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Vol. 59 No. 5


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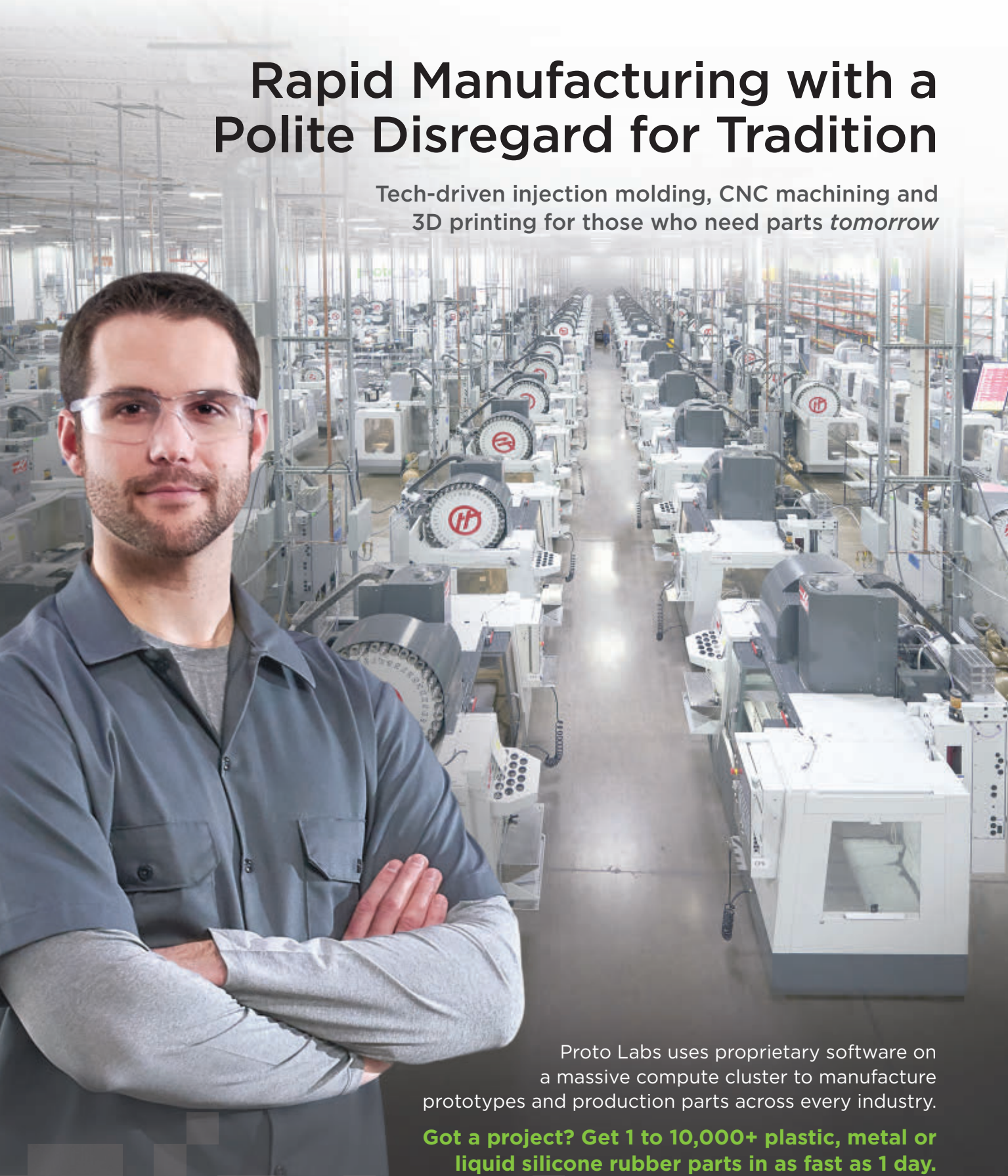

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KASEY PANETTA | EDITOR
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Let's talk about space

Most of the time, my job is just like any other job. I have day-to-day responsibilities like debating topics with commenters, writing blogs about things that annoy the commenters, and then writing up blogs about the terrible things commenters sometimes say. (Just kidding.) But I do have a certain daily routine here at ECN, and every so often I get to break that routine and do something a little bit different.

We launched a series called *Engineering Live* a little while back and it's one of my favorite things about my job. For those of you who haven't had a chance to check one out yet, Engineering Live is a video-based roundtable with experts from across the industry. The topics have ranged from AC versus DC to the Internet of Things and they've asked difficult industry questions about how we get (and keep) kids interested in STEM education and the future of wearable devices.

Recently, I had the opportunity to moderate an *Engineering Live* titled, "What happened to our fascination with space?" The panelists, as always, had very impressive resumes. We had Rebecca Spyke Keiser, formerly of NASA, who is now the Director of International Science & Engineering at the National Science Foundation; Elizabeth Bierman, President of the Society of Women Engineers and a Senior Project Engineer at Honeywell aerospace; and Dr. Mamta Patel Nagaraja, Science Communications at NASA Science Mission Directorate.

It was, as you may have noticed, ECN's first all-female *Engineering Live* panel and we took a fascinating look at what's going on behind the scenes at some of the foremost aerospace institutions in the country and how different generations require different approaches. I have to say, they've pretty much nailed it and these experts offered some great advice to future studiers of space.

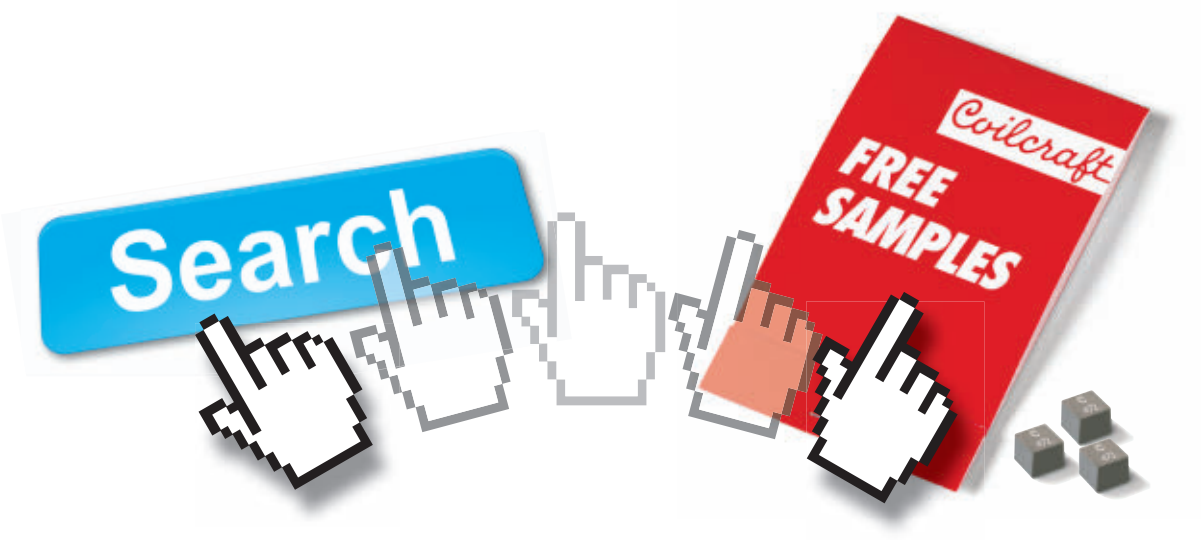
You can check out all the *Engineering Live* notable discussions at www.ecnmag.com, but you can view the space engineering live OnDemand at www.ecnmag.com/SpaceEngineeringLive. Keep an eye out for our upcoming broadcasts and let us know if you have a great topic to debate.

Until next issue,

Kasey Panetta

Kasey Panetta
Editor

From Search to Samples in Seconds



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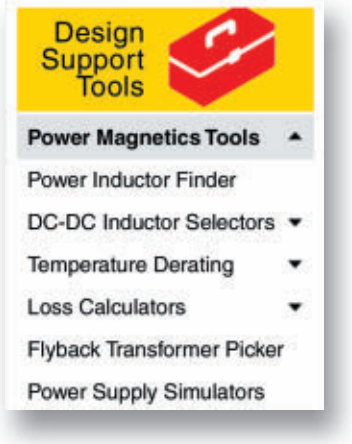

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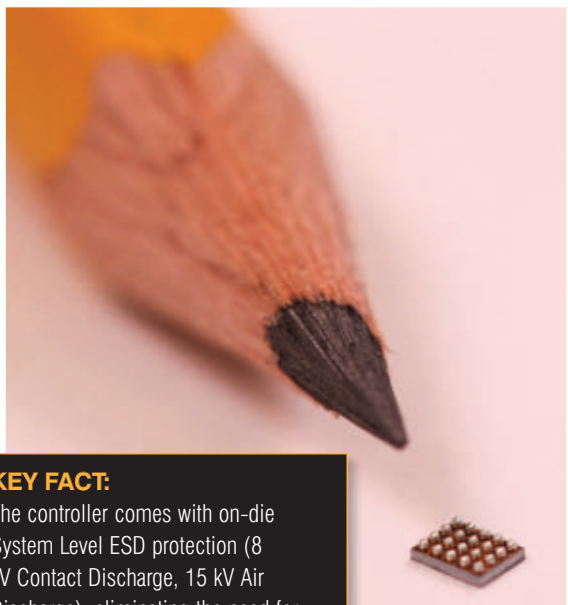
KEY FACT:
Fast erase times can provide a significant cost savings to customers, by minimizing the time required for testing and firmware updates.

Memory devices provide fastest erase time in industry

Microchip Technology Inc. announced a new family of 3V Serial Quad I/O interface (or SQI interface) SuperFlash memory devices. This three-member 26 Series SQI interface family is available with 16-Mbit, 32-Mbit, or 64-Mbit of memory, and is manufactured using Microchip's high-performance CMOS technology, which provides the industry's fastest erase times and superior reliability, according to the company. Sector and block erase commands are completed in just 18 ms, and a full chip erase operation is completed in 35 ms.
For more information, visit www.microchip.com.



KEY FACT:
The controller comes with on-die System Level ESD protection (8 kV Contact Discharge, 15 kV Air Discharge), eliminating the need for external components for this protection.

Controller offers ultra-small footprint

Cypress Semiconductor Corp. sampled an ultra-small footprint, integrated USB Type-C cable controller solution with power delivery. Optimized for 2.4-mm thin USB Type-C cable connectors, the programmable EZ-PD CCG2 controller is fully capable of supporting any USB Type-C Downstream Facing Port or Upstream Facing Port applications. The product is available in a 3.3 mm2 Wafer Level Chip Scale Package and is the first programmable solution to fully integrate both the Type-C transceiver and termination resistors needed for Type-C communication.
For more information, visit www.cypress.com.

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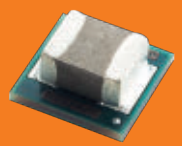

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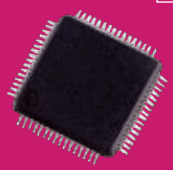

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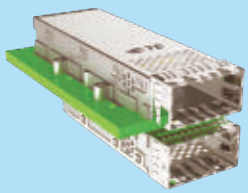

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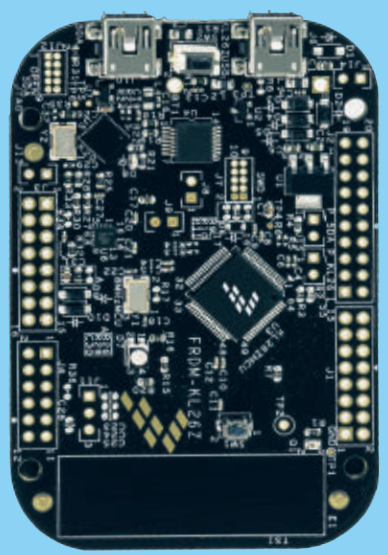

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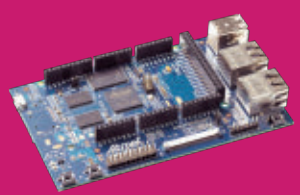

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Adhesive-backed stacking spacers engineered to lock-fit chassis-to-board

A new assortment of adhesive-backed Nylon stacking Spacers/ Supports is among the latest circuit board hardware components available from Keystone Electronics Corp. Supports are engineered to lock-fit a chassis-to-board without the use of tools. These devices have an adhesive backing for securing to a chassis while the other end easily snaps into a PCB with a strong, retentive grip. Available in a sturdy mount or slim line design to accommodate a variety of design requirements. Adhesive lock-fit supports are supplied in heights from .187" (4.75 mm) to .825" (15.9 mm). Features include:

- A one-piece flame resistant molded Nylon, UL rated 94V-0.
- Adhesive backed supports are strong, reliable and lightweight.
- Component ensures consistent, close dimensional tolerances.

For more information, visit www.keyeleco.com.

USB enclosures designed for wide range of OEM applications

TEKO has launched its new TEK-USB standard USB enclosure. The enclosure is designed for a wide range of OEM applications including USB dongles, pen drives, and wireless transmitters. The enclosures have an attractive snap-together design with an integrated soft touch protection ring in the middle. The PCB and USB connector are captured inside the enclosure. A separate cap is supplied for the protruding USB connector. Features include:

- An LED light pipe on the cover – so users can monitor activity – and a recessed area on the bottom for labels and markings.
- Available in one size (2.28" x 0.98" x 0.40") and is molded in White/Light Gray plastic as standard. Custom colours can be supplied – minimum order quantity 500 pcs.
- The top and base are molded in Novodur P2H-AT (a standard impact strength, high gloss plastic with an anti-static additive).
- The intermediate ring is molded in LARIPUR 8020 (a polyester-based TPU also used in sports soles and screen elements).

For more information, visit www.tekoenclosures.com.

TWEET

Kasey Panetta @kcpanetta

I'm moderating an all-female panel on #SPACE! Starring @twopikeiser of @NSF, @SWEtalk, and @BeyondTheCurls of @NASA! http://ow.ly/LHHI4

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Engineering Update #104: Amazon drones leaving America

- **Amazon drones have left America**
  With the ink still drying on the FAAs newest drone regulations, which include requiring the pilots to be licensed and the drones to always be in line sight of the pilot and a spotter, Amazon has taken off for the Great White North.
- **Duck drone could spy on airborne or underwater enemies**
  The defense apparatus is increasingly looking towards nature to inspire the next generation of unmanned aerial vehicles – or in this case, an aerial vehicle that can also poke its head underwater.
- **A wristband that helps musicians keep the beat**
  The Soundbrenner Pulse is one of the most unique wearables on the market. The Soundbrenner is designed for a single purpose: to help musicians keep the beat with a vibrating mechanism that's allegedly 6 times stronger than a smartphone's.

This inappropriate card game will fund STEM scholarships for women (and why that's amazing)

By Kasey Panetta, Editor, @kcpanetta

It seems like everyone is trying to figure out how to get kids in STEM and how to keep them there. There is a particular interest in increasing the number of women in STEM professions because the numbers, particularly in certain sectors of STEM, are astonishingly low. But sometimes these programs come from the most unexpected of places.

TWEET

Jason Lomberg @JasonECNMag

China adds attack capability to the "Great Firewall". Researchers dub it the "Great Cannon" http://bit.ly/1H3js4F

@ecnonline #GreatCannon

75,000

Amount of renewable energy workers to be trained by 2020

This is why arming domestic drones is a very bad idea

By Jason Lomberg, Digital Editor, @JasonECNmag

This is the worst fear of anyone skeptical of domestic drones.

UAVs represent a potential goldmine, with commercial and scientific functions and a treasure trove of DIY applications on the docket. But for every hobbyist tinkering in their lab, there's a police force planning surveillance activities and untold privacy concerns. Then there's this – police in India plan to arm drones with pepper spray to disperse protestors. And we're not far behind in America.

Police in Lucknow, India, purchased five drones, costing 600,000 rupees ($9,600) each, and plan to deploy them later this month. Equipped with hi-res cameras, the drones include two kilograms (4.4 pounds) of pepper and have a one-kilometer range.

The quantum dots revolution

Offering both clarity and affordability, quantum dots could be the "next big thing" in the display market.

By **Jason Lomberg**, Digital Editor, @JasonECNMag

Quantum dots are the most important technological development that no one has heard of. At least not when compared to the buzz about 4K, curved displays, the Internet of Things, or other Consumer Electronic Show (CES) titans.

It's not exactly a new technology as scientists first discovered the tech back in 1981. This technology has made cameo appearances at SID Display Week and other optoelectronics events, but CES 2015 was the first to showcase quantum dots on so large a platform.

The quantum dots display at CES 2015 was notable because it was the first show where the difference between this technology and other displays was qualifiable.

The building blocks of a colorful revolution

Quantum dots are essentially semiconductor nanocrystals designed to emit light in a very efficient, lifelike manner. Efficiency is key. High-energy blue light is directed onto phosphorescent "dots" that convert the blue light to either red or green light, depending on their size, and they can be configured to deliver only the color of light desired and little else.

This results in sharper colors at a fraction of the cost, which opens a floodgate of potential applications. Quantum dots found their way into transistors, solar cells, medical imaging, and even quantum computing. Just recently, researchers at Princeton used quantum dots to design a tiny microwave laser (a "maser") the size of a rice grain with the eventual goal of constructing quantum-computing systems out of semiconductor materials.

Getting into your homeIt's the consumer market where quantum dots figure to shake up the established order, and QD Vision's unique "Color IQ" technology is at the forefront of this revolution. While most color

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displays produce only 60 to 70 percent of the National Television System Committee (NTSC) standard for color quality, QD Vision's IQ optics achieve over 100 percent of the standard.

QD Vision offered ECN a private demo of its Color IQ tech at CES and demonstrated a palpable improvement over existing technologies. Most quantum dot TVs were hit or miss, but, TCL, a China-based electronics company, exhibited QD Vision's tech in a standout commercial display. And believe it or not, the company's original plans were actually far more ambitious.

A brand new paradigm or a complement?

Originally, QD Vision toyed with the idea of Quantum Dot LEDs (QLEDs) replacing today's LED panels, but after a number of tests, determined the quickest path to commercialization was as a complement to existing LED technologies.

And by integrating their quantum dots with existing solid-state lighting technologies, QD Vision put their own unique spin on these semiconductor nanocrystals. Most iterations apply the dots to the layers of films beneath a display. But this is expensive. According to John Volkmann, Chief Marketing Officer for QD Vision, barrier film can add over $100 to a typical 55" display's bill-of-materials (TCL's H9700 quantum dot TV happens to be of the 55-inch persuasion). The H9700 takes a different route.

With the H9700, QD Vision uses edge optic packaging to dramatically reduce costs. "By definition, edge-lit solutions are going to be lower cost, because of how seamlessly they integrate into today's fully-depreciated LED manufacturing processes," says Volkmann.

The company applies a thin glass tube – which looks like a long, yellow thermometer – along the edge of an LED display, often behind the bezel. And the results speak for themselves. You could readily detect the sharp improvement (see figure 1) over "regular" LED and OLED displays.

To date, TCL is the only manufacturer utilizing QD Vision's optics – and the H9700 is only available in China (for now) – but Philips and AOC have each announced monitors based on these edge-lit quantum dots for the first half of this year. And other OEMs should follow suit throughout 2015. ECN

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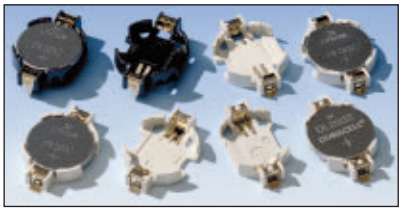

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Ensuring security in the connected home

The importance of ensuring protected connections in the IoT.

By **Ogi Brkic**, VP of Marketing and Business Development, Elliptic Technologies

If you recently visited one of the many consumer trade shows, it was hard to miss the proliferation of Internet of Things (IoT) devices targeting home automation. Anything from simple temperature sensors and wirelessly controlled power outlets to complex home gateways are the future of the intelligent connected home. Add to that a plan by all major appliance manufacturers to include connectivity capabilities into their product line and you are left with a very complex ecosystem of devices. Simply connecting all of these devices will be a challenge, not to mention ensuring their interoperability, and more importantly, establishing trust.

There are numerous connectivity standards that will be used to connect devices in the intelligent home: Bluetooth (LE), WiFi, Zigbee, Zwave, etc. Most of these connectivity standards have specified cryptographic algorithms and protocols to protect the communication channel. However, protecting the communication link does not establish trust between devices, it simply encrypts the connections between a node and its access point or hub. In order to build trust, these devices need to authenticate to one another. Today, the industry is at its infancy as it relates to IoT standards. Multiple alliances (AllJoin, Thread, Home Kit, etc.) will drive their own implementations of authentication protocols before standards bodies such as IEEE and IETF publish common standards that ensure device interoperability and ease of use. In the meantime, IoT products need flexible designs able to react to new, undiscovered threats and to adapt to new protocols.

Security plays a critical role in the market adoption of the IoT. It's easy to imagine a scenario in which an intruder uses a connected appliance to gain control of someone's smart home or access to their personal information. Whatever the application, security must be addressed from the initial design and remain the core component of the system. This is essential in the deployment of these devices and the promise behind the intelligent connected home.

Invisible security

In the intelligent connected home, routers, home gateways, and other IoT hubs will represent critical components of the home IoT ecosystem. It is likely that multiple IoT hubs will be present in many homes, and hubs take on many forms. Some of these will be specialized for particular applications, others for particular wireless or broadband protocols. Hubs may take the form of a traditional router with or without integrated broadband technology, a cablevision, satellite TV or IPTV set-top box, or a common home appliance. It is likely that, as is common now, a single gateway will connect the home to an external broadband or wireless network, and will also act as aggregation and control points for end point devices connected through the short range wireless standards mentioned above. The home gateway will in some cases be responsible for securely communicating data to and from the cloud, enabling premium services such as streamed 4K content, and may occasionally be

responsible for securely updating other connected IoT devices such as appliances, sensors and alarm systems. Today, the majority of hundreds of millions of home routers are using rudimentary software based security. Almost a year after the OpenSSL Heartbleed bug was discovered, according to the Cisco Annual Security 2015 Report, 56 percent of devices indexed by Cisco use versions of OpenSSL more than 50 months old. We cannot rely on consumers to protect themselves and ensure that software patches are up to date. Security must be invisible to them and it should just work. So then, how can these hubs be trusted?

It all starts at the root

An IoT hub should incorporate a root of trust that enables upstream and downstream connected devices to be properly identified and authenticated to each other. There are multiple ways to implement a root of trust, but all are created through a combination of software, firmware and hardware.

A software-only approach is the least secure; however, it may fit well into cost-sensitive designs where performance is not critical (low cost sensor, etc.). Also, a software approach is the only available method to establish a root of trust for devices already deployed in the field. Various obfuscation techniques can be used to establish trust using a software-only approach. This is not a recommended approach for intelligent home gateways, except in the cases where security has to be improved on a device already deployed in the field.

In a hardware-only approach, a root of trust is a standalone chip inside a device (TPM, etc.). This approach is more secure than the software-only approach. Secrets embedded inside a system are used to build trust. Drawbacks of this approach are that it requires dedicated hardware and the security perimeter is the device (router). This is not a suitable approach for cost sensitive solutions and it lacks field update flexibility needed to address future security threats and field updates.

A combination of software/firmware and embedded hardware is an optimal way to implement a highly secure root of trust. This approach provides a very tight security boundary, depending on implementation, either the entire System on Chip (SoC) or a portion of the SoC. The most secure approach limits the security boundary to a portion of the SoC. Embedded hardware ensures that the important secrets are protected inside the SoC and software/firmware ensures

that design is flexible and will enable secure future field updates.

Assuming that a device has an embedded root of trust, how do we leverage it to improve the security of an IoT hub and the other IoT devices connected to it?

Secure enablement for the IoT made easy with a Root of Trust

The graphic below depicts a typical IoT value chain: sensor and actuator nodes connect to an aggregation point or home gateway, and ultimately in many cases to the cloud.

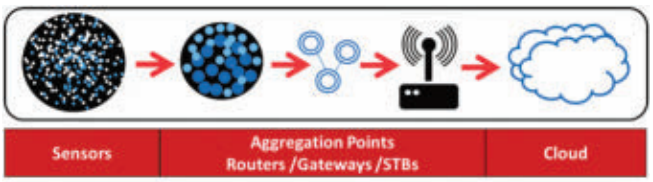

Figure 1: IoT device value chain; Trust has to propagate though the entire IoT value chain to ensure the eco system integrity and enables provisioning of the secure services. (Image courtesy of Elliptic Technologies)

Embedding a hardware root of trust enables chip manufacturers and their OEM/ODM customers to create a strong cryptographic device identity that is permanently bound to that unique device instance. This identity may be used by the manufacturer on the owner's behalf to provide secure maintenance or enable new features and services over the entire lifecycle of the device. Of course, it is possible to create other identities for the device that may be used in different contexts or different applications.

A critical element of retaining an owner's trust in a device is that the device's integrity can be measured and demonstrated. This trust can then be extended to the network in the neighborhood of the IoT hub. Extending trust requires a set of fundamental security features: secure bootstrap, peer authentication, and access control. In all three cases, the root of trust facilitates these features, protecting their processes and sensitive information.

Secure Boot: The secure code that runs on an IoT hub must be trusted. Trust in this context means that the firmware running on the device is in the state it was in when last supplied by its manufacturer. The root of trust is used to initiate the secure boot process to validate the host processor firmware. Some implementations extend this with the ability to measure the integrity of host firmware during run-time. This further protects against intrusion and tampering. ECN

Peer Authentication: It is often essential to ensure that one or more of the upstream or downstream devices communicating with the hub can be trusted. To ensure this trust, a mutually agreed upon authentication scheme is used. A root of trust can ensure the integrity of the authentication protocol, as well as ensuring the confidentiality of the private secret data used in the authentication protocol. Peers will be supplied by many different companies, so there will be numerous different identification and authentication protocols that are widely used. A programmable root of trust will ensure flexibility in the choice of protocols for different uses.

Access Control: With the ability to identify and authenticate peers comes the ability to distinguish and regulate different levels of access both to services provided by the IoT hub and to the network itself. The IoT hub is a natural place to implement access control policies in a consistent and centralized fashion.

Especially in the early years of the Internet of Things, there will be numerous standards, ecosystems, and communication and security protocols all vying to become the common way to connect things to each other. This means that there will be many of each for some time to come, and new ones will emerge over time. IoT hubs are the logical points in the network that will be the multiprotocol devices that collect, aggregate and reformulate data from things before forwarding it over standard Internet protocols (increasingly IPv6) to devices and services that will fuse and create value from disparate endpoints. This is, after all, where the power of the IoT will ultimately be found: the relationships between data form numerous independent things. Accordingly, IoT hubs will have to be masters of adaptability and flexibility, and the root of trust device will have to fit this mold too. Thus the ability to upgrade its functionality in a secure and trustworthy way will be a key measure of a usable root of trust. Hardening its functionality at the expense of this flexibility to adapt to new requirements will just assure early obsolescence.

Cryptography is not security. Understanding system requirements is critical to design a secure device. Protecting devices from known security threats is not enough. The system composed of a network of devices has to adapt to an ever-changing threat landscape. IoT devices will be in the field for a long time and will be exposed to new threats as the market matures and is exposed to new attacks and adversaries. The ability to protect against known security threats; to detect the new ones; and to adjust to these threats is critical for every well-designed system. ECN

Designing power management ICs for modern uses

How the evolution of technology requires a new era of power management ICs.

By **Peter Wilson**, Sr. Staff Product Marketing Manager, Renesas Electronics America

Power management ICs have evolved and are now standard in applications like standard 12 V rail supplies and embedded systems that require high efficiency and low power usage. With new technology innovations, more features are being incorporated into power management ICs. However, for industrial applications like distributed power systems, engineers need simple power IC devices that integrate power save mode and battery backup circuit solutions in order to move their designs to market more quickly, efficiently, and cost-effectively.

The power save mode provides a light load mode to conserve power until needed by the load, all the while maintaining a fast load transient response for system reliability. With the addition of a battery backup circuit, this allows critical components such as SRAM, microcontroller (MCU), and real time clocks to be automatically transferred to a battery backup system for uninterrupted power. These new power management ICs are also easy to use by reducing the amount of external components.

Semiconductor companies today are enabling the evolution to a more energy-efficient world and providing customers the tools they need to create the next generation of energy-efficient products and services from MCUs to power delivery. Take the voltage rail for example. The use of a 12 V voltage rail is common in many industrial and consumer applications such as communication, office equipment, home appliances, and smart utility meters. The 12 V rail typically needs to be converted to a lower voltage, between 3.3 V to 1 V, in order to provide the operating

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voltage for ICs in the system.

There are two options in order to convert and regulate the voltage: linear regulators or switching (buck) regulators. Linear regulators have the advantage of simplicity, but the disadvantage of low efficiency, as they essentially convert the voltage through resistive losses via Ohm's law. When compared to linear regulators, switching buck regulators are highly efficient, but require more components for operation. High-efficiency is a driving factor in today's electronics environment. The rapid spread of buck regulators have benefited many designs by enabling longer operating times in battery-powered applications and more efficient data centers, which results in more applications transitioning to higher energy efficiency using buck regulators.

Today's designers also want to improve light-load efficiency without increasing cost and complexity of design. Many buck regulators have been used and "re-used" in subsequent designs over the course of years since this approach saves time. However, "re-used" designs may not meet current efficiency standards, lack modern features and aren't cost efficient. In contrast, the semiconductor industry is expanding and developing more efficient buck DC/DC regulators that provide high efficiency at light load and incorporate feature sets that reduce the number of external components required.

New simple power ICs are designed with these engineering criteria in mind. For instance, new power ICs have 16 V input capable synchronous buck regulators that deliver up to 3 A of continuous load current at voltages as low as 0.8 V. These ICs offer both pulse-width modulation mode (PWM) and pulse-frequency modulation (PFM) modes and can move seamlessly between the two. PWM is widespread. The use of PFM is widely used in portable applications, and is now being utilized in wider input buck regulators. Selecting high-efficiency synchronous buck DC/DC regulator with a built-in auto PFM mode is an easy choice that allows designers to reduce power consumption and save hundreds of milliwatts of power dissipation under light-load conditions, which can translate to several kilowatt-hour/year without sacrificing cost or performance.

PFM is a nonlinear operation, which effectively lowers the frequency of the switching-cycle event and thereby lowers the switching losses in the regulator. There are several variations of PFM and all operate according to the basic principle of initiating switching cycles only as needed to maintain the output voltage. While in PWM mode, the frequency is constant and the frequency is altered to keep a constant Vout, and consequently, the output ripple voltage is larger.

To optimize the system-level efficiency of the regulator, it is best to alternate between PFM and PWM operating modes at the peak of the PWM efficiency curve. The combined PFM and PWM efficiency curve will provide the total profile of circuits load efficiency.

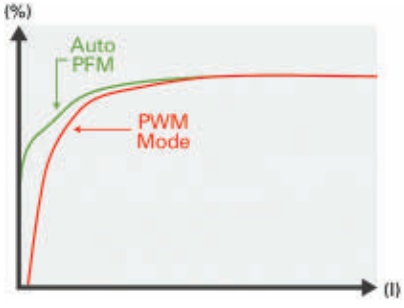

Figure 1. PWM and PFM efficiency illustration (All credit: Renesas Electronics America Inc.)

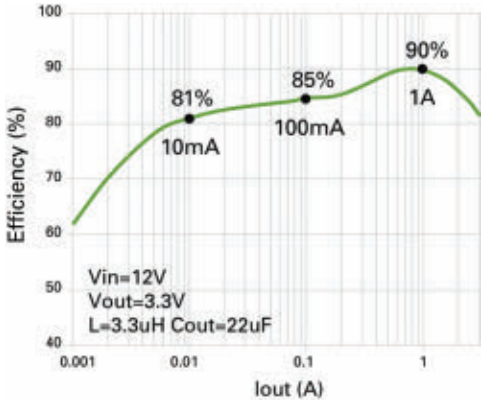

Figure 2. Auto PFM mode demonstrated by RAA230133 device

In order to reduce losses during extended periods of inactivity, new power management ICs can now offer a light-load mode to save power until needed by the load. The transitions from low activity to a heavy-load demand can induce load transient perturbations in the output voltage.

The voltage transient is around 100 mV of output deviation with a Vin=8 V and a Vout=1.1 V while operating in PWM mode. The compensation is internal and there is no need for external compensation components. Today's buck regulators must have small transient deviation to a change in the load conditions and have a fast response to load conditions while the output voltage transient magnitude and duration are minimized.

Many electronic systems may use a small coin battery or super capacitor as a local power source, which allows the circuit to maintain operation through brief power interruptions without shutting down. The battery-backup circuit keeps the battery voltage to the SRAM, MCU, and other items such as a real-time clock operational. This replaces the common method of using a pair of diodes to implement a battery backup circuit for devices that require power even when the system is powered.

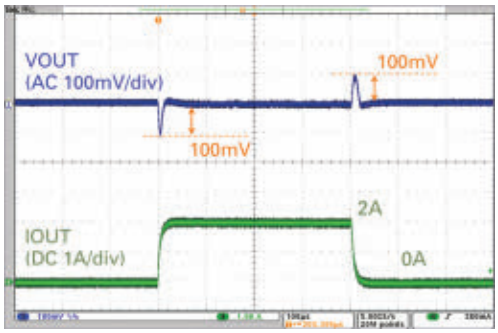

Figure 3. Renesas Electronics' RAA230133 has only 22μF of output capacitance and quickly recovers from the load step (Source: Renesas Electronics America Inc.)

The buck regulator with a 3.3 Vout and automatically switches over when DC/DC stops. The battery output (VBBout) is about 0.3 V lower due to the resistance of the internal switch used to transfer the battery voltage to the load. Thus, the designer must carefully choose a battery that will provide the proper voltage and current for the needed duration of the power backup requirements. This feature allows easy implementation of a continuous backup load current needed for critical components during an outage of the main Vcc and consequent shut down of the buck regulator. There are no additional circuitry needs for the battery backup.

These synchronous buck regulators can serve multiple applications with high efficiency. With the addition of a battery backup circuit into the buck regulator IC, critical loads are automatically transferred to a battery backup system for uninterrupted power. This allows designers to simplify design by reducing components, which saves space on the PCB and reduces the overall bill of materials. ECN

Harsh environment design necessities for miniature cables and connectors.

By **Robert Stanton**, Director of Technology, Omnetics Connector Corp.

Cable and connectors must often be selected or designed for the specific environment or application they are to be used. Silicon chip capabilities continue to expand where electronic systems are used. Sensors, detectors, and complete circuits are placed farther out on end-of-arm robotics systems, deeper into the sea for surveillance cameras, and immediately behind drill bits in down-hole drilling and logging tools. Navigation circuits are installed on roving vehicles on Mars, monitors are mounted inside gas pipelines, and military personal are carrying high-tech electronic packs through muddy swamps and over desert mountain peaks.

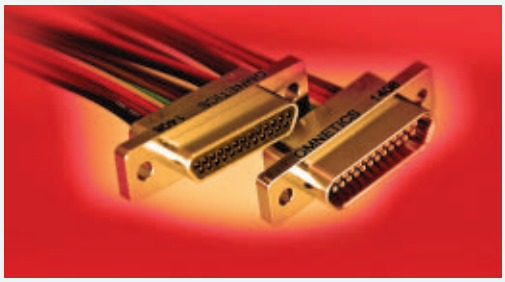

Figure 1. Extremely high-use application connectors at hand. (Images courtesy of Omnetics Connector Corp.)

Miniaturized cables and connectors are being designed to function across these kinds of harsh environmental conditions. System designers must be aware of the expected conditions their equipment will be exposed to. When basic rugged performance is expected, one can refer to an industry standard list of specifications like Mil-DTL- 83513 for micro-d connectors. This is an excellent general approach to ensure the connectors meet those conditions. There are multiple suppliers of these designs who meet the general "ruggedized" specifications.

In many cases, however, connector and cable designers must ensure their interconnection equipment survives and performs well beyond the standard specifications in truly extreme environments. Rather than looking at testing connectors to pass general specifications, the system designer must begin a specific check list that focuses on the worst of times. It is also important to remember that "extreme performance" can include a product operation in well-controlled environments that must also endure very high-speed motion with millions upon millions of operations a day. By using a check list to compare potential hazards, one can define the best connector materials to use and what method of latching, sealing, or insulating is needed. Each portion of the connector and cable should be reviewed against the list. One can then search connector suppliers for harsh environmental use. Oftentimes, no standard connectors of the correct size or electrical capability meets the circuit and module needs. The solution includes well-established solid modeling design systems for connectors and cable systems. Sitting down with the connector designer and going through the demands help define the connector. Application-specific connectors and cables have come of age with the coupling of automated machining equipment and 3-D printing of first-article products. Most often, a solid model can be completed within two to three days for the

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design team to review. Frequent reference to the harsh environmental conditions will keep design on track and assure better performance.

Focusing on the extreme challenges can be daunting but productive. A classic example is petroleum development and research. Many functions occur at temperatures of 200 degrees centigrade and in some cases exceeding 250 degrees centigrade. System designers must be specific about temperature level and also the length of time at that temperature. As heat goes up, electrical resistance of the circuit and conductivity is reduced. At the same time, connectors use insulator materials that must not sag or melt during the peak times at highest temperatures. At high temperatures, wire can become brittle, should be of the correct metal alloys, and be covered with unique insulating jacketing. In summary, a list of materials and design format cables must be pre-selected as the design is being completed. Assembly of the final connector and cable using preemptive selection and design should assure the system of success. ECN

Figure 2. Very high-temperature Micro-Ds connectors.

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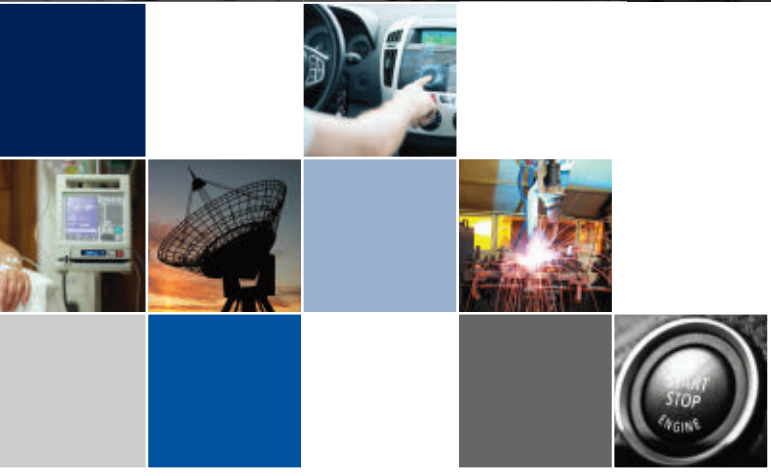

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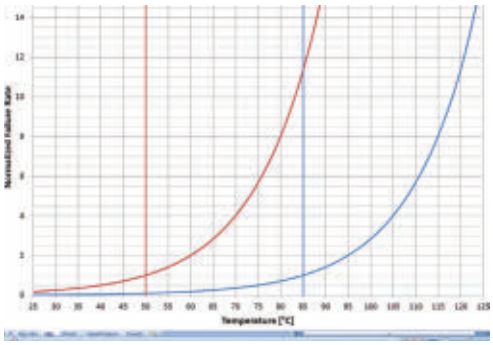

Normalized failure rates for semiconductors with a nominal operating temperature of 50 °C (red) and for devices characterized at 85 °C (blue).

While ever-smaller semiconductor-process nodes move from cutting edge to leading edge to mainstream, in percentage terms, smaller devices aren't driving faster processor clocks or memory busses nearly so much as they are increasing functional density. However, even at constant clock rates, a 40 percent increase in functional density corresponds approximately to a doubling of load-power density—dissipation per unit device area.

With increasing power density, well-characterized thermal-management designs are critical to achieving a high degree of product reliability. Several semiconductor failure mechanisms model with exponential temperature dependencies. Even modest changes in operating temperature—increase or decrease—can affect failure rates. Figure 1 illustrates one class of such failure mechanism with relative failure rates normalized for devices with a nominal operating temperature of 50 °C (red) and for devices characterized at 85 °C (blue).

Outside of the military and aero/astro markets, reliability doesn't get much overt attention per se. However, given the many means available for customers to rate products and share their experiences, premature failures can quickly damage products' reputations, particularly if customers perceive a disappointing trend.

Keep your cool

Although the world of fins and fans is but a small part of thermal management, technologies for cooling electronics drive a significant and growing market segment. For example, sales of thermal interface materials alone will likely reach $3.7 billion this year.

The contact efficiency—the ratio of contact to mating areas—between electronic heat sources and heat sinks can be as low as 3%, according to a recent report by ResearchMoz. Such low effective coupling area is largely due to micro voids on mating surfaces. The wide variety of available thermal pastes, pads, gels, and liquids allow thermo-mechanical designers to improve thermal interfaces' heat conduction—a key attribute for reliable high-density electronic assemblies.

Cooling systems must move heat away from its sources—usually semiconductors, magnetics, and resistive components—to an external thermodynamic heat reservoir. Think large body of water for nuclear power plants and the atmosphere for everything else. Cooling systems can take advantage of conduction, convection, or radiation in any combination but all must transport heat from source to reservoir. In this regard, simply removing heat from a semiconductor is insufficient. The task doesn't complete until that heat flows out of the system so that components operate at or below their target temperatures.

Manufacturers typically form heat sinks of aluminum because they can easily extrude, cast, or machine the metal; it exhibits good thermal conductivity and specific heat; and it provides strong structures of low weight and cost.

Innovations in semiconductor packaging have improved heat flow through pins,

supplementing traditional top-side cooling, but requiring means to extract heat from the circuit board. In recent years, some manufacturers have developed packaging technologies that accommodate two-sided cooling. Primarily popular with power-management components due to their low pin count, two sided cooling requires additional thermo-mechanical engineering within the system design, but can significantly increase the heat flow out of semiconductors and modules.

Biology, nanostructures, and the future of cool

Bi-phase or phase-transition heat spreaders and heat pipes, commonly found in laptop computers and other highly dense electronic assemblies, take advantage of the large heat of vaporization exhibited by readily available liquids. The most popular is water because it is non-toxic, it provides unusually high specific heat and heat of vaporization. Bi-phase spreaders and heat pipes can support large heat flows over considerable distance with no moving parts. Heat extracted from the application vaporizes some of the liquid. The vapor travels to a condenser, which serves as a heat exchanger. Condensed liquid flows along internal structures by means of wicking or capillary action through narrow pathways and sintered metal guides.

Late in March this year, researchers at Drexel University announced what could be the most important leap in cooling technologies since the commercialization of bi-phase components. Dr Matthew McCarthy and his team at the Multiscale Thermofluidics Lab have been working on methods to improve heat transfer efficiency in phase-transition structures that, remarkably, make use of the tobacco mosaic virus (TMV), shown in figure 2.

According to a Drexel report, the TMV consists of a single strand of RNA surrounded by thousands of coat protein strands. A genetically modified strain features "chemical binding sites—like molecular hooks—on the outer surface of the viruses that allow them to attach to nearly any substrate we want to use," McCarthy explains. These include stainless steel, aluminum, copper, gold, silicon, and a range of polymers.

Still in the development phase, test surfaces form by pouring a TMV bearing solution onto a substrate. Billions of rod-shaped viruses attach to the substrate, forming a "bristly layer" of nanostructures. The next process step coats the viruses with a thin metallic layer, typically nickel, which renders the viruses inert. The result is what McCarthy refers to as "metallic grass"—a coating of evenly spaced tendrils providing a very high surface area.

The structures support very high heat flows compared to other phase-transition structures. "These coating essentially act like a sponge, when a vapor bubble forms on the surface they wick liquid underneath it using capillary forces to delay the dry-out phenomena associated with critical heat flux. The result is a greater than three-times increase in the critical heat flux, which allows safe operation at higher and higher heat transfer rates," McCarthy explains. Early applications are likely to include steam turbines for electric generation and electronic cooling.

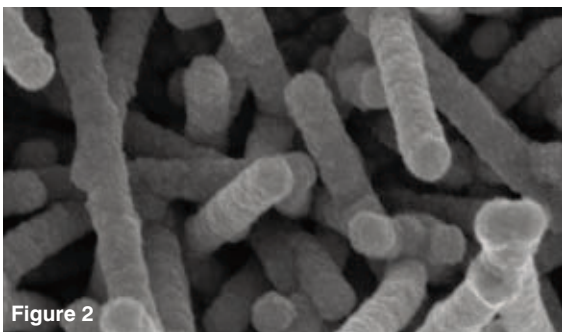

Figure 2

Tobacco mosaic viruses serve as the template for building nickel-coated nanostructures. (Image courtesy of Drexel University)

BRAINSTORM

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Q: 3D TVs are out. What's the next big thing for the displays market?

Matthias Pfeiffer, CTO of Displays, New Vision Display, Inc

TV markets can differ greatly depending on region. That means that the demands that drive the market in the near future are also different. In North America, average size will continue to increase, while in regions with smaller living rooms, sleek designs (extra thin, frameless, curved etc.) will be sought after. Independent of geographic area, resolution will further increase to 4k and even 8k sets and color gamut will increase through the use of saturated color backlight technologies like quantum dot fluorescence.

Smart TVs and personal computers will merge, resulting in even smarter TVs with powerful build-in web browser, communication software, and voice command recognition that are touch or gesture-enabled. We will interact with the TV much the same way as we will interact with our mobile phones and tablets. The TV will become our video-phone, our family calendar and notice board, and our portal to the outside world, while continuing to serve its classic function as the monitor for our video player, DVR and game consoles, internet content, and, yes, TV receiver. It will even offer several of these options simultaneously in different windows. Success will depend much more on user interface and user experience than on display technology.

Colin Geis, Product Marketing Manager, Red Lion Controls

The next big thing in the display market is not image resolution, refresh rates or screen size, but the ability to display important business intelligence through the collection of real-time data. This enables visual management, the process of displaying critical information such as Key Performance Indicators (KPIs), Overall Equipment Effectiveness (OEE), and Andon messages that relate specifically to production output, efficiency and quality.

By collecting and displaying this data on the factory floor, employees get a better sense of production levels and strive for higher performance. Visual management provides actionable information for supervisors to better monitor performance and proactively determine areas that need improvement. The overall result helps drive productivity and efficiency throughout the organization.

One example could be a contract packaging company using KPIs to drive productivity. Let's say this organization employs teams of workers to assemble packages, and determines quotes for new jobs based upon prior time studies. Considering the unique nature of every project, making a profit on a given job is dependent on the team's ability to set up the production line for a new run within the shortest period of time, and be able to maintain the assumed production rate for the entirety of each job. To accomplish this, real-time information is required to confirm if assumptions made during the quoting process are being met. By installing large LCD television screens on each line, the packaging company is now able to collect, display, and record conveyor speeds, alongside time elapsed during changeover periods. This allows supervisors to visualize data, monitor operations, and take immediate action when changeovers take too long or workers fail to meet required packaging rates.

In the end, the organization turned displays into a useful business tool, leveraging visual management to increase profitability and improve productivity with faster completion times.

Power inductors offer Isat ratings up to 59.2 Amps

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- The compact, surface mount measures just 7.0 X 7.5 mm, with a maximum height of 4.2 mm.
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- They are also constructed of proprietary materials that are not subject to thermal aging issues associated with other iron powder core inductors.

For more information, visit www.coilcraft.com.

Modules allow for power, flexibility for DAQ system

HBM , Inc has introduced two new modules for its SomatXR Data Acquisition System. The addition of the CX23-R data recorder and the EX23-R Ethernet switch make the SomatXR data acquisition system more powerful and flexible than other DAQ systems designed for harsh environments.

The data recorder is the heart of the data acquisition system. It synchronizes all connected measurement modules, computes and records values based on measurements, and stores recorded measurement data using smart data compression. It includes the following interfaces:

- three digital inputs and two digital outputs,
- a GPS interface for connecting a GPS receiver,
- three CAN interfaces (ISO 11898, CAN 2.0A and 2.0B),
- two Ethernet ports for connection to other SomatXR modules, and an Ethernet host port for connecting a PC with an up-to-date web browser for system configuration and data analysis.

For more information, visit www.hbm.com.

AC/DC power supplies are designed for board level applications

Now available from MicroPower Direct, the MPL-05SEUP series is a family of ultra-miniature, 5W AC/DC power supplies. These low cost power supplies are specifically designed to provide the small package, robust features and safety approval required for a variety of board level applications where performance requirements are high, but space is limited Six standard models operate from a universal input of 85VAC to 264 VAC; providing regulated single outputs of 3.3, 5, 9, 12, 15, or 24 VDC. They may also be used in high voltage DC/DC applications with an input of 100 to 400 VDC.

Features include:

- Tight line/load regulation.
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- All models are approved to EN 60950.
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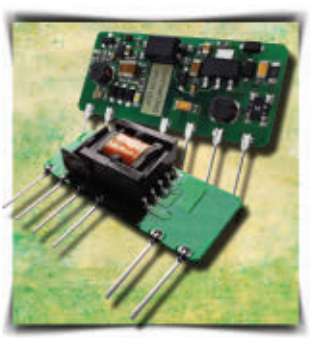
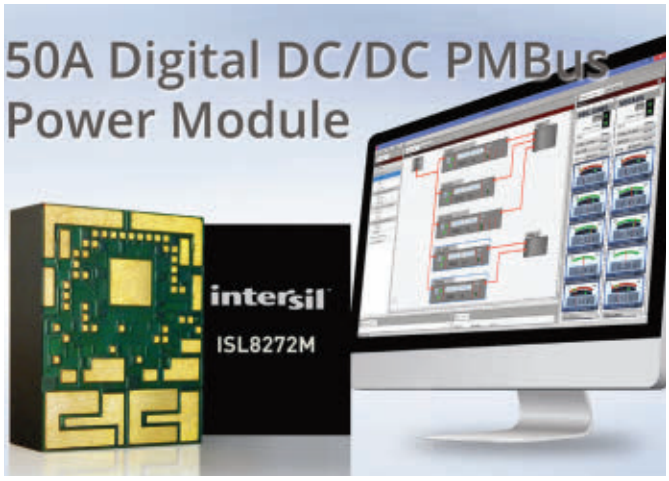


DC/DC power module delivers up to 50 A of output current

Intersil Corporation announced the industry's first 50A fully encapsulated digital DC/DC PMBus power module. The ISL8272M is a complete step-down power supply that delivers up to 50 A of output current from industry standard 12 V or 5 V input power rails, and four modules can be combined to support up to 200 A rails. It provides point-of load conversions for advanced FPGAs, ASICs, processors, and memory in space-constrained and power-dense telecom and datacom applications. The device is also well suited for high-end instrumentation, industrial and medical equipment.



Features include:

- 50A output current power supply with current sharing, multi-phase and multi-modules support for up to 200A power rails.
- PMBus-enabled solution for full system configuration, telemetry and monitoring of all conversions and operating parameters.
- Up to 96 percent conversion efficiency with 1 percent output voltage accuracy.
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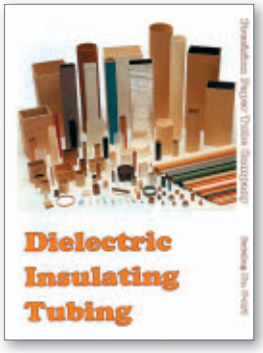

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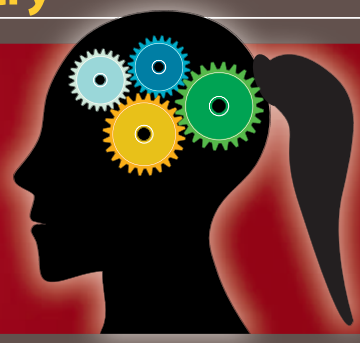
The White Board

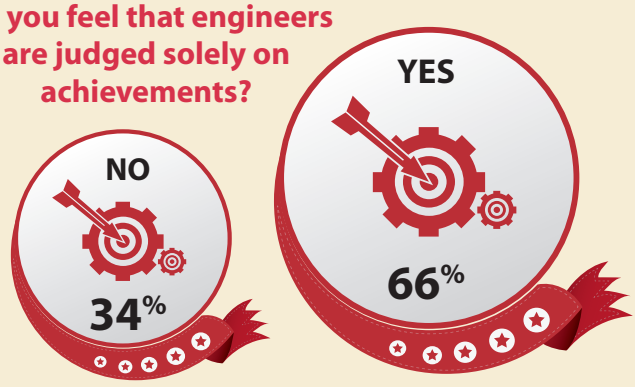
Gender in the Design Engineering Industry

By Kasey Panetta, Editor

The idea that engineering lacks diversity is a controversial one, but the numbers don't lie. In 2015, only 14 percent of engineers were women, up from just 5.8 percent in the early 1980s. The data from ECN's gender survey was particularly revealing. For example, when divided by gender, 100 percent of female respondants agreed that gender equality was a problem in design engineering, just under 44 percent of male respondents thought it was an issue.

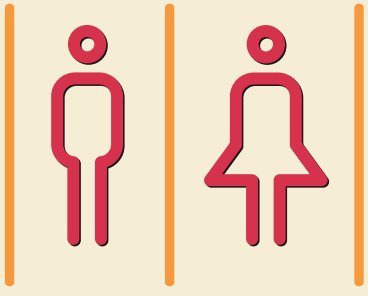


Do you feel that engineers are judged solely on achievements?

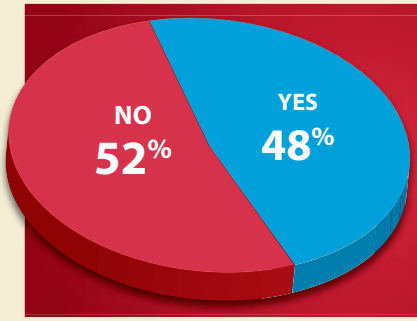


Is it beneficial to have a mix of men and women on a team?

YES it brings different perspectives **23%**

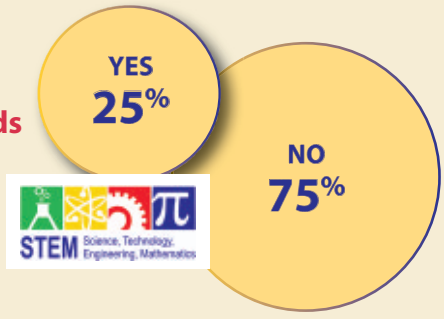


NO I don't think it matters **77%**

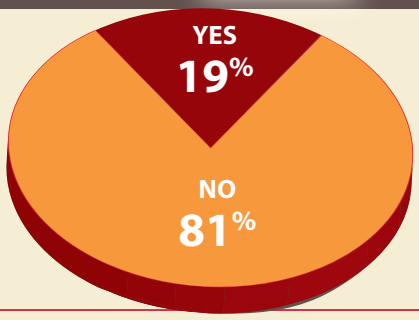


Do you believe that gender equality is a problem in the design engineering industry?

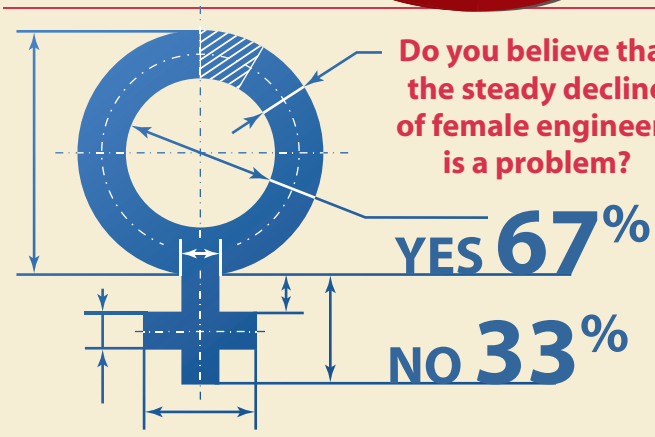
Does the STEM movement cater too much towards getting women involved in the field?



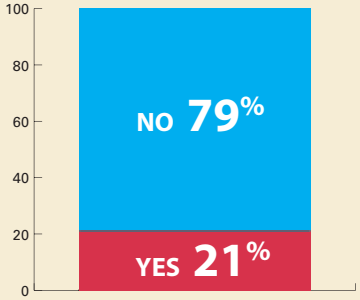
Do you believe that gender equality is a problem at your company?



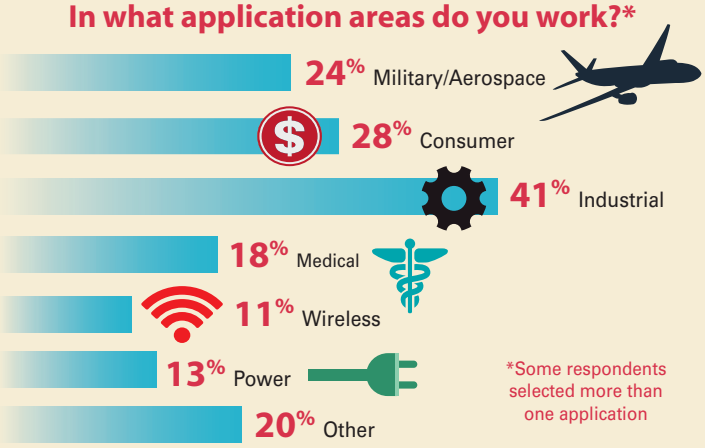
Do you believe that the steady decline of female engineers is a problem?



Do you ever feel as if you've been treated differently because of your gender?



In what application areas do you work?*



*Some respondents selected more than one application

designed by Larry Corby, Digital Artist

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