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DRONE ALONE

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High tech competes for acclaim at Olympic Games



Faster higher stronger ... and accelerated by tech?

That seems to be what athletes and spectators experienced

during the recent Winter Games held in Pyeongchang South Korea, as we were not just getting to watch the ultimate showdown in winter sports, but also witnessing the most high-tech Games in history.

Major companies like South Korea's own Samsung, LG and Hyundai along with American multinational Intel delivered some cutting-edge innovations for the global event, including self-driving cars, virtual-reality viewing stations and super-fast video streaming. Intel started things off by orchestrating a record-setting performance of 1,218 Shooting Star drones flying in sync during the opening ceremonies. The Intel-backed

UAVs also provided broadcasting, entertainment and security services.

At the helm of it all was 5G, the wireless network technology that mobile carriers around the world have been racing to adopt. The games were broadcast on the 'world's first' 5G network, with transmission speeds near 1,000 times faster than existing long-term evolution (LTE) networks. Serving as somewhat as a testing ground during the event, the 5G network is expected to revolutionize the broadcasting industry - capable of delivering massive data needed for virtual reality (VR) or hologram services.

Samsung ran simulated snowboarding and cross-country skiing competitions for fans, as well as providing the most widespread use of 360-degree virtual reality (VR) cameras of any major global sports event.

Promoting its artificial intelligence (AI) advances to the world, talking robot guides were

positioned throughout the airport and event venues to assist with directions, game details and tips for tourist, all while speaking English, Chinese, Korean or Japanese. Transportation between event venues was handled by Hyundai's self-driving buses.

Leading edge tech was taken right down the athletes themselves - at least during the training processes. Take for example, Dutch speed skaters that wore high-tech haptic suits, which constantly monitored their body positions, allowing coaches to recommend minor adjustments by vibrating different portions of the suits while the athletes were wearing them.

U.S. skiers trained with headsets that administered transcranial stimulation, which are small, targeted currents of electricity delivered to the brain's motor cortex. The headsets supposedly help increase the effectiveness of training and make it easier for athletes to build new skills.

Tech may very well leave a lingering impact now the Games are done, as some political observers suggest the Olympic Village of Pyeongchang could be converted into a Smart City, where cars can send real-time data to traffic lights and display boards can transmit information people are looking up on their phones.

Already known as a booming tech hub, South Korea did manage to impress its visitors with cutting-edge innovations. As the world's fifth biggest exporter and 10th-largest economy, the Asian nation is home to 50 million people and a base to many emerging tech giants - most of which should benefit from the global exposure. **EP&T**

STEPHEN LAW
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AUTONOMOUS CARS SHINE AT AUTOSHOW



The world in which automobiles drive themselves may be closer than most of us thought?

Certainly something that is forecasted in the future, although the timeline is mere speculation because there are various levels that need to be reached before automobiles can truly drive themselves without any human assistance.

It all made for an interesting discussion during a panel discussion amongst auto industry peers during the Canadian International AutoShow in Toronto recently.

Panelists agree that the first wave of vehicles in this new era of automation will happen in the next few years and will be something representing partial automation and conditional automation. Automobile manufacturers are spending hundreds of millions of dollars in research and development, either on their own or in partnerships with technology companies, developing systems to become the first in line to deliver autonomous cars.

Governments are also investing heavily in autonomous vehicle research. The Province of Ontario announced in 2017 an allocation of \$80 million for an Autonomous Vehicle Innovation Network and designated Stratford as the hub of it.

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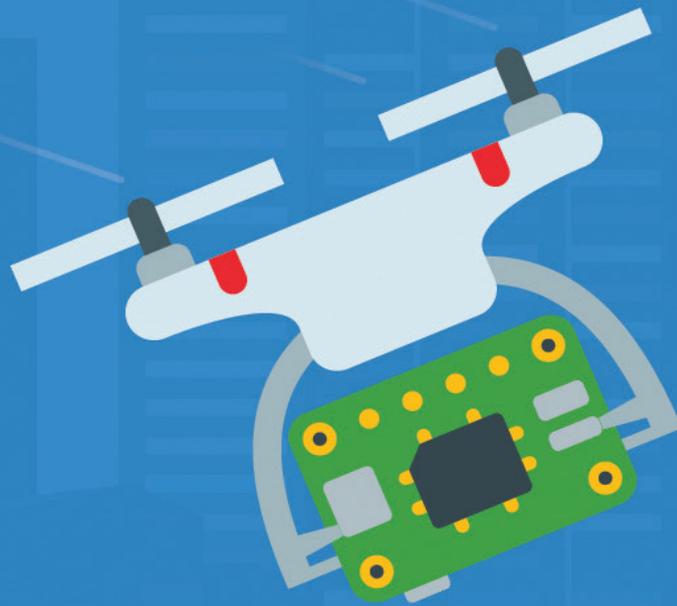
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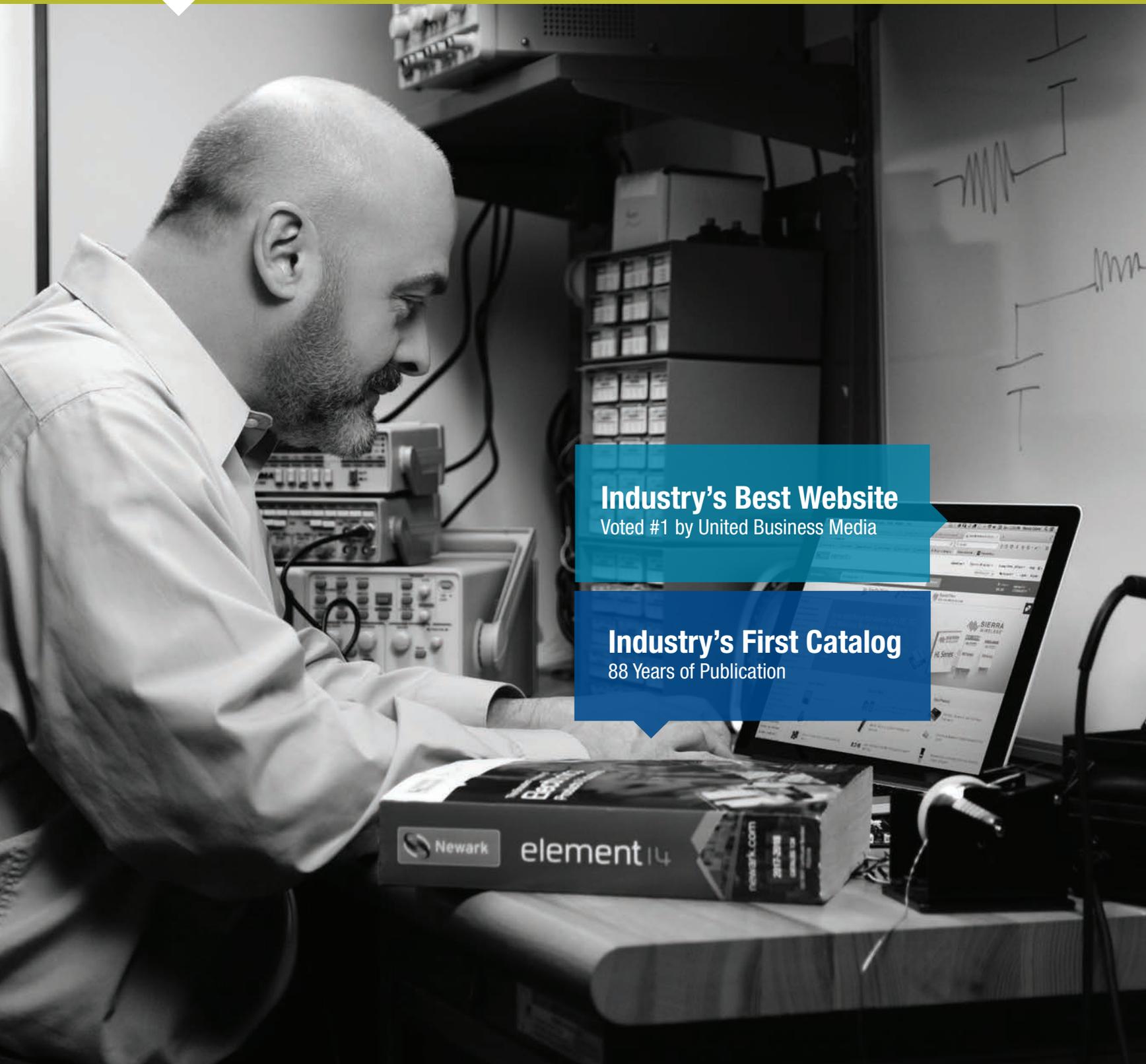
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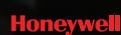


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NEWSWATCH

FLEXIBLE, HYBRID ELECTRONICS

TORONTO TO HOST FLEXIBLE, HYBRID ELECTRONICS EVENT

The intelliFLEX Innovation Alliance will host CPES2018, a conference and trade show exhibition for flexible and hybrid electronics (FHE), from May 23-24 at Centennial College's Conference Centre in Toronto.

"This event boasts an impressive roster of sponsors, partners and exhibitors," says Peter Kallai. "We are working hard to spread the word and secure the partnerships across our industry ecosystem."

Since last year's event, intelliFLEX has rebranded and redefined its focus to support its diverse members. This will be reflected in the agenda, as the event explores all facets of FHE, including flexible, 2D and 3D printable, wearable, stretchable, smart textiles and flex-integrated circuit technologies, software and applications.

Building on the success of last year's start-up mentoring and pitch sessions, CPES2018 will again feature an investor panel, as well as a new launch pad program for startups to demonstrate their products. More than 150 organizations and 200 attendees are expected, with industry-leading speakers and keynotes from around the world. This will of course include many intelliFLEX member organizations that are working on a wide range of solutions to power the latest innovations.

In addition to two days of technical programming targeted at academics, FHE industrial companies and end-use companies, CPES2018 will feature 20 industrial exhibitors, up to 10 startups, 15 university and college technical posters and master classes. intelliflex.org/cpes2018

TEST & CERTIFICATION

TÜV SÜD OPENS PRODUCT TESTING LAB IN KANATA

TÜV SÜD, Newmarket ON, a global provider of testing, auditing, inspection and certification services, has opened a new regulatory compliance testing lab in Kanata ON. The high-tech facility will serve for safety, electromagnetic compatibility, wireless and NEBS (Network Equipment Building Systems) testing.

An experienced staff of 12 will work within the 23,000-square-foot lab that provides wireless and EMC testing utilizing 10 meter and 3 meter ambient free semi-anechoic chambers.



CPES2018 conference & trade show for flexible and hybrid electronics on May 23-24 in Toronto.

Environmental, power and safety testing is also available with upgrade equipment. Expansion of its wireless testing capabilities is planned.

WEARABLES

MYANT LAUNCHES SKIIN SMART CLOTHING PLATFORM

Myant Inc., a Toronto-based innovation hub for designing wearable tech products, launched its SKIIN smart clothing platform in January.

SKIIN is a digital intelligent interface designed to connect the wearer to "self, others, IoT and AI," according to Myant founder and CEO Tony Chahine. Designed to interact with the 'age of information', SKIIN textiles provide a bidirectional connection between the user's body and the world around them. Like a second skin, this new textile computing platform can read, record, analyze and respond to the user's needs.

"We wanted to create an ambient interface to provide access to the marginalized segment of the population, like children and some elderly people," says Chahine. "We believe that the advancement of technology should revolve around humans. SKIIN was created with that idea in mind."

Chahine says the launch of SKIIN represents a paradigm shift as the comfortable form factor will profoundly affect many industries. In Healthcare, for example, SKIIN can deliver increased compliance - opening up the possibilities of remote monitoring and virtual therapy, or by simply allowing for continuous and anticipatory data. The automotive, aerospace, insurance and financial industries will also benefit from this

new digital presence, according to Chahine.



Myant's smart underwear line SKIIN.

SKIIN products are designed with a diverse sensor and actuator mix that enables the wearer to gain 'holistic insight' into their physical and mental state. SKIIN is the first product that, being comfortable and washable, is truly wearable. This will allow for the option of a 24-hours a day, 7 days a week connection.

The SKIIN smart underwear and bras are designed with six sensors that allow the wearers to comfortably track daily activity, sleep and stress levels - operating as IoT devices.

CEM ACQUISITION

CELESTICA TO ACQUIRE ATRENNE INTEGRATED

Celestica Inc., a Toronto-based multinational electronics manufacturing services (EMS) firm, is seeking to acquire Atrenne Integrated Solutions Inc., New Hope MN.

Atrenne is a designer and manufacturer of ruggedized electromechanical solutions serving multiple markets, primarily for military and commercial

200

attendees representing FHE, including flexible, 2D and 3D printable, wearable, stretchable, smart textiles and flex-integrated circuit technologies, software and applications.



aerospace applications. Atrenne's integrated solutions serve a full spectrum of next-gen, mission-critical applications in Mil/Aero programs Headquartered in the US, Atrenne has two US-based, ITAR-certified sites (Brockton MA and New Hope, MN) plus Xiamen, China.

AI FORUM

MONTREAL TO HOST AI FORUM THIS SPRING

Aiming to bring together some of the most important players in the artificial intelligence (AI) industry, C2 Montréal and Element AI will join forces to host the 2nd edition of the Artificial Intelligence Forum. The event will take place from May 23 to May 25 at the Arsenal

in Montreal.

The forum will look at the vast potential of AI, while exploring the possibilities it harbors for the future. This year's conferences and panels will cater to company executives and leaders who want to leverage artificial intelligence as a business solution, those who want to better manage AI's impact on their existing resources, as well as those who strive to dig deeper into their understanding of this new technology.

DISTY PORTAL

ELECTRO SONIC LAUNCHES CUSTOMER WEB PORTAL

Electro Sonic, Markham ON, a leading Canadian distributor of electromechanical, interconnect and passive components recently introduced a new customer web portal access. The web service provides customers with immediate access to price and availability on more than 1-million part numbers.



"With our new web portal, customers now have an additional hassle-free tool to communicate with our sales team," says Niall Flanagan, national sales manager, Electro Sonic. "The vast functionality will allow them to price quotes, schedule orders, request RMAs and expedites."

In addition, the customer web portal provides the ability to view orders, tracking information and invoices, view contract and discount pricing, as well as visibility on bonded inventory. In 2016, e-sonic.com went through a make-over which included predictive search / autocomplete, 'quick buy' from search results, as well as featured products.

ISO STANDARDS

ADVANCED INTERCONNECTIONS TRANSITIONS TO ISO 9001:2015 STANDARD

Advanced Interconnections Corp. (AIC), manufacturer of PC board connectors and semiconductor sockets, has received a successful recertification of its quality management system to the newest ISO 9001 Standard, which is focused on consistently meeting customer and regulatory requirements, while striving for process improvement and risk abatement. **EP&T**

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In conversation with **DAVE KROETSCH**, co-founder and chief technology officer of Aeryon Labs

Blend of engineering talent keeps Waterloo drone maker in top flight position



Aeryon Labs Inc. is trusted by military, public safety and energy customers around the world for small

Unmanned Aircraft Systems (sUAS) and end-to-end solutions that deliver life and resource saving, actionable aerial intelligence. Headquartered in Waterloo ON, Aeryon's industrial-grade, field-proven sUAS solutions are used across a wide range of applications.

The Aeryon team has a broad range of experience in fields including: computer and electrical engineering, video processing, digital video compression, telecommunications, mechanical and mechatronic system design and software development – as well as knowledge and expertise in robotics and image compression.



Describe the process of managing all of those engineering disciplines under one roof.

Just as it takes many systems functioning in unison to enable a drone to

fly in some of the harshest environments on the planet, it also requires many engineering disciplines working well together to design and build a reliable, high performance, technically complex aircraft.

Aeryon Labs has an architect assigned to each technical development area who is responsible for its subsystems on Aeryon's aircraft. They ensure that their subsystem meets all of its objectives and requirements without adversely affecting other subsystems. This group of subsystem architects, along with a Chief Architect, work together to ensure product design and development schedules align. In many ways, building a drone has the integration complexity of building a cell phone. Keeping systems small and lightweight, drives the need to build many subsystems from scratch, as opposed to using off-the-shelf modules. This requires Aeryon to have subject matter experts in various fields and specialties.

Aeryon balances the rigor of building a high-performance Unmanned Aircraft System while trying to remain nimble in



order to keep pace with the development of advanced component technologies and consumer drones.

What are some of the biggest challenges related to retaining and attracting the strongest engineering team in such diverse design areas?

Building a drone requires touching almost every area of engineering – software, AI, computer vision, mechanical engineering, aerodynamics, electrical design and of course the manufacturing engineering capabilities that bring a product to life. Given the advanced nature of the product, it also means that Aeryon needs some of the brightest minds in each design area. We, of course, need to focus on the culture to ensure Aeryon is an enjoyable and rewarding place to work. But, what really helps attract and maintain such brilliant minds is the autonomy we try to give developers to build the best product they

Aeryon Labs co-founder and CTO, Dave Kroetsch

can and the mastery of their field they can show by pushing the bounds in their fields of interest. It also doesn't hurt that our drones are used for some pretty amazing and meaningful applications.

In 2017 Aeryon Labs Inc. was recognized by The Globe and Mail and Mediacorp Canada Inc., the organizer of the 4th annual Canada's Top Small & Medium Employers competition, as one of Canada's best workplaces among small and medium enterprises. Aeryon was recognized for its forward-thinking human resources policies, including its health spending account that provides greater flexibility and tax-free savings for qualified medical expenses. Our talented and diverse team continues to grow, and we will continue to strive to retain and attract the best and brightest minds."

What level of interest in robotics did the founding partners have prior to

forming the company.
Aeryon had 3 co-founders – Dave Kroetsch, Mike Peasgood and Steffen Lindner, each of us were passionate about robotics

prior to forming the company. The beginnings of Aeryon were borne out of academic robotics competitions run by the Association for Unmanned Vehicle Systems (AUVSI). Since the early 1990's, these competitions focused on pushing the development of unmanned air, ground and water robotics technologies. I began competing in these AUVSI student competitions in 1996 and Mike joined in 2002.

We worked together at a Waterloo startup called PixStream, designing digital video systems for the TV broadcast industry. This laid the foundation for how we would approach the drone robotics biz. Coming from a high-tech, enterprise-grade background – as opposed to many other drone companies that evolved from either the toy market or military industries – Aeryon took a unique approach to building its products. The team knew their products needed to be easy to use and deploy at scale. This led us to developing and delivering a digital encrypted network that could fly multiple drones.

1996

is when Kroetsch began competing in these AUVSI student competitions.

Describe the growing importance robotics and automation play in the future of all tech design.

As corporations and the defense industry recognize the value in safety, efficiency and cost effectiveness of robotics and drones, we believe the demand will exponentially increase. We will continue to see robotics replace humans in many dull, dirty and dangerous operations in the future. This begins by being an extension of a human – a remote control set of eyes or hands to get a

Building a drone requires touching almost every area of engineering – software, AI, computer vision, mechanical engineering, aerodynamics, electrical design and of course the manufacturing engineering capabilities

job done. Humans are, in many ways, limiting the capability of these remote robotics. These machines are often capable of moving faster and more precisely than humans are able to control them, while not requiring sleep or breaks for meals. They are able to generate far more data than their human operators can consume.

This is where autonomy and AI come to play. As machines become more autonomous, they will be able to carry out much of their mission requirements without human intervention, and only involve humans for critical decision making.

We're already seeing this come to pass with drones. For example, Aeryon began by making simple remote-control drones, which have evolved over the last decade to drones that are automatically able to map an area, track a target with the camera or automatically come home in case of a malfunction. These capabilities will expand to include on-board AI that can recognize things and automatically conduct missions.

Describe how every element of Aeryon Labs' business is growing - including its manufacturing and/or R&D.

Aeryon is growing every area of the business, from customer support to manufacturing, as the markets increase their adoption of drones. The past few years saw customers trial a small number of drones to demonstrate the applicability of drones to their missions and prove the utility of Aeryon's aircraft. These

trials have matured into large deployments, which has put growth demands on the business. In the last 12 months, Aeryon has opened 2 offices in the US, added sales and support staff in several international geographies and is in the process of adding local manufacturing capabilities in its major markets.

More customer deployments drive more customer requirements. Aeryon prides itself on being able to deliver rapid solutions development through a hands-on, agile team that

is able to quickly respond to customer requests. This has led to an expansion of R&D to fulfill these customer requests – customized payloads, software features and system integrations. The product team is also busy innovating. We're always working on our next-generation aircraft and expanding the team to build systems that are even more autonomous.

Q. Describe the breadth of your customer base, not just by sector, but geographically.

Aeryon has customers in over 35 countries, covering 6 of the 7 continents. While the company was founded with the intent of bringing drones to the commercial market, the company has experienced the most growth in military markets, with over 20 militaries possessing Aeryon products.

As regulations enabling non-governmental use have opened up domestically, we're seeing our public safety and energy market customers expand their use of drones. We are also seeing experimentation with consumer drones culminate in the need for industrial-grade aircraft – and this is where Aeryon excels.

How important is it to be Waterloo-based and does it help remain relevant and accessible to potential hiring talent.

When evaluating locations to start the company, Waterloo was a natural first choice. The University of Waterloo has created a fantastic

technical talent base from which to draw and Aeryon has made heavy use of the Engineering departments co-op intern program. I (Dave Kroetsch) earned my BSc and MSc in Engineering from the University of Waterloo. The university has an 'enterprise-minded' DNA, which has served the company well.

BlackBerry also drew a large number of world-class engineers to the region and as those people seek new employment, Aeryon has been able to draw on that amazing talent very close to home. In many ways, a drone is a lot like a phone - replace the touch screen with propellers, and the rest of the technologies and challenges in design and manufacturing are the same.

Being based in Canada has also been of benefit from a regulatory perspective, as Canada has a more permissive export regime than the US, and for years had more permissive access to airspace for drone users and developers.

Detail the importance of manufacturing product in Canada.

Production in Canada is a strong selling point for many international customers. Aeryon's products are not encumbered by US ITAR restrictions, like many other military drones, and Canadian technology and companies are very well received worldwide.

As many high-volume, low-tech jobs have moved overseas, what has remained in Canada is high-tech, high-quality manufacturing. Aeryon is able to benefit from this trend and makes extensive use of local manufacturing companies for its components. By maintaining control of final assembly and in-house testing at our facility in Waterloo, Aeryon can ensure product quality as well as a tight control on intellectual property.

Does the firm currently have room for expansion and what are some targets or goals for the next five years?

Aeryon continues on a high-growth trajectory – expanding revenues and expanding geographically. The company has also moved from a hardware-focused company to a series of software offerings integrated with our drones as well as others.

Our 41,000 sq. ft. facility is bursting at the seams and the company is looking to grow our



SkyRanger sUAS with Military Operator



Aeryon SkyRanger drone in Flight



Transmission Line Inspection

presence in Waterloo. We have also opened offices in Boston, Salt Lake City and Denver, where our Aeryon Defense subsidiary is located to better serve our U.S. Department of Defense customers.

We also see opportunity for expansion of the company's product lines to include even more autonomous capability and AI technologies, which will allow one operator to command multiple drones at one time.

Q. What do you feel were some of the key or strategic events that occurred early on to help establish Aeryon Labs as a leader in the global UAV market?

Approaching our markets with a ready-to-fly solution that was focused on reliability and ease-of-use was a key strategic difference in Aeryon's approach. While this may seem obvious now, it was definitely innovative in 2007. Because of the team's experience in enterprise markets and networked digital technology, our product architecture was years ahead of the competition.

An early tradeshow with the

product in Amman, Jordan was also very influential in the company's direction. While Aeryon was established to bring drones to the commercial market, an early partner took the product to an international military show.

Aeryon's approach resonated very well with this customer base, and Aeryon followed these opportunities into international military markets. This allowed Aeryon to grow and flourish, while waiting for domestic public safety and commercial markets to open up and mature.

We strive to support our Military, Public Safety and Energy customers around the world, providing small Unmanned Aircraft Systems (SUAS) and end-to-end solutions that deliver life and resource saving, actionable aerial intelligence. **EP&T**



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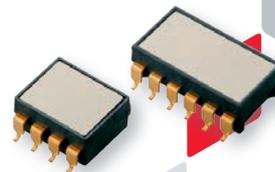
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Biggest pitfalls of designing power systems?

Engineers share their top problems that hamper power system design **BY VICOR CORP.**

→ Today, engineers are asked to find creative solutions to deliver more power from less space and with higher efficiencies. This makes power-system design an increasingly important part of developing technologically-advanced electronic equipment. Research by Vicor found that these engineers are facing a myriad of challenges meeting cost and schedule targets.

The research found that power-system developers around the globe perceive the biggest challenge to be changes in specifications for the power system during development. Although it may be surprising that this was the biggest problem, rather than technical challenges associated with meeting the system's requirements, in fact changing specifications make it even harder to deliver a project on time and on budget.

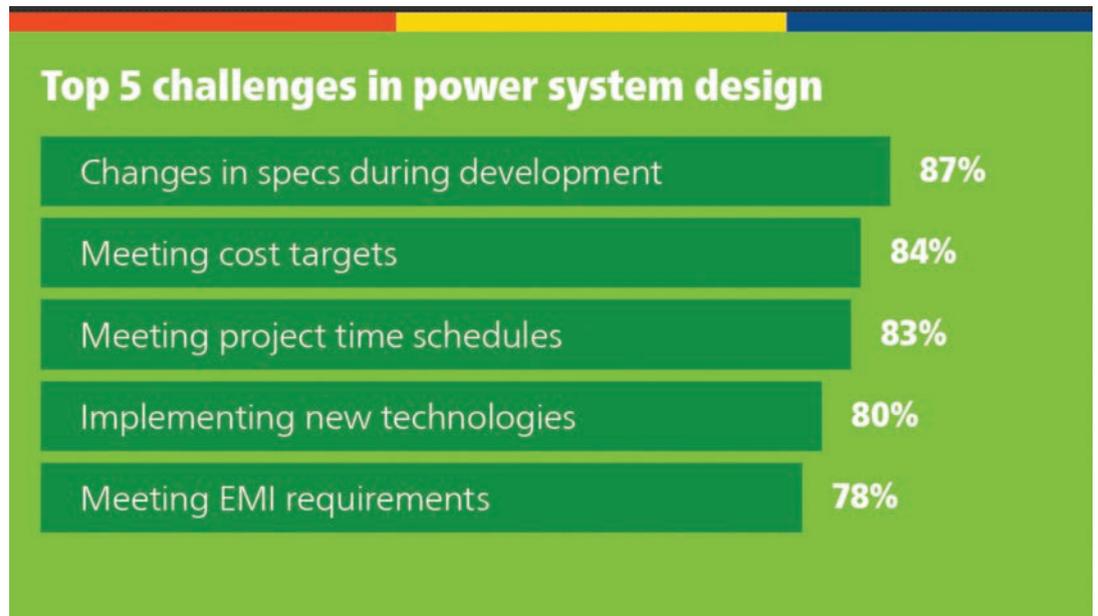
The graph (at right) summarizes the responses given when power designers were asked to identify their biggest challenges.

Changing specs is the top problem

Changes to specifications during development was the biggest issue that power-system designers surveyed must overcome, with almost all (87%) struggling to deal with this challenge. Changes in specifications mean project delays and increased cost due to the additional work required to modify the design to meet the new requirements.

It's clear that these changes do have a major impact on projects, as most of those surveyed (65%) said that changes to product specification are a major contributor to delays in power-system development. Although two thirds of power engineers already see the negative impact of changes on their projects, the problem is likely to get worse as the majority (67%) believed that changes were becoming more common.

The impact of these changes can be dramatic. Almost all (80%) engineers



surveyed are struggling to meet project time scales, with a similar number (79%) seeing the time given to each project reducing, and three quarters (72%) having to increase the rate of innovation due to shorter product life cycles. The changes to specifications can only increase the time pressure.

Delayed projects can have a large financial impact. To put it into perspective, take an example of an application that an OEM's business projections show as starting to pay back within two years of the new system's five-year product life. The project development in this example takes eight months. If there is even just a two-month delay, the return could reduce by as much as 20%. For a development of \$1M the loss of contribution could exceed \$350K when one takes into account the reduced product life, as well as the increase in associated development costs. Additionally, these costs would typically be passed to the customer, reducing competitiveness.

With half (48%) of our respondents experiencing delays of two months or more, it's clear that reducing or

eliminating overruns would result in a significant improvement to profitability.

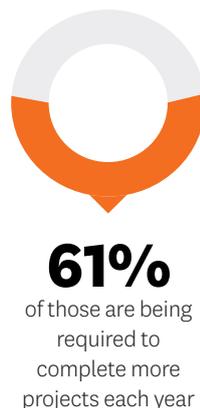
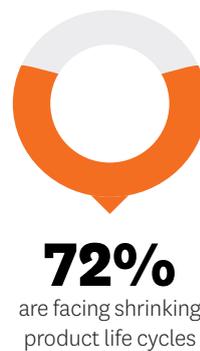
The impact can also be personal, eroding the morale and confidence of engineers who struggle to chase the moving specification goalposts. In our experience, it's likely that specification changes are a factor causing power developers to, on average, rate their power expertise as only 59/100, especially when three quarters of them say

they have insufficient in-house expertise to manage the changes.

What's behind spec changes?

As the survey findings highlight, changes to specifications are pretty much inevitable for most engineers (87% of our respondents said this was a problem). In our experience, changes are most frequently driven by technical issues, particularly when the exact power budget is not known at the start of the project, loads are changed or restrictions are placed on thermal management due to space restrictions. External market or competitive forces can also cause a change to specifications because: customer demands change; there are changes (or will be changes) to the legislative landscape; or a competitor launches a new product. All of these factors may cause an organization to re-evaluate what the market now needs.

The impact of these changes will vary, depending on the length of product life cycle, market leadership and other internal market forces and levels of risk. But what's important to note in the context of this survey is that





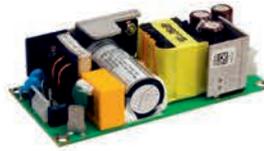
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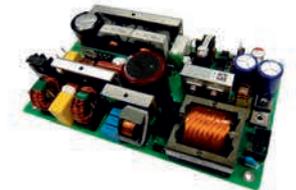
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engineers have little or no control over what is happening, they can only look to find ways to ameliorate their impact. Whatever the causes, we meet with an increasing number of power developers who are having to deal with the specification changing after they have begun designing.

Optimizing change

If changes to specifications are inevitable, then there is little point in trying to avoid them: power system designers should instead look at strategies that mitigate the impact of changes.

An inflexible approach to power design will make it harder to deal with changes in specifications. This is particularly the case when a custom power system is developed using discrete components or purchased from a vendor. In this case, any changes to the inputs or outputs requires complex and timeconsuming redesign work. At worst, discrete designs might need a different technology to meet the new requirements.

New, flexible approaches using modular power components (termed the Power Component Design Methodology by Vicor) may provide a way forward to enable power developers to accommodate changing specs without incurring significant delays. This approach uses small, easily-interchangeable products that allow changes to be accommodated quickly and easily. Using power components also increases the certainty of performance: it's much easier to accurately forecast the size and performance of power sys-



80%
stated meeting project schedules is a problem



79%
said target times are reducing

tems developed using this approach.

Engineers typically use online tools when implementing the Power Component Design Methodology. The Vicor PowerBench offers a suite of free tools that not only allow systems to be designed and optimized quickly and easily, but also allow for revisions to meet new specifications quickly and easily.

Summary

Changes to specifications after development has started is the biggest challenge for power-system designers and the problem is getting worse. Conventional approaches to power system design using discrete components were developed when specifications were less fluid and their lack of flexibility makes adapting to the inevitable changes difficult, time-consuming and expensive.

Using modular power components offers several benefits, particularly the flexibility to make modifications to power systems quickly and easily. Switching to this new approach may not stop power engineers' bosses changing their mind, but will reduce the stress and cost of the new requirements.

Vicor conducted an online research project to understand the challenges and issues facing power-system designers using an email questionnaire sent to engineers involved in power-system design around the world.

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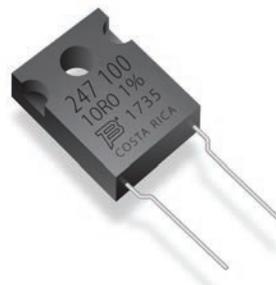
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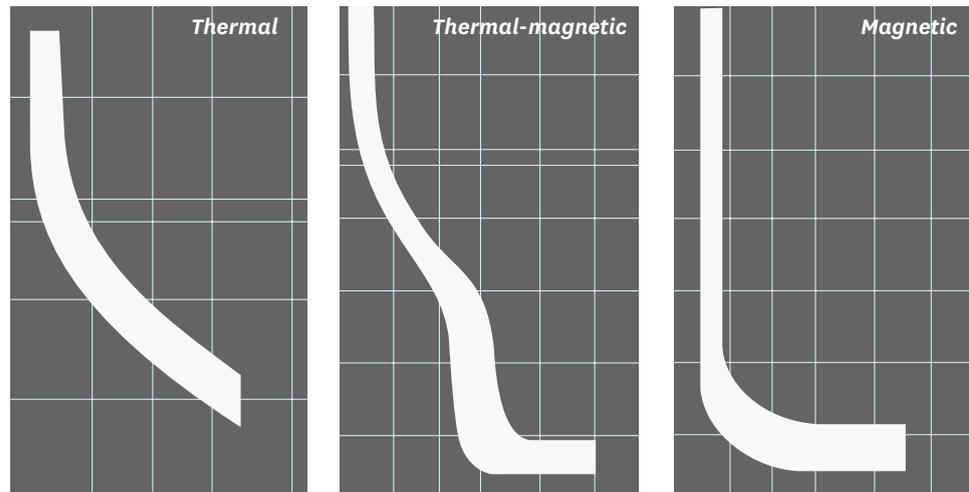
12 Most common mistakes when specifying circuit protection

BY E-T-A CIRCUIT BREAKERS



It's only a circuit breaker. Yet there is enough complexity and confusion when it comes to specifying circuit protection that many engineers are designing equipment with too little or too much protection. Under protected circuits leave equipment vulnerable to damaging electrical surges. Over protected circuits add cost and can lead to nuisance tripping. Like Goldilocks and the Three Bears, the goal is to specify circuit protection that is 'just right'.

As a global manufacturer of circuit breakers, E-T-A has selected the 12 most common pitfalls.



1. Specifying wrong circuit breaker type for application

The number one mistake made is specifying the wrong circuit breaker technology for the application. There are four choices of circuit breaker technology: thermal, magnetic, thermal-magnetic and high performance. Each has a different trip profile in relation to time and current, and each has distinct mechanical characteristics.

MAGNETIC CIRCUIT BREAKERS

Magnetic circuit breakers operate via a solenoid, and trip nearly instantly as soon as the threshold current has been reached. This type is appropriate for printed circuit board applications and impulse disconnection in control applications.

THERMAL CIRCUIT BREAKERS

Thermal circuit breakers incorporate a heat-responsive bimetal strip or disk. This type has a slower characteristic curve that discriminates between safe temporary surges and prolonged overloads.

THERMAL-MAGNETIC CIRCUIT BREAKERS

Thermal-magnetic circuit breakers combine the benefits of a thermal and magnetic circuit breaker: a delay that avoids nuisance tripping caused by normal inrush current, and fast response at high currents.

HIGH PERFORMANCE CIRCUIT BREAKERS

Where reliable operation under adverse conditions is required, high performance circuit breakers provide high interrupting capacity and excellent environmental specifications. Typically these circuit breakers serve aerospace, defense and similar heavy-duty applications where extreme vibration, mechanical shock, and other conditions are present.

2. Specifying too high a rating in an effort to avoid nuisance tripping caused by in-rush or transient currents

Engineers are concerned about nuisance tripping, as they should be, but they often specify a breaker rated much higher than they should. Part of the reason is confusion between fuses and circuit breakers. Engineers are used to oversizing fuses as a way to prevent nuisance tripping. However, there is no need to oversize a circuit breaker.

Unlike a fuse rating, a circuit breaker rating tells you the maximum current that the circuit breaker will consistently maintain in ambient room temperature. Thus, a 10A circuit breaker will maintain a 10A current without nuisance tripping. In fact, a typical 4A circuit breaker with a slow trip profile will tolerate a temporary 10A current surge without nuisance tripping.

3. Failure to provide spacing

It is important to maintain recommended minimum spacing requirements between non-temperature-compensated thermal circuit breakers. A mere 1 mm spacing between breakers is all that is required. Without this tiny thermal gap, the circuit breakers can heat up and increase the sensitivity of the bimetal trip mechanism. If the breakers must touch each other, derate them to 80% of their normal amperage rating.



80%

If the breakers must touch each other, derate them to 80% of their normal amperage rating.

4. Over specifying or ambiguously specifying the degree of protection

Terms such as drip-proof, ignition protection, water splash protection and dust proof are in common usage but may be misleading unless standard definitions are applied. When specifying, use the established standards as a measure, such as EN 60529/IEC 529, which defines the degree of protection of electrical equipment.

5. Selecting correct actuation

Circuit breakers are reset manually by means of an actuator. There are many types of actuators, including press-to-reset, push-pull, push-push, rocker, toggle, baton and press-to-reset with manual release. The actuator type is more than a cosmetic consideration. For example, critical applications

usually call for push-pull style actuators, because they are the most resistant to accidental actuation. The type of actuator you select will be determined by the location of the circuit breaker, the need for illumination, the need for human operator safety or convenience and the consequences of accidental engagement.

6. Failure to consider using circuit breakers as on/off switches

Many circuit breakers are designed to be both a breaker and on/off switch. The advantages of a combination device are a reduction in components, less consumption of panel space, reduced wiring and increased protection over ordinary switches.

7. Specifying the wrong type of terminal

Circuit breakers with plug-in style quick connect terminals simplify installation and replacement (they must also be soldered). Screw terminal connections are more secure and suited for high current and high-vibration environments. Quick connect terminals may be used for breakers rated up to 25A.

8. Specifying a fuse when a circuit breaker is better

Although fuses provide inexpensive circuit protection, the cost savings should be weighed against the low total cost of ownership of circuit breakers. Foremost, circuit breakers can be quickly reset, enabling the circuit to be restored with a minimum of downtime. In addition, there is no assurance that a replacement fuse will be of the proper rating. If a fuse is replaced by a higher rated fuse, overheating and catastrophic equipment failure may occur.

9. Specifying the wrong type of circuit breaker for a high vibration environment

Typically, the trigger of a magnetic circuit breaker is a hinged metal armature that closes in response to the movement of a magnetic coil. This design makes magnetic circuit breakers (and magnetic-hydraulic circuit breakers) particularly vulnerable to vibration, which can cause the armature to close prematurely.

10. Failure to derate

As a rule of thumb, the circuit breaker should be rated for 100% of the load. However, some applications require a circuit breaker to operate continuously in either high or low temperatures. In these cases, follow the manufacturer's guidelines for derating. For example, an application calling for 10A protection requires a 12A rated thermal circuit breaker when it is operated at 50° C.

11. Derating when it is not necessary

The performance of a thermal circuit breaker is sensitive to fluctuations in ambient temperature. It will trip at higher amperage in a cold environment, and it will trip at a lower amperage in a hot environment.

One common mistake is to assume that derating is necessary for thermal circuit breakers in environments that experience rises in ambient temperature. Actually, the performance of a thermal circuit breaker tracks the performance needs of the system, assuming it is exposed to the same heat source. For example, motor windings need more protection from overheating at 90° C than the same windings need at 20° C.

12. Over specifying interrupting capacity

Interrupting capacity is the maximum amperage a circuit breaker can safely interrupt. Circuit breaker manufacturers publish this specification along with the number of times the circuit breaker will perform this feat. To comply with various standards, engineers must specify circuit breakers with adequate interrupting capacity.

Summary

If you keep these tips in mind, it is easy to specify the right measure of circuit protection at the lowest cost. Start the selection process by working to truly understand your load. Then decide which type of circuit breaker is suited to your application. Avoid the common mistakes, and you will be rewarded with a reliable design. **EP&T**

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An IBM cryostat wired for a 50 qubit system, participating in the IBM Q Network.

IBM's Quantum computation center

Set to radically alter our data perceptions **BY BOB SUTOR**

Every person on the planet will create 1.7MB of data per second by 2020, according to an IDC report. That's 40 total zettabytes in a year, where a zettabyte is 1 with 21 zeroes following it. For comparison, that same report estimated global data to grow to 2.7 zettabytes – in 2012. All this data will pass through aptly named datacenters currently sprawled across 1.94 billion square feet throughout the globe, including the Arctic Circle and under water (for another comparison: that's about 25 square miles larger than Vancouver). The concept of how we think datacenters operate and grow is about to radically change with the reality of a completely new kind of computer: quantum computers.

Quantum computers entered the public consciousness in 2016 when a 5-qubit system was put on the cloud for anyone to experiment with by IBM. Today, IBM has several quantum computers, including an open, public 16-qubit system, and a 20-qubit commercial system – housed in a

computation center that a dozen companies, universities and US government labs are tapping into for case studies and application research.

I say “computation center,” and not a full-blown datacenter, because quantum computers will be doing computations in coordination with traditional classical computers, which will handle the data tasks. Quantum computers operate in a completely unique way and might accelerate some of the underlying calculations in areas such as AI, for example.

Fragile, powerful: Tapping into a quantum computer

A qubit, short for quantum bit, is the building block of a quantum computer. It's analogous to a classical computer bit in that it holds information to be processed. However, instead of representing just a 1 or 0, as in a classical system, a qubit's quantum state can take on other values during operation. Like a classical bit, though, a qubit will be just 0 or 1 when you look at the answer at the end of the compu-

IBM scientists work in the IBM Q computation center at the Thomas J Watson Research Center in Yorktown Heights, New York. The new center houses IBM's most advanced quantum computers, which are accessible via the IBM Cloud to organizations participating in the IBM Q Network.

(Photo by Connie Zhou)

tation.

This exponential power to represent such additional states is what excites scientists about qubits – and now developers and business leaders. Just 50 of them can represent more than one quadrillion values, simultaneously. That's more zeros or ones than any super computer on earth can manage.

Stabilizing a quantum computer's qubits requires pumping liquid helium into the chips to cool them to 15 milliKelvin, or a fraction above absolute zero, which is colder than outer space. The 2,000-plus parts of the system are protected from the elements inside a pillar-shaped dilution refrigerator that hangs from the lab's ceiling – it's definitely not a traditional server. Otherwise, any disturbance or noise from light, movement, or sound will collapse the qubits.

Input in the form of a signal from an algorithm execution, sent by a classical computer, moves through the dilution refrigerator's microwave lines, down through a mixing chamber that cools and attenuates the signal until it reaches the cryoperm shield at the bottom, where it's processed by the qubits. Output, what will be measured from the qubits' calculation, moves back up the system through amplifiers and coaxial cables (at a balmy 4 Kelvin) to be read as ones and zeros by a classical computer, and then sent back through the cloud to a user.

With all settings perfect, qubits are only coherent, or available for access and measurement, for about 100 microseconds. In other words, we have less than one-three-hundredth of an eye blink to ask this exponentially smart device a question. And the answer can only be a “yes” or a “no.”

Quantum doesn't follow the (Moore's) law

Quantum computers will not pick up the Moore's Law torch when today's classical computers' processors can no longer keep doubling in computational power on a regular basis. Qubits' exponential ability to calculate in ways intractable by even supercomputers will still require being understood by a classical computer. So, yes quantum computers may soon solve previously impossible problems, but they will also work alongside classical computers for the foreseeable future

These early days of quantum computers hearken back to room-sized mainframe that were large and fragile. As we know now, they were also full of potential. So, before you decide to wait for scientists to eliminate decoherence and make fault-tolerant qubits, know that these complex, cold systems with brief execution times can still offer "quantum advantages" worth exploring.

That's why 70,000 users have signed up to run more than two million experiments on the IBM Q Experience – and, to date, have published at least 50 papers based on those experiments.

Getting quantum ready means developing quantum algorithms. Last year, our scientists modeled the largest molecule using a quantum computer with algorithms running on 7-qubit systems. Today, IBM Q Experience users have access to a 16-qubit system, while IBM Q Network clients have access to 20 qubits. IBM scientists also announced that they are working with a prototype 50 qubit machine. Users

can write their own algorithms and test them via the cloud.

Quantum power is in a bigger ecosystem, not a bigger building

IBM Q's computation center takes up about 2,000 square feet. That's a far cry from the millions of square feet that datacenters occupy. As we improve the technology and add machines, our footprint will likely grow, but our bigger focus is on the growth in our ecosystem of users. What if everyone in the 1950s had had 5 to 10 years to prepare for the mainframe, from hardware to programming, while they were still prototypes? In hindsight, we can all see that jumping in early would have been the right decision. That's where we are with quantum computing today. Now is the time to begin exploring what we can do with quantum computers across a variety of potential applications. **EP&T**

Bob Sutor, vice-president, IBM Q Strategy & Ecosystem, IBM Research



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TEARDOWN

Looking inside the Samsung Gear Fit 2 Pro Fitness Band OEM upgrades original unit to become water resistant

BY STACY WEGNER AND DANIEL YANG, TECH INSIGHTS

Tech Insights has seen its share of smart watches and fitness bands, including a couple, if not all, of what Samsung has on offer. One of their early fitness bands, the 2014 Gear Fit SM-R350 was followed up with the Samsung Gear Fit 2 SM-R360. Both were well designed and offered a range of features, but any activity involving water left them both... dead in the water.

The first Gear, the Gear SM-R350, included Bluetooth connectivity, and was based on an STMicroelectronics ARM Cortex-M4 MCU. The follow-up

Gear Fit 2 SM-R360 upgraded to include WiFi and GPS and was based on a Samsung Exynos 3250 Applications processor (AP). But this year Samsung jumped in to the deep end and upgraded the Gear Fit 2 series to the new 5 ATM waterproof Gear Fit 2 Pro SM-R365. It includes everything offered in the SM-R360, plus the addition of swim activity tracking.

TechInsights has already conducted a teardown on the Samsung Gear Fit2 Pro SM-R365, here's our cross comparison.

Application Processor (PoP)

The SM-R365 has the same Exynos 3250 Dual-Core Applications processor in a Package on Package (PoP) assembly underneath the same Samsung KM-FJ20005D-A213, an eMMC with 4 GB MLC NAND Flash and 512 GB LPDDR3 SDRAM mixed-memory package.

Navigation and Wireless SoC

Here, too, the Gear Fit 2 and the Gear Fit 2 Pro fitness bands use the same GNSS hub and WiFi / Bluetooth SOC components. Both have the Broadcom BCM4774 for GPS, GNSS, Glonass, Galileo, and Beidou support, and the same Broadcom BCM43436 for WiFi / Bluetooth connectivity.

Inertial Module

The first sensor we are going to mention is the STMicroelectronics LSM6DS2, featuring a 3D accelerometer and a 3D gyroscope. Again, this is the same STMicroelectronics MEMS sensor used in the Gear Fit 2 SM-R360.

Pressure Sensors – a One-Two Punch?

Here is something sort of new. We say 'sort of' because we first found the same STMicroelectronics LPS22H pressure sensor in both the SM-R350 and SM-R360 smart fitness bands.

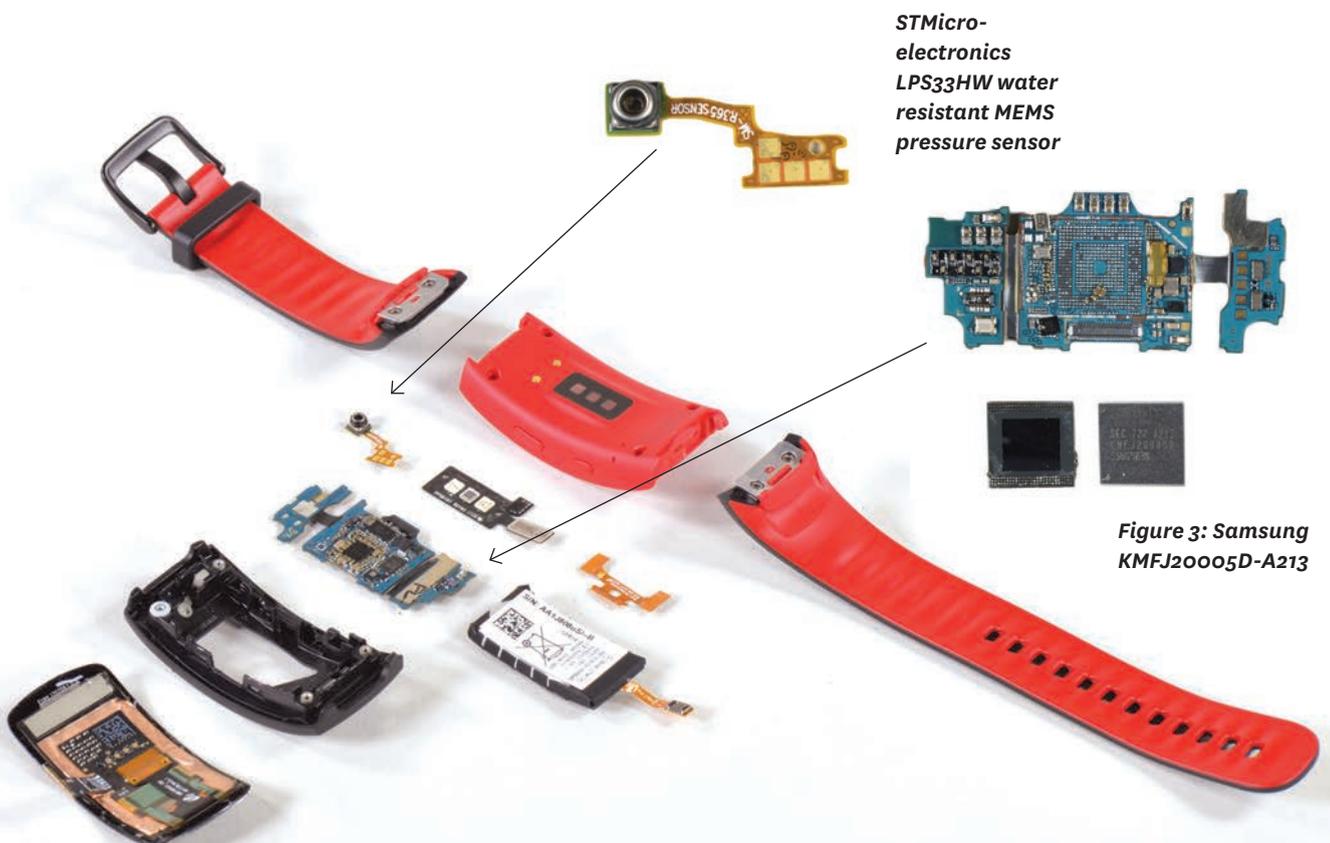
What is new however, is the second pressure sensor we found: the STMicroelectronics LPS33HW, a water-resistant MEMS pressure sensor. The LPS33HW is how Samsung upgraded from the Gear Fit 2 IP68 water-resistance rating to the 5 ATM rating, and

added swim activity tracking in the Gear Fit2 Pro SM-R365. Yes, we found not one, but two pressure sensors. Other wearables with swim tracking, like the Casio WSD-F10 use only one sensor - the Alps HSPPAD132A - while the popular Finnish-designed Polar M600 can

also track swim activities without a using a pressure sensor at all. Instead, the Polar M600 tracks swimming activities using an app and the STMicroelectronics LSM6DS2 6-axis MEMS accelerometer & gyroscope. Yes, the same STMicroelectronics LSM6DS2

found in the Gear Fit 2 fitness bands. **EP&T**

By Stacy Wegner, Daniel Yang, Tech Insights, Ottawa



STMicroelectronics LPS33HW water resistant MEMS pressure sensor

Figure 3: Samsung KM-FJ20005D-A213

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