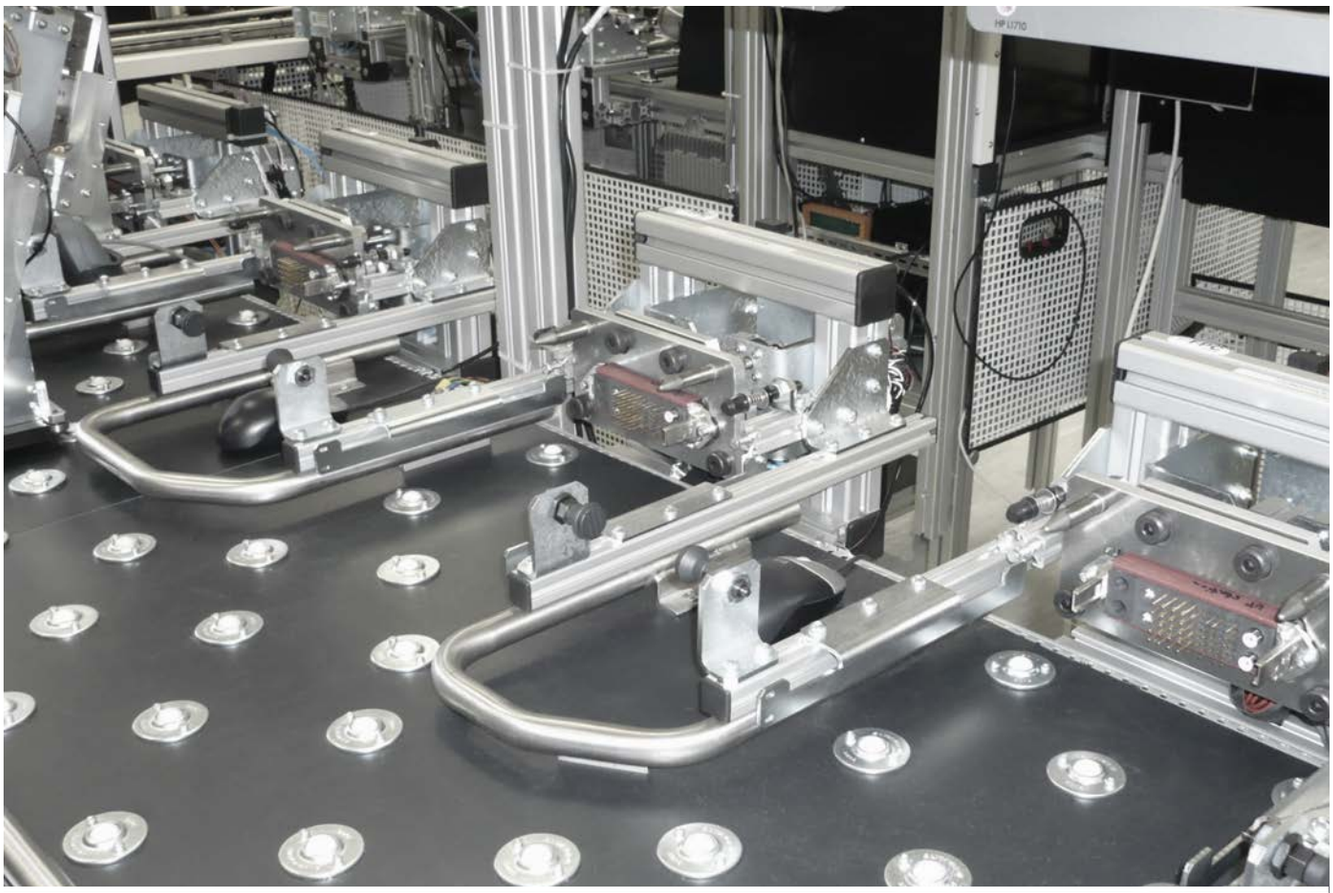

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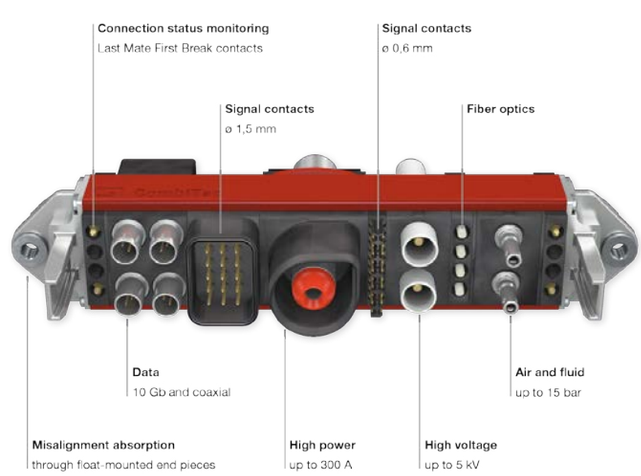

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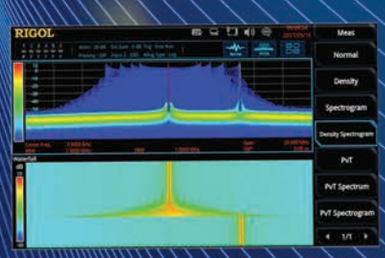

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The performance advantages of 10-bit A/D converters in scopes

BY ANDREAS GRIMM

Today, electronic designs are highly integrated components and are based on various technologies. If you want to measure small parts of signals in the presence of large amplitudes, you need an oscilloscope with a high vertical resolution. Digital oscilloscopes typically have a vertical resolution of 8 bit. But a 10-bit analog-to-digital converter (ADC) has four times more resolution than an 8-bit ADC. You can see signal details much more precisely.

Digital oscilloscopes are essential measuring instruments in electronic research, education and industry. When selecting a suitable oscilloscope, bandwidth and sample rate are often the main factors to consider. Memory depth and usability (including screen size) are further aspects.

In a growing number of applications, more than 8-bit vertical resolution is not only helpful but sometimes also necessary. Besides using A/D converters with a higher resolution, there are several methods available for increasing vertical resolution. Two often-used methods are averaging and high-resolution acquisition modes; both are covered in this article.

10 bits mean four times more resolution

Since their introduction, digital oscilloscopes have been equipped with A/D converters, which typically have an 8-bit resolution. This was mainly because there was no technology available for making higher-resolution A/D converters with the necessary sample rate and low noise. Furthermore, only high-end oscilloscopes commonly use manufacturer-specific A/D converters, while for cost reasons, entry-level scopes usually have off-the-shelf A/D converters. The latter are generally not state of the art.

Today there are A/D converters available with 10-bit or even 12-bit resolution and sample rates, which typically support bandwidth up to 1 GHz. Still, the higher price compared with 8-bit components has up to now prevented their use in instruments with a starting price of less than CAD$8,000.

The new R&S RTB2000 oscilloscopes use the proprietary 10-bit A/D converter that Rohde & Schwarz originally developed for the R&S Scope Rider, the industry's first isolated portable, multifunctional oscilloscope with options such as MSO and serial triggering and decoding of serial protocols.

Using this proprietarily developed component in the R&S RTB2000 makes it possible to achieve a higher vertical resolution compared with oscilloscopes that have an 8-bit A/D converter, while keeping the starting price at CAD$2,000.

Today, because voltage levels keep sinking and power supply efficiency requirements continue to rise, the tolerances when measuring electronic circuits are decreasing. As a result, the more accurate and the higher the resolution for voltage measurements, the better for the engineers. The following table shows the difference between 8-bit and 10-bit resolution. The example calculation for a 1 V signal yields a resolution of around 1 mV for the 10-bit converter. Developers who want to analyze signals of power electronics or who work with high dynamic ranges benefit from the signal measured with a resolution that is four times higher.

To make effective use of these smaller signal details, the oscilloscope must have a sufficiently low-noise frontend. For example, if the oscilloscope had a noise level of 4 mV in the example described above, the higher resolution would not bring any advantage, since it would only digitize the noise of the oscilloscope without revealing extra signal details compared with an 8-bit-based oscilloscope. Therefore, it is important not only to consider the oscilloscope's resolution but also its noise characteristics.

	8-bit A/D converter	10-bit A/D converter
Quantization steps (resolution)	2^8 = 256 steps	2^{10} = 1024 steps
Minimum resolution for a 1 V signal	3.91 mV	0.977 mV

8-bit ADC vs. 10-bit ADC resolution.

Increase vertical resolution

There are different methods for improving the vertical resolution of an oscilloscope, besides using an A/D converter. The two most common ones are averaging and high-resolution (HiRes) acquisition modes.

Averaging of multiple acquisitions

A common method for increasing resolution is the use of averaging. This is typically provided as a math functionality of the oscilloscope. This algorithm relies on averaging multiple consecutive acquisitions. As more acquisitions are averaged, the better the achievable resolution will be. An advantage of averaging is that it also reduces wideband noise, making the representation of the measured signal more accurate. However, there are two important disadvantages of this method:

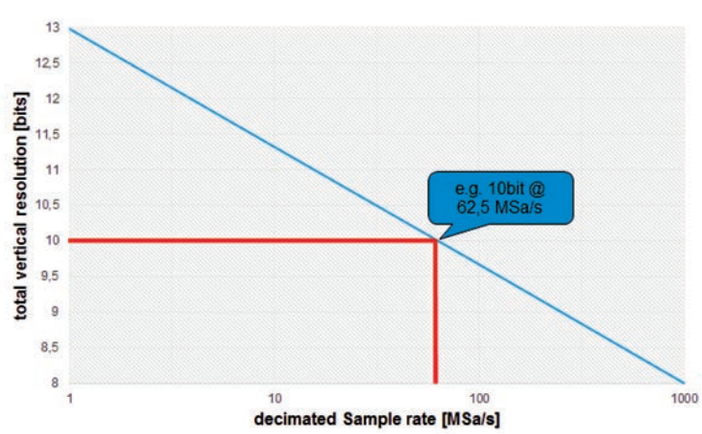
It takes time to acquire and process the data several hundred times to get the required resolution

It only works with repeating signals, such as clock signals.

Most signals do not repeat periodically, however, which means that averaging over several acquisitions cannot be used.

HiRes – averaging a single oversampled acquisition

More and more oscilloscopes support special acquisition (sometimes also called



Vertical resolution enhancement in HiRes mode.

decimation) modes, referred to as "HiRes", i.e. high resolution. This method exploits oversampling, resulting from a higher A/D converter sampling rate than the sampling rate needed for accurate signal reconstruction in line with the Nyquist criteria.

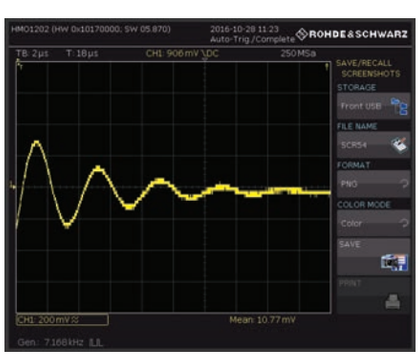
The additional samples are averaged and the resulting waveform is displayed. Since averaging is done within a single acquisition, this method yields higher vertical resolution also for nonrepeating events. Theoretically, the gain in vertical resolution is calculated as as 0.5*ln(N)/ln(2).

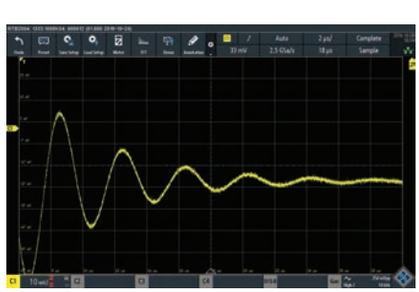
The variable N here represents the factor for oversampling. In order to gain e.g. two additional bits, a factor of 16 is required.

If an oscilloscope has a maximum sampling rate of 1 Gsample/s and an 8-bit A/D converter, it will have a decimated sampling rate of 62.5 Msample/s at 10-bit vertical resolution in HiRes mode. The following graph shows the relation for this example. This calculation reveals lower digital bandwidth as the main drawback using the HiRes mode.

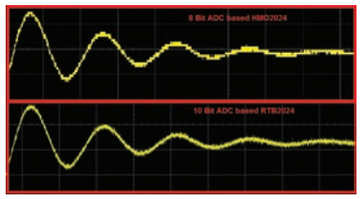
Real-world comparison

After this theoretical discussion of the different methods, the following example will illustrate





Comparison of the R&S HMO2024 with 8-bit ADC and its successor, the R&S RTB2024 with 10-bit ADC.



Zoomed comparison of 8-bit versus 10-bit resolution.

the effect of higher ADC resolution. The test signal used is an exponentially damped sine function, which is a relatively strong pulse with damped amplitude to both sides. This is a highly dynamic signal, and we will examine the small details. A signal of this type is available as a predefined function in many waveform generators, including the built-in waveform generator of the R&S RTB2000.

The signal is connected to a R&S HMO2024, an oscilloscope recognized for its low-noise acquisition path with 200 MHz bandwidth. This oscilloscope uses an off-the-shelf 8-bit A/D converter. The same signal is fed in to the new R&S RTB2000. The unit includes an integrated 10-bit A/D converter.

It is clearly recognizable that the four times higher resolution of the R&S RTB2000 A/D converter combined with the low-noise frontend gives more detailed information and allows more accurate measurements.

If the zoom is set so that vertically and horizontally the same signal segment can be seen in both oscilloscopes, the difference becomes even more visible. On the R&S HMO, you can see the least significant bit of the 8-bit A/D converter, represented by the step-like display.

Conclusion

The vertical resolution of an oscilloscope is becoming more and more important due to new applications with lower voltages and smaller voltage differences.

As this article explains, different methods for increasing vertical resolution are now available beyond the typical 8-bit resolution. **EP&T**

Andreas Grimm, product sales manager oscilloscopes, Rohde & Schwarz

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MS2850A 5G measurement software for firm's Signal Analyzer MS2850A is compliant with the 3GPP 5G New Radio (5G NR) standard. With the software installed, unit provides an accurate solution to verify the RF Tx characteristics of next-generation 5G base stations and mobile devices, as well as satellite communications equipment and wideband communications systems. Software options support analyses of both uplink and downlink signals used by the sub-6 GHz frequencies as well as mmWave bands, such as 28 GHz and 39 GHz, in the 5G NR standard.

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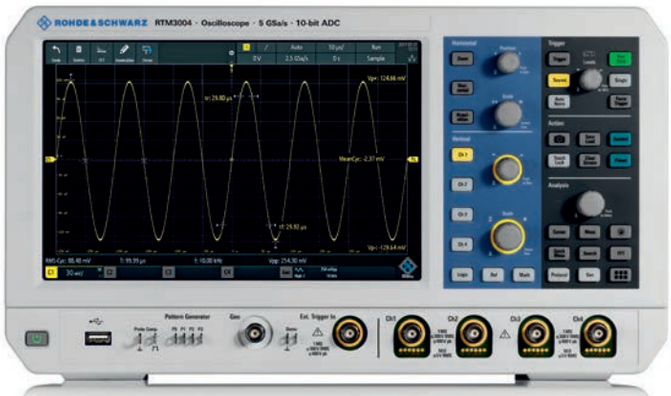

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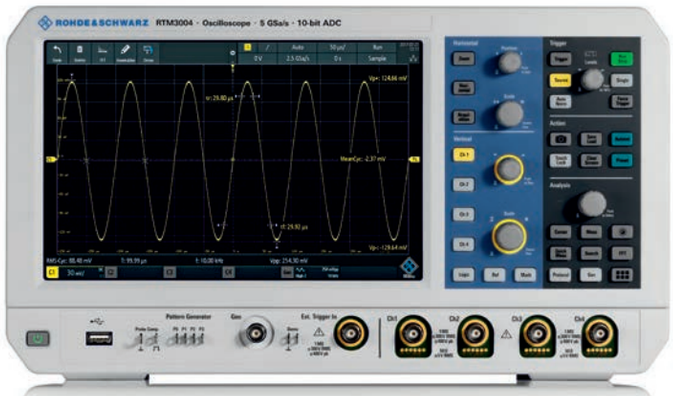

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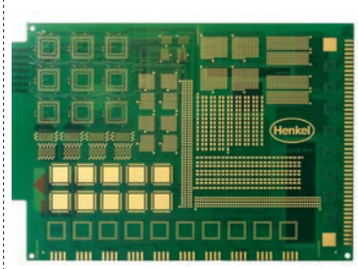

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SCHURTER

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www.schurterinc.com

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Custom fabricator brings drone and camera players together

Nova Scotia-based Protocase delivers on parts and plates

In today's agricultural industry, producers use technology in order to better predict growing systems, assess crop health and deal with extreme weather events. Drones, for one, have become an important tool for agricultural producers looking to capture aerial photography and video of their crops.

Also known as unmanned aerial vehicles, drones aren't actually new technology, having been used commercially in other industries since the early 1980s. However, thanks to new innovations and relaxed regulations, drones are being used more than ever before by agricultural producers looking to work smarter, not harder.

Aiming to corner a piece of the growing market, Minneapolis-based Sentera creates complete photographic solutions for drone equipment, which feature high-tech cameras with ultra-light sensors and specialized software for data analysis. In November 2017, the company debuted its gimbaled Double 4K and Quad sensors, called the Quad Gimbal, which features parts and plates made by Nova-Scotia based custom fabricator Protocase Inc.

Close-up view of Sentera Quad Gimbal mounted on DJI Inspire Drone

A Complete Solution: The Quad Gimbal

Sentera's Quad Gimbal is the company's most powerful camera, with the most advanced sensors on the market. The camera's four lenses allow users to gather data from four different bands of light simultaneously, giving agricultural producers a superior look at their crops.

But, having a camera without a drone doesn't get you very far for aerial photography, of course, which is where DJI comes into play. DJI is the world's largest drone maker, and Sentera designed the Quad Gimbal camera to attach seamlessly to DJI's Inspire 1 & 2 Drones, making it a complete solution for agricultural producers looking for a clear aerial view of their crops.

The Quad Gimbal features, as the name suggests, a Sentera-designed motorized gimbal. Gimbals are a pivoted support system that allows an object to remain horizontal, regardless of the motion around it. This is a crucial piece of the puzzle for effective aerial photography, as instability can easily result in compromised image quality.

As with all Sentera products, the Quad Gimbal for Inspire encompasses proprietary software called FieldAgent Platform, which provides users with a complete look at various data, including weed mapping, population analysis and Normalized Difference Vegetation Index (NDVI) analysis.

"Typically, only our most advanced customers use the Quad Camera, such as university and corporate researchers, as well and industrial and enterprise users," says Ethan Oscarson, mechanical engineer at Sentera. "However, with a new plug and play approach, and an increased understanding of diagnosing problems in the field, the average farmer may soon have a use for this advanced of a product."

Designing the Quad Gimbal

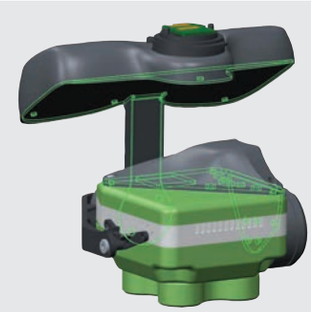
With the overarching goal of ease and simplicity in mind, the team at Sentera wanted the Quad Gimbal to integrate seamlessly with the DJI's Inspire 1 and Inspire 2 drones.

"These drones have a locking mount on the front of the aircraft that DJI utilizes for their

3D view of the Sentera Quad Gimbal

IMU plate highlighted: Mounts the IMU, Ethernet Port to the Camera as well as the camera to the pitch motor

Back Plate Highlighted: Provides a bottom cover for the electronics enclosure, protects against GSP interference and provides cable management.



Quad Gimbal, with Both Protocase-Made Parts Highlighted

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Secure Connections Are Essential

The premier supplier of power system components worldwide, Interpower® presents an innovation of safety and security with Interpower Connector Locks.

To help prevent accidental power interruptions, secure your cord set to a power inlet or outlet with the new Interpower Connector Locks. This system provides the security and stability necessary to help protect your equipment in numerous applications, including medical and information technology.

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internally-manufactured gimbaled cameras," says Oscarson. "Our goal was to utilize this mount in order to give users the option of easily changing out payloads and flying each mission with a payload specific to that mission."

Along with stability, another requirement for the Sentera team was to create a design that was lightweight, as weight can drastically affect flight time.

Oscarson explains that the original Quad Gimbal design was conservatively designed to place the GPS receiver far away from any electronics that could cause interference. The end result in those early prototypes was a much larger unit. But, once Sentera approached Protocase to custom manufacture the parts it required, the iteration proved fruitful.

"With the help of the sheet metal plates by Protocase, we found we could effectively shield any undesired emissions, which ultimately allowed us to shrink the overall size of the product."

Protocase manufactured two key plates for the Quad Gimbal both 5052-32 Aluminum, powdercoated flat black:

IMU Plate (Tilt Motor Bracket): This bracket mounts the inertial measurement unit (IMU) and Ethernet port to the camera, and also mounts the camera to the pitch motor.

Back Plate: Besides providing a bottom cover for the electronics enclosure, this plate also protects against GPS interference and provides cable management.

Custom Manufacturing with Protocase

Sentera's chief mechanical engineer, Ryan Nelson, recommended Protocase to Oscarson, a mechanical engineer who first started at the company as an intern in 2015.

With his work focused on designing solutions that integrate the company's cameras onto drones, Oscarson spends his days designing in CAD (using Creo Parametric), GPS testing, prototyping and, of course, flying drones.

"With all of that prototyping and testing, having responsive suppliers such as Protocase, who can quickly complete custom work exactly to specifications, is crucial to proper research and development," says Oscarson.

"The fast turnaround, quality products and reasonable pricing keep us coming back," Oscarson enthuses.

The Future for Sentera

With the agriculture sector continuing to grow and shift due to market demands and technological advancements, Oscarson is hesitant to predict future projects for Sentera, and how they'll develop.

"The use of drones for agriculture is a relatively new concept, and applications are always being discovered," he says. "At Sentera, we're always trying to innovate and design products to support the grower's needs of today, and also the future." **EP&T**

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greater process flexibility and post-assembly adaptability. Material is a one-part, cure-in-place liquid gap filler allowing use with automated dispensing equipment for high-volume manufacturing operations. Applied as a liquid, the material penetrates small gaps for complete coverage. Once cured, product provides optimized surface contact and thermal transfer with a 1.5 W/m-K thermal conductivity.

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SCHURTER

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Constraint management—rules-based design and verification reduces design cycle time

BY ED CLARK

In a time where deadlines are shortening and designs are becoming more complex, there is no room for error. Specifying rules and requirements upfront in the design process is one way to try and mitigate any future issues—even the simplest of designs have hundreds of rules which need to be managed. In many pcb design tools, these rules and requirements become constraints that guide the process to ensure they are all followed.

Along with increased design complexity, constraint complexity is growing. Most designers are already looking at rules regarding spacing allowances, dynamic phase tolerance requirements, propagation delays, return paths, etc., but as the number of constraints increases, so does the difficulty to manage them.

For example, since differential pair constraints are set in both the physical and electrical domain, if you count all those rules plus any possible delay and match-delay rules, each differential pair can have as many as 13 specific constraints assigned to it. Multiply this by the number of differential pairs in the average design and you can see how overwhelming and difficult it can be to manage and maintain these constraints over time.

Why a Constraint-Driven Design Process?

The manual processes of communicating and maintaining constraint rules and requirements through 'engineering notes,' excel spreadsheets, properties, etc. will no longer suffice and can lead to miscommunicated constraints. This results in errors, causing unnecessary iterations between electrical engineers and layout designers. This process can then snowball the problem, eventually turning into a costly redesign or, at the very least, a lengthy project delay with additional costs. Nowadays, the key to success is to prevent any foreseeable design issues from occurring and to eliminate any other unnecessary design respins. Adopting a constraint-driven, aka correct-by-design (CBD), process can help do this.

CBD is a simple concept: it states that design rules (physical, spacing, electrical, signal/power integrity, manufacturing, assembly, and fabrication) need to be taken into consideration as early in the design process as possible to ensure the engineering design intent is implemented in the pcb design practices. Its main goal is to help identify and fix rule violations when they happen, not after numerous design decisions have been made based on faulty assumptions.

With a constraint-driven process, intelligence is added early in the design phase identifying errors as they happen to guide the process past the pitfalls that can result in a respin.

While setting up and implementing this type of design flow may seem like a daunting task, this single point-of-truth for constraint and process management has been production-proven to shorten design cycle time. In fact, a recent Aberdeen study states companies who implement constraint-driven design more often experience first-turn design success, since it allows designers to identify issues before designs are pushed into production. These companies had 54% better performance on meeting product launch date targets.

In our competitive market, a constraint-driven design approach is no longer optional—it is a requirement for success.

Completing a design using double data rate (DDR) or high-speed designs would be impossible without a robust, constraint management system. In addition, the ability to tune nets directly from the feedback of this system while routing or using an autorouter to follow rules is imperative.

Cross-probing, the ability to mark errors to be fixed or waived, or the ability to tell if the error is okay from an engineering, assembly, or manufacturing perspective is not only critical, but a requirement.

Often, chip and board vendors will supply topologies and rules in ECAD formats, but if the design dictates a change in the form factor, the designer will need to do constraint development himself.

In figure 1, the tabs on the left side of a constraint manager (the highlighted red rectangle) shows the 'Electrical' tab is open. Notice how everything is organized, very efficient, and easy-to-use. This makes the difficult process of managing the complexity simple and is the key to productivity and first-spin design success.

To the right of the electrical tab is a spreadsheet of the constraints. It shows some of the DDR3 constraints required for this design and defines each constraint. In this case, it shows a matched group of signals (Bank0) that had to be length-matched (it could also be defined in time—pS) to strobe line within 25 mils. The red highlighted text fields on the right side shows two columns: Actual (routed length) and the Margin (of error). The values are shown in red because the traces have not met their respective constraints.

Intelligent Constraint Development and Implementation

During the development process, to create the constraints needed to achieve a design with sound signal quality in addition to completing any other design requirements, you must be able to do a graphical constraint definition in the schematic or before the net is routed.

A unified and integrated approach to visualizing and simulating the circuits to create the proper impedances and matched

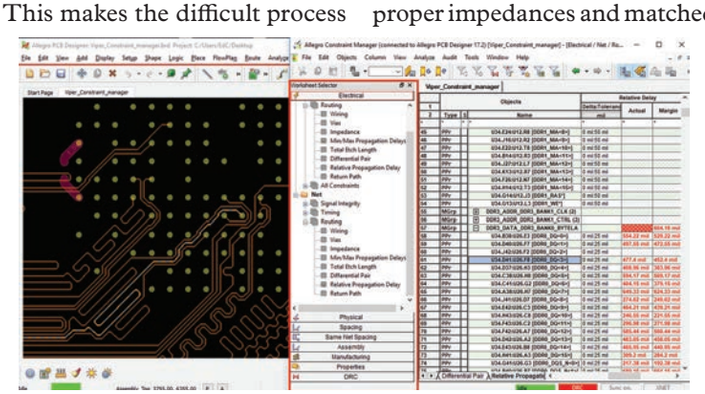


Figure 1: The constraint manager keeps everything organized, very efficient and easy-to-use.

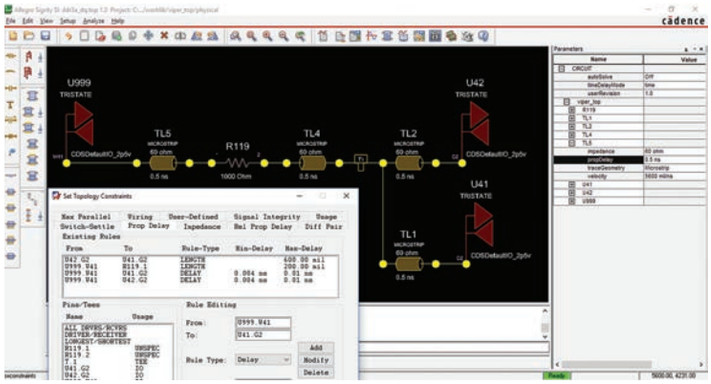


Figure 2: This shows the characterization of a digital signal going from one driver pin to two receiver pins.

delays (relative prop delays, lengths, and topologies) is of critical importance for the design to perform "correctly by design" such that the design intent and IP are maintained, implemented, and verified in real-time.

As the adage goes, Garbage in = Garbage out. In the design world, 'garbage out' equates to design respins. Therefore, it is critical to have the proper constraints in place as well as an advanced stackup editor which includes impedance calculators (single-sided and differential) that can easily be stored and reused in a single technology file.

The accuracy associated with these impedance calculations can help ensure manufacturing accuracy and assures signal quality. Figure 2 shows the characterization of a digital signal going from one driver pin to two receiver pins. The simulation will show the effects of the series termination resistor, routed topology, length, and impedances of the segments.

It is very important to note that all these elements can be swept over ranges of values to find the perfect solution space for this design's intended application and mitigating other issues like electromagnetic interference (EMI). Simulation allows a designer to correctly constrain a net, like the one shown, without over constraining it.

It is also essential for a Constraint Management System (CMS) to be stackup aware. Since the pcb stackup plays a major part in the design process, repeatability and accuracy describing the pcb stackup with accurate representation of the materials and rules are essential to a CBD workflow.

Every design will have design rule violations; however, depending on the design density, the number and types of design rule check (DRC) violations can quickly become overwhelming, requiring weeks to check each one (or take the risk of a fatal design flaw). What is critically important to manage is the spacing, physical and electrical rules, and violations (DRC Errors).

These errors must be managed in such a way that the designer can easily cross-probe the issue and either fix or waive it in a managed way. Without a centralized, unified CMS this is nearly impossible.

DRC markers on the pcb layout provide a good feedback mechanism to the pcb designer and keeps them aware of problems as they arise. However, a single move of some copper can cause an avalanche of DRCs, making it difficult to see which to address first. The CMS provides a nice overview and allows cross-probing between the design and the constraint violations to easily pinpoint the problems.

Developing a good set of constraints can take a fair amount of design time, but hopefully it is now clear that the follow-on time savings and error-avoidance far surpass the initial effort. In addition, a good CMS can provide one more big time and error saver: it can save and load constraints. All the effort you put into constraint development will continue to pay dividends in future designs. Obviously, all designs are different and will require their own level of constraint development, but there is also commonality. For example, if several designs have DDR3 busses in them, then reusing all that up-front work makes the next DDR3 design easier with pre-created, pre-vetted constraints.

What to Look for in a Constraint Management

When looking for a constraint management system, be sure to ask yourself the follow questions:

1. Does the system understand engineering rules required for layout and manufacturing? Can it pull rules from multiple sources?

- A robust CMS will be unified and integrated into the schematic and layout editors with cross-probing including:
- Integrated graphical topology-driven constraint definition, simulation, and application
- Length or time-based constraints
- Full suite of electrical constraints with custom formula capability
- Robust physical and spacing rules (class to class rules)
- Regions rules for spacing and physical constraints
- Same net DRCs for advanced technologies (HDI)
- Impedance rules (checking for nets crossing gaps in the planes or voids)
- Manufacturing rules
- Assembly rules
- Fabrication rules
- A robust stackup editor with board material and loss tangents
- Integrated field solvers and extraction
- * Lossy frequency dependent transmission line pre/post route simulation and extractions
- Via modeling and extraction

2. Can the system easily communicate design intent amongst various team members?

Most constraints are known or discovered during the initial design creation—when the design is being captured in a schematic. It is therefore best to be able to define those constraints during the schematic phase. Then they need to be available during pcb layout, when most constraints are used. However, some constraints are determined during layout, so those need to be documented as well and made available to those working on the schematic.

3. Can the system check your design for errors and provide feedback in real-time?

The main idea behind setting constraints upfront is to help ensure the design is going to function as expected. Therefore, it is important that the system can alert the designer to any errors as they occur, so no progress is accidentally made based on bad design. Think of the constraints like the bumper cars at a carnival: sometimes the cars are hard to keep straight, but the bumpers on (the CMS) are there to help bring (the design) back on track quickly.

4. Is it flexible/easy-to-edit?

Who wants to replace one arduous task with another? Having a CMS that is flexible and easy to work with is essential to a successful implementation. Best CMS systems will allow designers to manage constraints directly within the CAD environment, allowing teams to get up and running quickly.

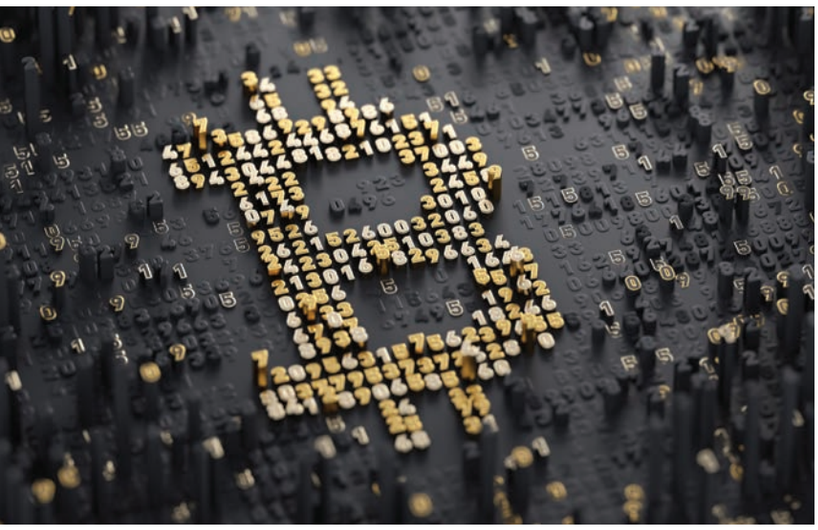
5. Are the embedded constraints and rules reusable?

While a team's designs are not all the same, there might be some constraints or rules which can be applied to multiple designs (i.e., electrical rules). To save time and reduce errors, it is imperative that a CMS allows for the reuse of these assets.

Preparation = Success

When constraints are done in the beginning of the design process, designers can be confident knowing once the design phase is done, it will move through the other phases with fewer or no errors requiring redesign. A CMS that can check work in real-time, as the design process is executed, provides reduced risks and the peace of mind that once board routing starts, the constraints will keep the board designer from violating any of the rules set up front. **EP&T**

Ed Clark, *business development manager, EMA Design Automation Inc.*



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KONTRON

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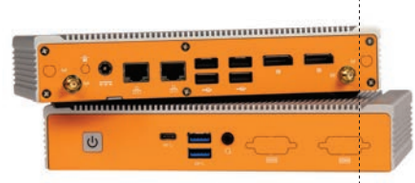
www.logicsupply.com/ml350



FPGA PROGRAMMABLE PLATFORM COMPRISES LOGIC, ROUTING, EMBEDDED MEMORY

EFINIX

Trion programmable platform in FPGA architectural innovation was built using firm's Quantum programmable technology, comprising logic, routing, embedded memory and DSP blocks. The first eight FPGAs in the Trion platform are built on SMIC's 40nm process.

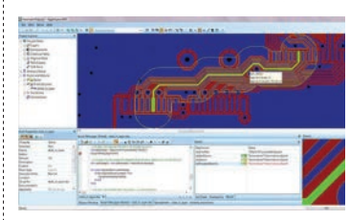
Products range from 4K to 150K logic elements (LEs) and support standard interfaces such as GPIO, PLLs, oscillators, MIPI, DDR, LVDS, among others.

www.efinixinc.com

PCB DESIGN VERIFICATION SOFTWARE FLAGS EMI/EMC ISSUES

MENTOR GRAPHICS

HyperLynx Design Rule Checking (DRC) printed circuit board (pcb)



design verification software rapidly identifies design issues affecting EMI/EMC signal integrity and power integrity. Product provides fast, comprehensive electrical design verification to all pcb layout persons, hardware engineers and SI/PI/EMC experts, regardless of their layout tool or level of expertise. Product's automated approach can be used iteratively, to identify design violations that lead to signal integrity, power integrity, and EMI/EMC issues, eliminating manual inspection and pcb cycle bottlenecks.

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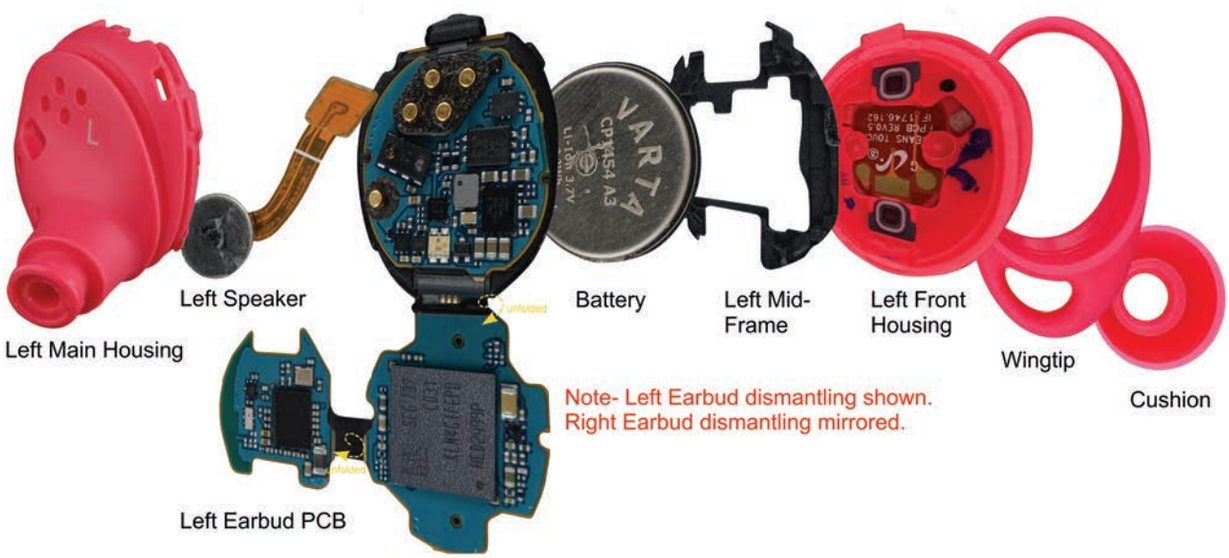
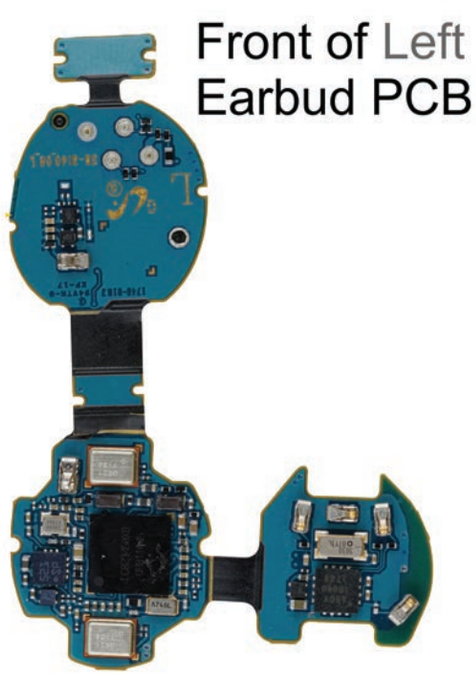
Samsung Gear IconX 2018 gears up its game

2nd generation betters Bluetooth & boosts battery

BY JIM MIELKE, VP TEARDOWNS, ABI RESEARCH

ABI Research has been tearing down products since 2011. Wearables were added to the teardown service in 2013 when wearables were still a nascent market. When ABI research tore down the Samsung Gear IconX back in 2016, we were impressed by Samsung's first foray into the truly wireless earbuds game but were underwhelmed with a few of the technical aspects. With the introduction of the Gear IconX 2018, Samsung has focused on the first-generation misses with improved battery life and better wireless performance. The look and style may be similar, but Samsung made many changes inside and out. Here is ABI Research's cross comparison of the Gear IconX and the Gear IconX 2018:





Connectivity and Battery

Samsung stayed with Broadcom for the connectivity integrated circuit but transitioned from the BCM43436 to the BCM43013. The BCM43013 uses a smaller process node than its predecessor and thus draws significantly lower power (1/3 power in some cases). This is one enabler for the improved battery life experience of the IconX 2018 *vs.* the prior version- improving from 1.5hr of streaming to 5hrs. The other key enabler is the increased battery capacity. The IconX 2018 sports an 85mAh battery whereas the original IconX drew from a 50mAh battery.

Sensors

All the sensors changed suppliers in the new version of the IconX. The mem microphones (2 per earbud for a total of 4) were previously purchased from Knowles but the 2018 version switched to Goertek. The accelerometer used in the IconX 2018 is a Bosh BHA250 whereas the prior IconX used a STM LIS2HH12 accelerometer. Lastly the ADI heart rate sensor was eliminated completely but Samsung added a proximity sensor purchased from Sensortek (STK3013).

Audio and Power management

Above continues to supply the MC80F1604 touch controller for the touch controls on the earbuds while On Semi's LC823450 audio processor maintains the audio functions. The main difference in the audio/power management section of the earbuds is the addition of Maxim's PMIC (Power management integrated circuit). The Max77650 supports the charging, regulations and LED driver functions.

Memory

The 4GB of eMMc Nand flash is Samsung's own KLM4G1FEPD in both models of the IconX.

Charging Base

The charging base for the IconX 2018 has some mechanical changes along with a change in the MCU controller. The original IconX used an Abov MC96F8316 8b MCU while the new IconX 2018 uses a 32b Arm Cortex M0+ MCU from STM- ST-M32L072RBH6.

These findings are from ABI Research's Teardowns (https://teardowniq.com/).