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Vol. 59 No. 11

Simplifying Solid-State Lighting Control

Portables And Wearables Drive Miniaturization Of Components

Brushless DC – A Practical Guide to Implementation

Modernizing Communications Networks For Railway Safety

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KASEY PANETTA | EDITOR
kasey.panetta@advantagemedia.com

What Makes An Engineer?

Among the great mysteries of the world, including but not limited to "Who shot JFK", "How the heck did Stonehenge happen", and "Can someone please explain hammerpants to me," there exists one more great question: What makes an engineer?

I've met a lot of engineers over the past few years—I mean, A LOT of engineers—and I'm always interested in how they arrived at their current position. Was it fated from birth? A class they took in high school? A particularly inspiring movie or book? I've asked around a bit and while the introduction details vary from person to person, almost every engineer I've met exudes a love of tinkering, problem solving, and figuring out how stuff works.

I've heard many stories about taking apart electronics—generally much to mom and dad's dismay—to see what makes the television tick or why the radio is able to function. I've heard inspiring stories about sudden high school epiphanies and following in the footsteps of inspiring heroes.

But what I want to know now, is how did YOU end up as an engineer? Throughout 2016, ECN will be publishing several features about the life of an engineer. What makes an engineer tick—which, by the way, many of those dismantled clocks never ticked nor tocked again—and what drives the pursuit of this crazy career.

You'll be seeing some surveys pop up in your mailbox (if you're not signed up for the newsletters, visit www.ecnmag.com to do so) and you'll read about how industry greats and regular joes ended up working in labs and on benches.

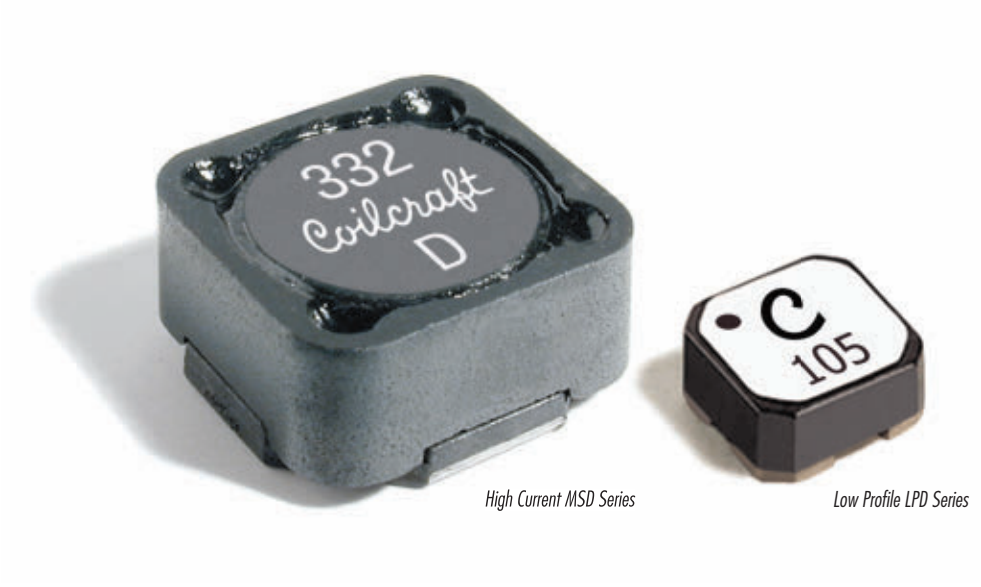
So, dear reader, I ask you this: What made you want to be an engineer? Think about it, write it down, make a short film, write a poem, and send it on to me at kasey.panetta@advantagemedia.com. You could be featured on the site or in the magazine. From what I can tell in the comment section, most of you have stories to tell, so fire up the old computer and tell your tale.

Until Next Issue,

Kasey Panetta

Kasey Panetta
Editor, ECN
Do you have something you'd like to talk about? Email me at Kasey.panetta@advantagemedia.com or tweet at me @kcpanetta.

The Ultimate Power Couple



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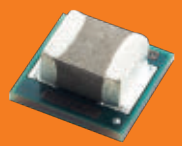

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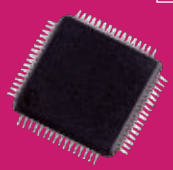

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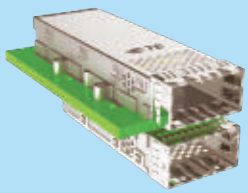

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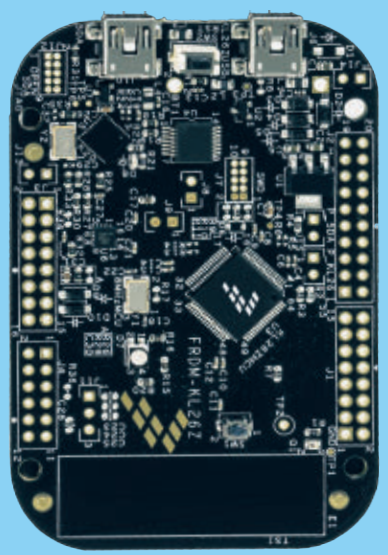

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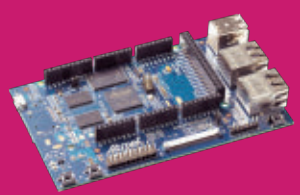

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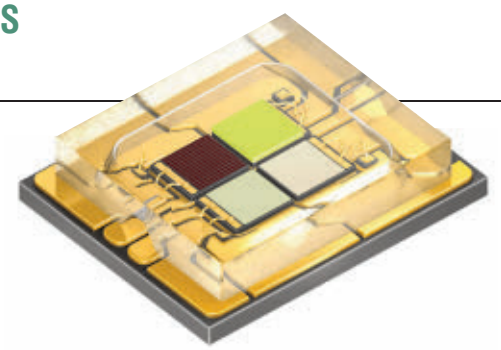

Osram Opto Semiconductors' new Osram Ostar Stage LED features four high-power chips with the latest thin-film and UX:3 technologies in red, green, blue, and white. Providing higher brightness with no increase in package size, this LED is ideal for use in stage spotlights. The four chips of the new high-power LED can be operated at up to 2.5 amperes (DC), thanks to improved chip technologies. This leads to twice the output of 30 watts (electric) from the same chip and package area compared to the existing version, adding another output class to the Osram Ostar Stage product family.

For more information, visit www.osram-os.com.

KEY SPEC:
These 1 mm^2 chips can be operated for the first time at up to 2.5 amperes (A), providing an output of 30 watts (W).

KEY SPEC:
The bundle offers a choice of two strain gage series: ZC-Series free-filament strain gages with etched Kanthal foil alloy grids and weldable LZ-Series wire strain gages with Nichrome V and Pt8W alloys.

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These gages are optimized for a wide variety of hostile environment applications, including geothermal measuring equipment, turbine engine control, and environmental test chambers in military, industrial, automotive, and down-hole drilling systems. Many analog circuits in these applications require components such as strain gages capable of surviving temperatures up to +2100°F (+1150°C).

For more information, visit www.micro-measurements.com.

ToF Signal Processing IC Detects Objects Up To Two Meters

Intersil Corporation has introduced an innovative time-of-flight (ToF) signal processing IC that provides a complete object detection and distance measurement solution when combined with an external emitter (LED or laser) and photodiode. The ISL29501 ToF device offers one-of-a-kind functionality, including ultra-small size, low-power consumption and superior performance ideal for connected devices that make up the Internet of Things (IoT), as well as consumer mobile devices and the emerging commercial drone market.

The ISL29501 overcomes the shortcomings of traditional amplitude-based proximity sensors and other ToF solutions that perform poorly in lighting conditions above 2,000 lux, or cannot provide distance information unless the object is perpendicular to the sensor.

For more information, visit www.intersil.com.

KEY SPEC:
The ISL29501 applies Intersil's power management expertise to save power and extend battery life through several innovations.

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Amount of time to refocus on the road after reading a text

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Engineering Update #131: Facebook Delivers The Internet From Space

- **Facebook Delivers the Internet From Space**
  Connecting people living in remote regions, traditional connectivity infrastructure is often difficult and inefficient. But now, Facebook finally may be one step closer to beaming Internet down from space.
- **A Scaleable Water Distiller**
  750 million people around the world lack access to clean drinking water. Alarmingly more than 840,000 people die each year from water-related diseases. Waterstillar is looking to change that.
- **SMRT Mouth Guard Monitors Hydration**
  Heat-related injuries are the leading cause of death Heat-related injuries are the leading cause of death and disability in high school athletes, according to the CDC. Dana Hawes, principal at Richmond Alternative School, along with retired super bowl champ Mike Robinson, have seen this first hand. That's why they've designed the SMRT Mouth, a mouth guard that tracks players' hydration, respiration, circulation, and exertion levels.

Does Space Really Need to be Politically Correct?

By Jamie Wisniewski, Associate Editor, @JamieECNmag

'Unmanned Rocket Explodes After Liftoff.' Most people would read this headline and think, "Thank goodness no one was on board!" because the term "unmanned" has, historically, been used to describe machines with no people on board. But others may think, "If there were people on board, I wonder what gender they would be?"

13 percent

Of engineers are women

From The NASA Vault: 10 Pictures From The Apollo Missions

By Kasey Panetta, Editor, @kcpanetta

Every so often NASA realizes it's been neglecting its adoring public and release some incredible footage or photos to put us off for a while.

(Just kidding. NASA releases awesome stuff all the time.)

But they have just released 8,400 high-res images from various missions that will blow your space socks off.

@kcpanetta Love love love what @BioCarbonEng is working on. Drones for trees! #FightDeforestation http://bit.ly/1OxFrV6 @ecnonline

Digital v Analog Power Supplies: Finding The Right Balance

The proper applications for digital versus analog power supplies.

By Frank Bidwell, Director of Engineering for the Engineering Services Group, XP Power

System effectiveness, status monitoring and energy efficiency require AC-DC power supplies to be monitored and controlled, and though the concept of doing this digitally has been around for some time, as end-designs are becoming more complex, many engineers are just starting to investigate the benefits that incorporating digital control into their system may bring.

A design engineer looking into digital methods of monitoring and controlling an AC-DC power supply may be drawn by the prospect of access to a high level of information compared to an analog system and the ability to control the output digitally. However, these functions come at the cost of system complexity.

Analog vs Digital

Digital control undoubtedly offers higher levels of flexibility. Power supplies can be turned on and off remotely, limits can be set on output voltages and currents and alarms on these levels enabled. Digital power supplies can provide monitoring data, such as temperature and fan performance, to help predict failures. Digital control can also ease calibration – parameters may be programmed instead of tweaking a pot in an analog power supply. On the down side, full digital control of a power supply involves many operating parameters and can be extremely complex. It requires a DSP with sophisticated software, which can be difficult to troubleshoot.

By comparison, analog control, having been used for 50+ years, is a tried and true method. Analog power supplies are stable and less prone to glitches, though they have limited flexibility. Parameters are defined during the design phase and cannot be changed later. While status can be monitored, control is usually limited to one possible reaction per parameter; with a digital power supply, there is usually an extensive range of input scenarios with multiple possible actions based on those scenarios, albeit limited by the speed of the processor.

Finding A Balance

Finding a compromise between analog and digital can be tricky. One approach to finding a balance between the two domains is to use a tried and true analog PWM controller with an addition of a digital interface, to create communication flexibility. In a typical design, an analog PWM controls the output voltage in real time, and a microprocessor monitors and adjusts that. The digital control board can artificially create multiple operating states by combining the single parameter control and status signals, allowing a higher level of flexibility than with the analog controller alone. This level of control suits the majority of customers who prioritise a cost-effective solution.

The analog PWM controller has the advantage of eliminating certain types of inaccuracies that are inherent to digital designs. For example, sampling signals with an ADC to feed to the DSP will introduce aliasing errors. Using a DSP to control the output will also introduce jitter into the PWM signal – this can cause sub-harmonics in the output leading to EMI problems in the application. Using an analog PWM effectively avoids this. However, since an analog PWM's switching frequency is set by hardware, this can't be adjusted. Also, a fixed control loop means this can't be optimised for different conditions without changing components.

Status Register CMD (hex)	Function	Protocol Type (R = Read / W = Write)	Number of Bytes
01h	On / Off Command (OPERATION)	Byte (R/W)	1 Read / Write
46h	Current Limit (in percent) (IOUT_OC_FAULT_LIMIT_	Word (R/W)	2 Read / Write
47h	Current Limit Fault Response (IOUT_OC_FAULT_RESPONSE)	Byte (R/W)	1 Read / Write
79h	Alarm Data Bits (STATUS_WORD)	Word (R Only)	2 Read Only
8Bh	Output Voltage (READ_VOUT)	Word (R Only)	2 Read Only
8Ch	Output Current (READ_IOUT)	Word (R Only)	2 Read Only
8Dh	Power Supply Ambient Temp (READ_TEMPERATURE_1)	Word (R Only)	2 Read Only
9Ah	Unit Model Number (MFR_MODEL)	Block (R/W)	10 Read / Write plus byte count
9Eh	Unit Serial Number (MFR_MODEL)	Block (R/W)	8 Read / Write plus byte count
99h	Unit Manufacturer ID (MRF_ID)	Block (R/W)	8 Read / Write plus byte count
D0h	Unit Run Time Information (MFR_SPECIFIC_00)	Block (R Only)	4 Read Only plus byte count

Table 1. The PMBus command structure for the GFR1K5.

Command Code	Code Name	Access Type	Data Format	Data Bytes
3h	CLEAR_FAULTS	Send Byte		1
20h	VOUT_MODE	Read Word	Linear	1
22h	VOUT_TRIM	Write Word	Linear	2
79h	STATUS_WORD	Read Word	Binary	2
7Eh	STATUS_CML	Read Byte	Binary	1
81h	STATUS_FANS_1_2	Read Byte	Binary	1
8Bh	READ_VOUT	Read Word	Linear	2
8Ch	READ_IOUT	Read Word	Linear	2
8Dh	READ_TEMPERATURE_1	Read Word	Linear	2
98h	PMBUS_REVISION	Read Byte	ASCII	1
99h	MFR_ID	Block Read	ASCII	8
9Ah	MFR_MODEL	Block Read	ASCII	15
9Bh	MFR_REVISION	Block Read	ASCII	2
9Eh	MFR_SERIAL	Block Read	ASCII	9
D0h	READ_VFAN	Read Word	Linear	2
D1h	READ_RUN_TIME	Block Word	Linear	4
D2h	IOUT_LIMIT_TRIM	Write Word	Linear	2

Table 2. The PMBus command structure of the EMH350, with a higher level of complexity compared to the GFR1K5.

Communications

The most widely-used communications protocol for digital control of power supplies is PMBus, a clearly defined industry standard intended to make power supplies plug-and-play, so that the interface from the end equipment can be designed without even seeing the power supply. While it's perfectly possible to control a digital power supply using a CAN bus, or Ethernet for example, this requires much more time developing a protocol stack for use in each specific application. PMBus is much simpler. It features a relatively simple interface (two I/O lines) which can help make hardware smaller, and there are only three layers to the PMBus stack, compared to 10 or 12 for a comparable Ethernet implementation. For this reason, designers in a hurry, and those without deep networking expertise or resources often choose PMBus.

Aside from monitoring and control functions, utilising the PMBus interface allows several additional applications. Battery charging is one example – since the output current and output power are monitored, a battery can be charged from the power supply without the need for an external interface. Power sequencing can also be implemented, using a multiple output power supply turned on or off at a particular time or in a particular sequence as determined by the system.

Real Applications

As an example, the GFR1K5, a 1U rack-mount 1500-W AC-DC front end from XP Power uses a PM Bus interface with a very simple command structure to give a practical amount of control, as shown in table 1. The output can be turned on and off, and the overcurrent shut down point can be set; hardware based shut down occurs at 110-140 percent of Inom, but a firmware shut down point can be set for 105 to 0 percent. Response to a firmware shut down can be specified as well (latch off or a hiccup mode with an adjustable number of retries or continuous retry).

The PMBus interface also enables monitoring capabilities: signals are available for output voltage, output current and temperature, and the data bits for the alarms can be set easily using the interface. Information can be retrieved about the model number and serial number (useful in a system with many power supplies) and the runtime is also available.

In summary, there are pros and cons to both the analog and digital control of power supplies, but an analog PWM controller with a PMBus interface picks the key benefits of both approaches, achieving a balance between functionality and cost. Different methods for accessing power supply functions are available, but the widely-used PMBus protocol is specially designed for power supplies and is therefore the easiest to implement, while offering full access to all the functionality of a modern AC-DC PSU. ECN

Brushless DC: A Practical Guide to Implementation

The benefits of utilizing BLDC motors.

By Mark Lewis, Vice President – Marketing and Sales, Dart Controls, Inc.

Brushless DC (BLDC) motors have the performance advantages of DC permanent magnet motors without the need for motor brush maintenance. BLDC motors have the additional advantages of very high base speed (20,000 RPM and higher), quiet operation and energy efficiency. In years past these advantages came with an initial investment premium. Today that premium over traditional DCPM motors has been reduced to the point where BLDC motors and drives may be seriously considered.

The following is provided to help designers and users have a better understanding of the practical aspects of implementing BLDC motors and drives in their variable speed applications.

Drive & Motor Connection

The market for BLDC drives and motors is fragmented – evidenced by the number of companies who list themselves as Motor Manufacturers (133) and Brushless DC Drive Manufacturers (50), according to ThomasNet. There is little standardization in terms of motor wire color coding, terminology or orientation – with eight or more wires to connect from the motor it is very easy to misconnect to the drive causing erratic performance or damage. It is not unusual that the drive and motor will come from separate suppliers to meet the users' requirements.

The recommendation when sampling a BLDC system is to request the motor, motor timing diagram and performance curve data all be sent to the drive manufacturer (or drive to the motor manufacturer). This will allow the suppliers involved to establish the correct connection and send the tested motor and drive to the user ready for evaluation.

Drive & Motor Voltage

There are defacto standard BLDC motor armature voltages on the market, with the most common being 24 V. Experience finds the designer/user has already selected the motor prior to investigating drive options. When selecting a drive, there seems to be an expectation to apply (example) 120 VAC source power and get 0-24 VDC out of the drive. While this is possible, it is not advisable. Source voltage should be considered when selecting motor armature voltage – wide discrepancies between them mean energy is needlessly dumped across the drive, and the drive is forced to operate inefficiently. Speed range is restricted and speed regulation is compromised. Energy savings are sacrificed.

Line voltage BLDC drives (120 VAC / 240 VAC, single phase) typically produce 160/320 armature voltages as designed for optimum performance. BLDC motors can be wound for these voltages and a growing number of BLDC motor manufacturers are offering these options.

In some cases the best option for the user is a low voltage motor. In the absence of a low voltage power supply, the recommendation is to buy one. There are many makes and models of power supplies on the market with all the necessary electrical certifications and voltage in/out combinations needed. Economy of scale makes the power supply manufacturer the best source for line voltage to DC voltage conversion, as opposed to a drive manufacturer incorporating this function into their product.

Drive & Motor Speed Regulation

The majority of BLDC drives are sensored (closed-loop) design. This means the drive is expecting some sort of feedback from the motor to verify its speed/rotor to phase position relationship to maintain electrical commutation by the drive. This feedback is accomplished using (typically) hall-effect transistors in the motor; or an encoder. Some drives and motors are being designed as 'sensor-less'. The key here is a sensored drive is designed for use with a sensored motor. There are applications for both sensored and sensor-less designs. The recommendation to equipment designers/industrial users who wish to regulate the speed of their motors under varying conditions use a sensored design.

BLDC technology is gaining momentum as equipment designers and users consider size, weight, performance and long-term maintenance in their selection process for motor/drive packages.

In the 1/2HP and below market, BLDC is a viable alternative to brushed DC and AC motor/drive packages in terms of overall cost. Some applications (pumps and fans) see distinct advantages in BLDC through the unique ability to run at higher speeds to produce equal throughput, at a smaller size/weight/cost. ECN

Which State Is The Most Energy Efficient?

By Kasey Panetta, Editor, @kcpanetta

Energy efficiency is a hot button issue in the United States, and every year the American Council for an Energy -Efficient Economy (ACEEE) releases a survey of all 50 states (plus D.C. and three territories) ranking them in order from most efficient to least efficient. Considering savings from 2014 the electricity efficiency programs totaled about 25.7 million MWh, this survey highlights what states are succeeding and which states aren't keeping up.

The states are all ranked on a 50-point scale. They're awarded points across six major policy areas: utility-sector energy efficiency, building energy codes, transportation efficiency, state-led initiatives, combined heat and power and appliance and equipment standards. They also take a look at which states have showcased the most improvement over the past year. This year, states can add points for areas like energy savings--up to six points for electricity savings and three for natural gas--and they also increased the importance of transportation when it comes to efficiency. States could earn a total of 10 points for their transportation category. Most importantly, the survey looks at how policies are shaping efficiency since good policies means good changes.

The scorecards break all the aspect of the point-system down on a state-by-state basis. It looks at things like if emergency vehicles are electric, the adoption and enforcement of building codes, or emissions programs. (Check out how your state ranks, here.)

So what state is the most efficient? This year the honor goes to Massachusetts followed by California, Vermont, Rhode Island, Oregon, Connecticut, Maryland, Washington, New York and a 10th place tie between Minnesota and Illinois.

Modernizing Communications Networks For Railway Safety

The emerging popularity of Internet Protocal/Multi-ProtoCol Label Switching.

By Thierry Sens, Marketing Director, Transportation Segment, Alcatel-Lucent

Railway safety is currently in the spotlight due to recent, high-profile accidents in the United States and Europe. While such tragic events are fortunately quite rare, there are technologies available today which could make such occurrences far less frequent.

These signaling and train control technologies can automatically trigger emergency brakes when certain conditions occur, such as a train exceeding the speed limit on a particular length of track, thereby overcoming incidents of driver error which are often at the heart of railway accidents (and which have been implicated in recent tragedies). However, the rollout of these technologies - known as Positive Train Control (PTC) in the U.S. and European Train Control System (ETCS) in Europe – has been slow and patchy, despite respective mandates calling for rapid deployment.

Why? One issue is of course cost; the modernization of these systems is a substantial undertaking. Additionally, there have been significant debates, particularly in Europe, as to how best to implement and evolve ETCS, and similar questions have been raised in the U.S. However, the recent spate of accidents should provide encouragement for railway operators to move more quickly to implement train control in their systems, both to save lives and to protect the industry's reputation. This moment also provides them with an opportunity; by deploying the latest communications technology to support these mission-critical capabilities, they can reap a variety of other benefits.

Internet Protocol/Multi-protocol Label Switching (IP/MPLS) has emerged as the networking technology of choice to support a wide variety of mission-critical applications in an equally wide array of industries and markets, from public safety networks for governments, to electric power distribution for utilities, to addressing operational requirements for transportation companies of all kinds. IP/MPLS is the technology at the foundation of the largest, most sophisticated communications service provider networks in operation today, and has been designed to meet the extremely demanding requirements of telecommunications networks, which are relied upon by consumers and businesses worldwide to address their communications needs.

As such, IP/MPLS networks adhere to the strictest requirements for reliability, resiliency, performance and security, making them ideal for delivering applications such as PTC and ETCS where failure simply isn't an option. At the same time, IP/MPLS networks offer the opportunity to introduce additional features that are very attractive to railway operators, such as CCTV networks to enhance safety and security, and onboard Wi-Fi to improve the passenger experience and support new, revenue generating services.

Traditionally, each of the various communications-related services delivered on railways were supported by a dedicated network deployed specifically for those services, based on technology that is increasingly obsolete. This created network 'silos' each of which needed to be managed independently. This is no small challenge, entailing considerable cost, staff time and maintenance resources, both in terms of equipment and personnel.

As an alternative, by combining IP/MPLS routing and switching equipment and microwave and LTE radio components, it is possible to build a converged IP/MPLS network that can host all of an operator's services on the same infrastructure, offering substantial benefits in terms of both performance and efficiency.

To date, neither the U.S. Federal Railroad Administration nor the European Union has been particularly aggressive when it comes to enforcing the mandates for PTC and ETCS implementation. However, it is certain that the requirements for train control solutions will not go away, and each deadly incident prompts renewed calls for the deployment of these life-saving technologies.

A variety of railway operators around the world are already working to put IP/MPLS networks in place to support their signaling applications – such as Refer in Portugal and Trafikverket in Sweden – while introducing features such as synchronous Ethernet, cyber attack protection, non-stop routing, non-stop services, and fast reroute.

Railway operators that proactively move in this direction are well placed to reap the rewards of improved interoperability, capacity, reliability and safety by hosting enhanced train control on IP/MPLS. The time to get rolling is today. ECN

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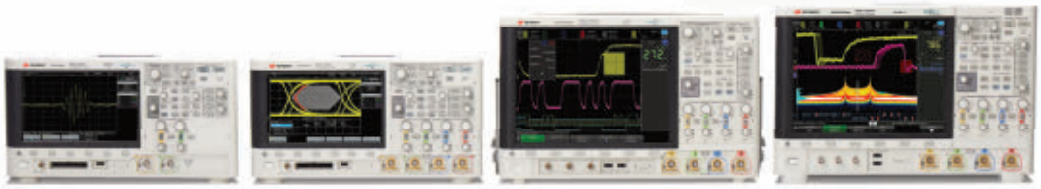

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Portables And Wearables Drive Miniaturization Of Components

By **Paul Pickering,** Technical Contributor

One long-term trend that shows no sign of abating is the move towards smaller and smaller electronic equipment. Desktop machines become laptops and then tablets. Phones squeeze more and more features into ever-thinner packages. X-ray machines that formerly required a dedicated room are now brought to patients on carts. New applications in industrial automation, medicine, and even the military are also following the same pattern.

We've all heard about Moore's Law and the huge increase in the density of transistors on a single integrated circuit - Intel's 4004 came in at 192 transistors/mm2 compared to 8.4 million/mm2 in the current-generation Xeon Haswell-EP - but that's only part of the picture. The trend towards packing more technology into a smaller space imposes severe constraints on designers across the board, from connectors to batteries to antennas.

In this article we will discuss a few of the components that have arisen in response to this challenge, as well as some applications that smaller sizes have made possible.

Antennas

Portable equipment and emerging Internet of Things (IoT) applications such as home automation, automatic meter reading, and wireless security have led to a proliferation of miniature antennas for cellular M2M, GPS, as well as WPAN and WLAN applications such as Bluetooth, Wi-Fi, WiMAX, and ZigBee. Antenova, for example, offers their gigaNova line: a sample product is the Fusca 2.4GHZ SMD antenna, which measures 4 mm x 3 mm x1.1 mm and claims 65 percent efficiency at that frequency.

The trend towards miniaturization applies to radar systems, too. Witness the May 2015 announcement by Google's Advance Technology and Progress (ATAP) group of Project Soli, a new interaction sensor that uses radar technology to capture movements and gestures of the human hand, the goal is to interact with wearables and other IoT devices. The Infineon radar sensor operates at 60 GHz (5 mm wavelength), and has a range of 0.05 – 5 m and a field of view of 180º. The demo system displayed uses an array of 2 x 2 microstrip patch antennas; the board, including antennas, measures less than 1" x 1", making it suitable for use in wearables.

Connectors

In a portable devices such as smartphones and tablets, space is at a premium, but you still have massive amounts of data to transfer between boards. In response, manufacturers have developed ultra low-profile microminiature Board-to-Board (BtB) connectors which feature high pin-count and small size. The interconnect medium is usually Flexible Flat Cable (FFC) or Flexible Printed Circuit (FPC).

For example, TE Connectivity offers a 0.35 mm fine pitch stackable BtB connector with a body width of only 1.85 mm and height as low as 0.6 mm. In RF, the Molex SSMCX is a super small micro-coaxial (MCX) connector developed for miniature radio and antenna applications. Operating up to 10 GHz, it's 30 percent smaller than the predecessor MMCX (micro-miniature coax). The first application is an IEEE 802.11x radio and antenna for a notebook computer.

Batteries

Apart from the mobile phone industry, another driving force in the downsizing of batteries is the medical field; miniature batteries with high volumetric efficiency are widely used in implantable medical applications such as neurological catheters, cardiovascular monitoring, and retinal or cochlear implants.

Implantable batteries employ a range of chemistries, including Lithium Manganese Dioxide (Li/MnO2), Lithium Thionyl Chloride (Li/SOCI2), Lithium Carbon Monofloride (Li/CFx), and Lithium Ion (Li-ion); EaglePicher's smallest Micro Cell occupies 0.1cc and weighs 0.1 g. Using Li/MnO2 chemistry, it outputs 2.8V and has a capacity of 2.5mAh.

For wearables, Panasonic's cylindrical Li-Ion CG-320 is 3.5 mm in diameter and 20 mm in length, making it

suitable for applications such as smart glasses, hearing aids and fitness bands; its nominal capacity of 13 mAh and 3.75 V output allows for Bluetooth and NFC (near-field communication) links with smartphones.

The future holds out promise for batteries orders of magnitude smaller: a team at Harvard has demonstrated a 960μm x 800μm battery using 3-D printing, and researchers at the University of Maryland have constructed a battery out of millions of "nanobatteries", each 50 μm tall and 250 nm wide, connected in parallel to form an array. Each nanobattery contains an anode, a cathode and a liquid electrolyte and is confined within the nanopores of an anodic aluminum oxide structure.

Miniature Motors

In the operating room, surgical procedures such as laproscopy and endoscopy require highly compact microdrives for positioners and other actuators; the drives must also be bioinert and withstand a range of sterilization procedures including autoclave, sterrad, EtO, gamma, and chemical sterilization.

Stepper motors are popular for these applications due a combination of high performance and small size; for example, Faulhaber offers products with diameters down to 6 mm and lengths of 9.5 mm.

Other manufacturers have introduced miniature stepper motors aimed at the portables market. Japanese manufacturer Nidec-Sanyko, for example, has a miniature 2-phase stepper motor with a 4-wire interface that features a diameter of 10mm and a height of 12 mm; operating from 5VDC, the unit comes with a gear of 3.5 mm diameter.

In addition to the medical applications mentioned above, miniature brushless DC (BLDC) motors are used in micro-robotics, SLR cameras and semiconductor manufacturing. Namiki offers a 10 mm-long BLDC with a diameter of 2.4 mm which has a no-load speed of 650 rpm and a stall torque of 200 μNm; 1.5 mm diameter models are in the prototype stage.

Miniature RFID Tags

Miniature components lead to miniature products, which in turn spawn innovative new applications; trying to understand and prevent bee colony death, scientist and engineers at CSIRO, Australia's national science agency, have developed a monitoring system that uses RFID tags small enough to be attached to individual honey bees.

The system relies on the IM5-PK2525 Ultra Small Package Tag (USPT) from Hitachi Chemical, which incorporates the Monza 5 tag chip from Seattle-based Impinj. The UHF tag has a carrier frequency of 860 – 920 MHz; it transmits a 96-bit Transponder ID (TID)

and a 128-bit Electronic Product Code (EPC), which is unique to each bee. The tag measures 2.5 mm x 2.5 mm x 0.4 mm and weighs 5.4 mg, allowing the bee to carry about 80% of its normal load.

Looking To The Future

These miniature components are impressive enough, but the expansion of the IoT over the next few years will accelerate the shrinkage, with connectivity finding its way into successively smaller and smaller devices. In a world where the "connected lightbulb" is already on the shelves at the local hardware store and an "ant-sized radio" has already been announced, the drive towards successively smaller (yet still more capable) devices looks set to go into high gear. ECN

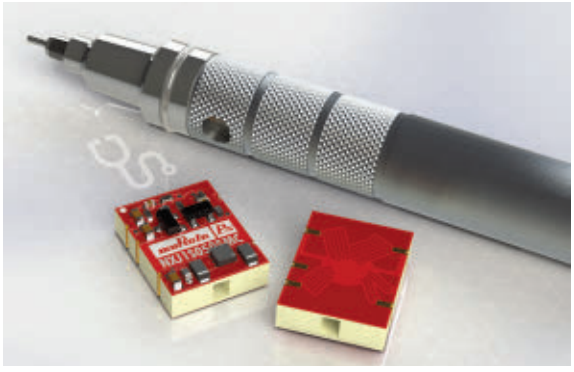
Why Are Researchers Gluing Sensors On Honey Bees?

Figure 1: attaching an RFID tag to a honey bee (source: ZDNet)

By **Kasey Panetta,** Editor, @kcpanetta

Maintaining a healthy honey bee population is vital to ensuring crops that require pollination are able to thrive. Unfortunately, habitat loss and increased use of pesticides and increasing amounts of diseases have decimated the wild bee population. Colony collapse syndrome, which is what scientists call it when a previously healthy colony suddenly dies off, is now a frequent occurrence that researchers are unable to stop. Plus, the colonies are also at risk of attack by Varroa destructor, a predatory mite that destroys entire colonies and has wreaked havoc with the honey bee population over the past 10 years. Luckily, honey bees in Australia have remain immune to the mite thus far, so researchers are using that geographic population to study and research colonies. It's an international effort, however, with scientists from Brazil, Mexico, New Zealand and the U.K. joining up to share the research.

1W Surface-Mount DC-DC Converters Offer High Reliability



Murata has introduced the NXJ1, a series of single output, high reliability, high isolation, 1W surface-mount DC-DC converters designed for medical products, with other applications in industrial, transport, and telecom markets. Manufactured by Murata Power Solutions and measuring only 13.72 x 10.46 x 4.36 mm, this compact low-profile series features six models comprising nominal input voltage options of 3.3, 5, or 12 VDC and single outputs of 3.3, 5, 12, or 15 VDC.
For more information, visit:www.murata-ps.com.

Automotive Image Sensor Includes LED Flicker Mitigation

ON Semiconductor announces sampling of ground-breaking LED Flicker Mitigation (LFM) technology in a new 2.3 megapixel (MP) CMOS image sensor that sets a new benchmark for automotive Advanced Driver Assistance Systems (ADAS) applications. Capable of capturing 1080p high dynamic range (HDR) video, the AR0231AT also includes features that support Automotive Safety Integrity Level B (ASIL B). The LFM technology (patent pending) eliminates high frequency LED flicker from traffic signs and vehicle LED lighting and allows Traffic Sign Reading algorithms to operate in all light conditions. The AR0231AT has a 1 / 2.7 in. (6.82 mm) optical format and a 1928 (horizontal) x 1208 (vertical) active pixel array. It uses the latest 3.0 micron Back Side Illuminated (BSI) pixel with ON Semiconductor's DR-Pix™ technology, which offers dual conversion gain for improved performance under all lighting conditions. It captures images in linear, HDR or LFM modes, and offers frame-to-frame context switching between modes.
For more information, visit: www.omsemi.com.

Simplifying Solid-State Lighting Control

By Koichiro Yoshimoto, Thyristor Business Development Manager, Semiconductor Business Unit, Littelfuse, Inc.

Solid-state lighting is quickly become the most popular lighting option for a wide range of applications. As incandescent lamps have been rendered largely obsolete, given the U.S. government's mandate to save energy, they are increasingly being replaced by Light Emitting Diode (LED) bulbs due to their long life (typically 25,000 hours) and the ease of adapting them to many different socket and shape requirements. As prices for LED bulbs continue to drop and become increasingly competitive with compact fluorescent (CFL) bulbs, some predict LED lighting's share of the residential lighting market will reach nearly 50 percent by 2016 and more than 70 percent in 2020. However, from the designer's perspective, it's important to understand that LED lighting and dimmer controls present different challenges than earlier technologies.

Triacs (short for triode for alternating current) make up the heart of AC light dimming controls. These components can conduct current in either direction when turned on. In the past, triacs used in dimmers were normally characterized and specified for incandescent lamp loads, which have high current ratings for both steady-state conditions and initial high in-rush currents, as well as very high end-of-life surge current when a filament ruptures.

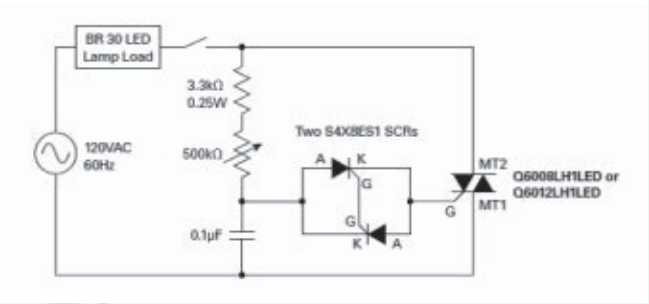


Figure 1. Dimmer circuit for a recessed flood lamp, incorporating two inverse parallel sensitive gate silicon-controlled rectifiers (SCRs). (All illustrations courtesy of Littelfuse, Inc)

In contrast, LEDs have much lower steady-state current than incandescent lamps, and their initial turn-on current can be much higher for a few microseconds at the beginning of each half-cycle of AC line voltage. Typically, the current spike for an AC replacement lamp is 6–8A peak; the steady-state follow current is less than 100mA.

LED bulbs for home lighting might draw 7.5W (A19 bulb-450 lumens) or higher, with a chandelier typically having from four to ten bulbs. However, a string of 50 Christmas lights could draw as little as 4.8W. An LED flood lamp for a recessed ceiling fixture designed to replace a typical filament unit that produces 750 lumens consumes only 13W (BR30) in contrast with the old filament unit, which normally draws 65W.

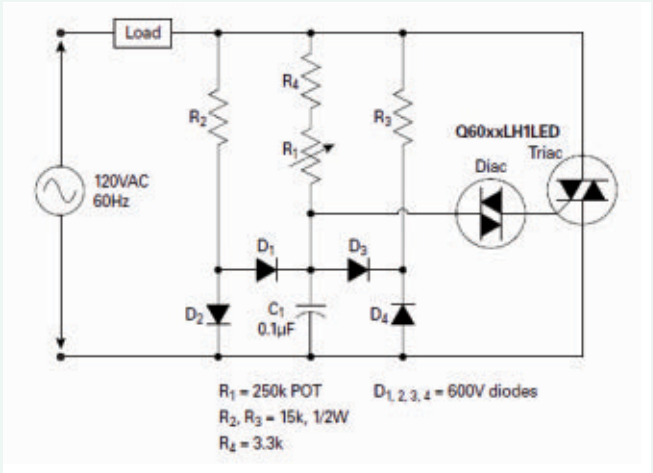


Figure 2. Dimmer circuit designed for improved hysteresis.

The latest generation of triacs make designing an AC circuit for controlling LED light output very simple because relatively few components are required: a firing/triggering capacitor, a potentiometer, and a voltage breakover triggering device. Using two inverse parallel sensitive gate silicon-controlled rectifiers (SCRs) as the voltage breakover triggering device allows the controlling circuit to produce a wide range of light level outputs. This also allows achieving a low hysteresis control because two SCRs form a full breakback trigger. Figure 1 illustrates a circuit diagram for a control suitable for a recessed flood lamp (such as a BR30 LED lamp).

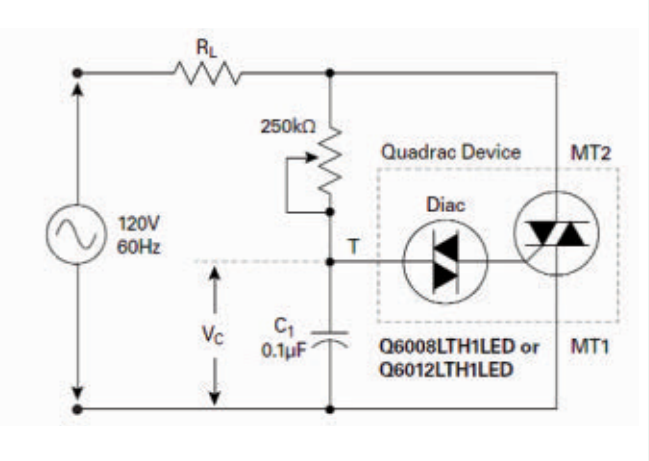


Figure 3. In this quadrac-based dimming circuit, the potentiometer is 250kΩ with built-in fixed end resistance of 3kΩ minimum. The quadrac device is a QxxxxLTH1LED with more sensitive triac die (low gate and holding current characteristics). RL is a minimum LED load of 10W. VC is the same as the triggering voltage of the built-in diac die.

This circuit allows the bulb to turn on at nearly the full 180° on each AC half-cycle; the RC timed turn-on also may be delayed to a small conduction angle on

each half-cycle for very low light output. A triac with low holding and latching current characteristics, allows the triac to remain on at very low current levels. Two inverse parallel sensitive gate SCRs (S4X8ES1) with their gates tied together produce a very low voltage triggering device with full breakback voltage, producing very low hysteresis. That allows the potentiometer to be set for a low conduction angle with turn-on being immediate when the line switch is turned off and on. The circuit diagram in Figure 2 improves upon older phase control/dimmer circuits that provided poor hysteresis by adding steering diodes around the C1 firing capacitor.

For applications in which a wide control range and low hysteresis are less critical, a quadrac device (a special type of thyristor that combines a diac and a triac) offers a simple variable light control alternative. Figure 3 illustrates how to reduce the component count further by combining the diac triggering device and an alternistor triac in a single TO-220 isolated mounting tab package. This control circuit allows a little lower full turn-on voltage due to higher VBO switching of the diac trigger device but offers a dimming function that operates from 175° to <90° of each AC half-cycle.

Developing Smart Solutions For Smart Lighting

By Thomas Rechlin, Senior FAE for Europe of RECOM Engineering in Gmunden, Austria; **Wolfgang Wolfsgruber,** Head of Quality Lab of RECOM Engineering in Gmunden, Austria

"Square pegs in round holes." This aptly describes the task engineers face when trying to develop the perfect lighting solution. As if it were not difficult enough to match LEDs with suitable LED drivers and embedding them in a suitable thermal environment, builders of "smart homes" now demand a multitude of intelligent lighting solutions, posing new challenges to lighting designers.

"Smart lighting" is the buzz word, and lamps are now expected to do much more than just brighten up a room when a switch is pressed. Lighting is now expected to adapt itself automatically to the needs of people, generating the perfect ambience for any activity, or putting goods and persons into the right light. These new smart solutions must also be energy-efficient, as consumers want to reduce their carbon footprint.

To meet all these objectives, engineers and designers are resorting to a number of innovative technologies and approaches.

Control Systems For Modern Lighting Solutions

When it comes to lighting control, there are two schools of thought. One group swears by wired systems, while the other prefers wireless solutions. Both options obviously have their advantages and disadvantages.

Wired systems, such as DALI, DMX, or KNX, are often perceived as outdated. The DALI interface was, for instance, standardized in the 1980s. Given the relatively high wiring costs, these solutions are not really suitable for retrofitting into existing buildings.

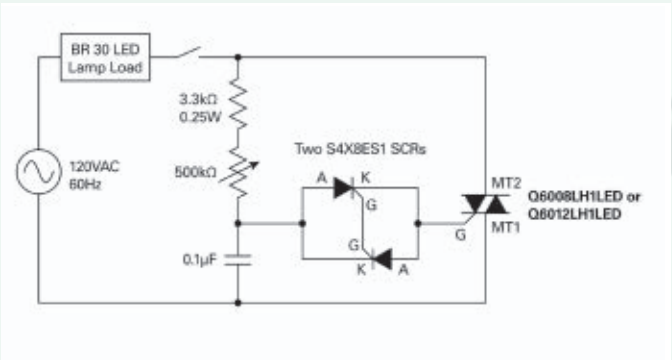


Fig. 1: Wired system in a configuration typical of commercial. (Illustrations courtesy of RECOM) premises.

On the other hand, the technology has proven very reliable, and can easily be installed by any electrician, as all that is required in most cases are two additional control wires. In addition, they are very resistant to interference.

Wired lighting control systems are therefore still the preferred solution for new buildings. Luminaires can be integrated directly into the building automation system (e.g. KNX), or installed with standardised gateways (e.g. DALI). Wired systems are normally programmed through a system controller that automatically searches for connected devices and assigns addresses during the commissioning process. This allows for easy configuration in groups, irrespective of the actual wiring. System components can also be serviced and replaced without the need for time-consuming reprogramming.

Wireless systems on the other hand are currently experiencing a real boom given the trend towards the Internet of Things (IoT).

Systems like WiFi, Bluetooth and ZigBee are predestined for retrofitting, as they do not require any additional wiring apart from a power line. By choosing suitable gateways, they can also be integrated into existing installations.

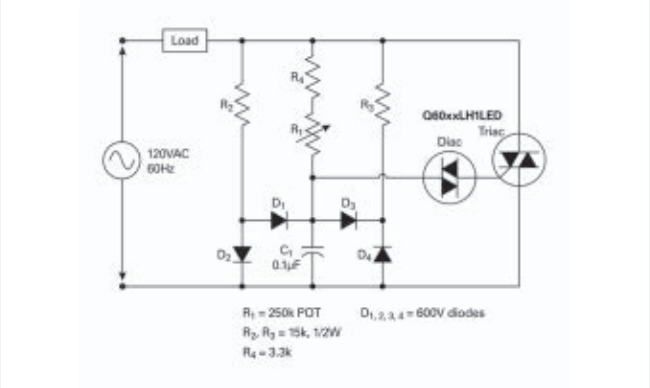


Fig. 2: Devices that can communicate with each other through a smart home wireless network.

Virtually all wireless technologies use Carrier Sense Multiple Access (CSMA) to communicate within the same frequency band. With CSMA, each network subscriber checks first whether the channel is free before sending a command. To prevent one device from continuously blocking the channel, the maximum transmission time of a data packet is limited. This ensures that all devices in the network can eventually send out their commands.

With the arrival of IoT, the number of devices in

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networks has grown substantially. Sometimes, this has made wireless systems overly complicated for users. Let's examine a typical example: A user is streaming a film via their home WiFi system to a tablet, while switching on the living room light with a wireless switch. As both applications use the same frequency band, the switch signal must wait until there is a free slot, and the light might not come on for several seconds. On the other hand, the streamed video image might become distorted the moment the light switch is pressed. This is not exactly what consumers expect from state-of-the art technology.

Led Drivers – The Underestimated Core Component

LED drivers need to be compatible with as many systems as possible. In addition, manufacturers face the challenge that a new LED model is brought to the market nearly every week. Unfortunately, these new products often come with custom current/voltage combinations. Manufacturers of LED drivers thus face the problem that virtually every LED model requires a special LED driver. Developing matching LED drivers for each and every new product in the market is obviously not sustainable, as only large production volumes can keep prices down. What is required is a universal solution.

When looking at the problem from a different angle, we can see that such a solution might just be within our grasp. How about a LED driver that does not produce a constant current (CC) or constant voltage (CV), but adapts the output to the connected LED? To achieve this, we need to further develop the principle of constant power.

Conventional LED drivers are controlled on the basis of the measured secondary side current (CC) or voltage (CV). These measurements are fed back to the primary side control IC that actuates the primary switcher.

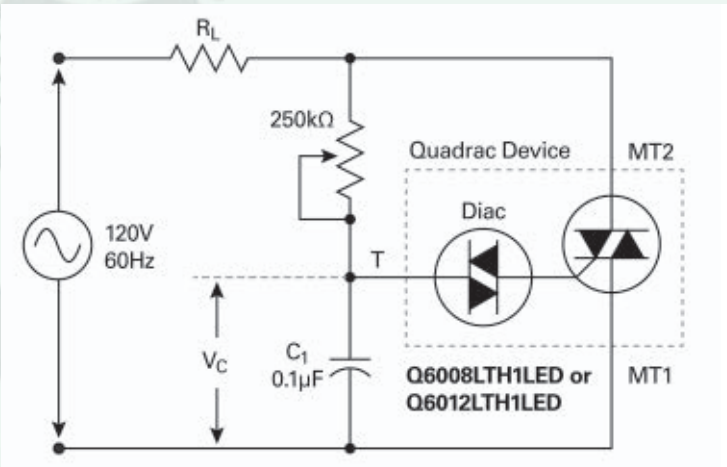

Fig. 3: Simplified block diagram of a self-calibrating LED driver with microprocessor and active PFC flyback controller.

Modern measuring technology, however, allows for accurate measurement of the actual LED characteristics. To use this information, we need a secondary side sensing circuit that measures the voltage relative to a variable output current

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(calibration) once the device is commissioned. After linearizing certain characteristic sections, the microprocessor can then control the secondary side buck-boost converter in such a way that the LED is always operated at its optimum. Such a system would allow for the separate control of any type of LED within a preset performance range.

As always, there's trouble in the details, especially when it comes to thermal drift or special and unique LED characteristics. The new technology would, however, put an end to the current practice where the LED driver is chosen solely based on the LED current and the forward bias voltage. Apart from all the new options for lighting designers, this approach would also have massive advantages for manufacturers, and drive down prices.

To take things one step further, it would even be possible to share the above calibration data with other LED drivers through the previously mentioned interfaces, producing a self-learning system. The operating modes of the LEDs could be changed on the spot, as required. At the push of a smartphone or tablet button, the LED could, for instance, be set to optimum brightness or optimum lifetime mode.

This technology is still in its infancy but there will come a time when it will become the only way forward for LED driver manufacturers. ECN

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Miniature Power Divider Serves 18GHz

RFMW, Ltd. announces design and sales support for the API Weinschel 1515-1 resistive power divider.

The 1515-1 offers SMA female connectors on all ports allowing a miniature design that's capable of supporting 18GHz applications. Rated at 1W CW, the API Weinschel divider can handle up to 1kW peak power input. Phase tracking between ports is 5 degrees maximum while amplitude tracking is 0.5dB max at 18GHz. Insertion loss beyond the 6dB nominal is only 1.5dB at 18GHz. The miniature design of the API 1515-1 measures 1.17 x 1.14 inches.

For more information, visit: www.rfmw.com.

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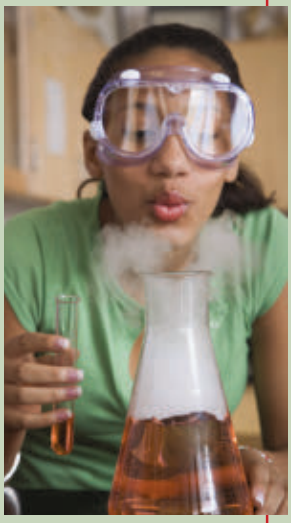

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NEW PRODUCTS

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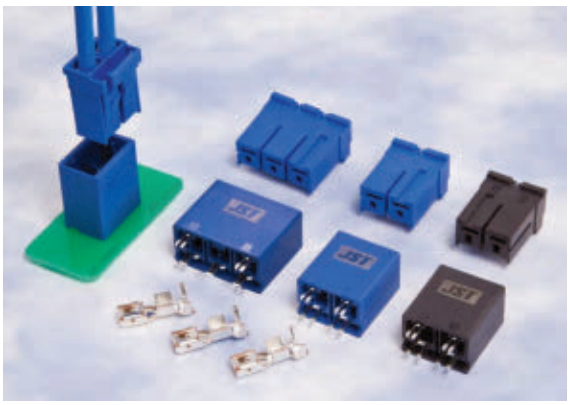

The new JFPS Series wire-to-board, 8.8 mm (.346") pitch, crimp style connectors, offer high reliability and provide stable contact performance under high vibration, distortion, and high current conditions. The headers and housings incorporate polarization, keying, and secure locking features. The unique contact locking feature is internal to the housing thereby eliminating contact back out and damage through handling external locking lances. The positive locking system is designed to fit inside the envelope of the header making it possible to stack the headers close together and still be able to release the positive lock. To facilitate proper mating, connectors offer keying and color coding.

The JFPS Series is available in 2 and 3 circuit sizes rated 35A (using 10 AWG) at 600V (AC/DC). The contacts are tin-plated over a copper alloy base material and accommodate a wire range of 12 AWG to 10 AWG. Temperature range is -40 C degrees to +105 C degrees including temperature rise in applying electrical current. PCB mounted headers are available in top entry configuration. Housings are molded in a RoHS compliant 94V-0 material.

Contacts are offered on standard size reels for semi-automatic or fully automatic application tooling.

For more information, visit www.jst.com.

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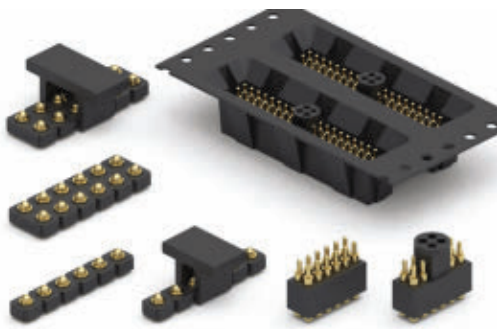


Three additional Mill-Max SMT spring-loaded connectors are now available packaged on tape and reel. With this development, all SMT spring-loaded connectors are now offered on tape and reel for automated pick & place assembly.

The 855-22-XXX-30-002191, from 4-40 positions, are double row and on a space saving .050" (1.27 mm) grid. Each spring pin features a base geometry of .029" (0.74 mm) round by .010" (0.25 mm) tall to maximize soldering surface area and provide secure attachment to the PCB. They can now be supplied on tape and reel thanks to a special "cap" which provides a pick & place surface for easy removal from the pocket and placement on the board. Each pin position has its own size tape. Please speak with an applications engineer for details.

The lowest profile spring-loaded connectors, just .100" in height are offered in single row, series 815-22-0XX-30-001191 and double row, series 817-22-0XX-30-001191, both on .100" (2.54 mm) grid. The single row is available in 2-10 positions and the double row in 4 -20 positions. Both the 815 and 817 series have a mid-stroke travel of .012" (.3mm) and full stroke capability of .020" - .024" (.508 - .61 mm). For surface mount applications where above board height is limited, these connectors are ideal.

For more information, visit: www.mill-max.com.

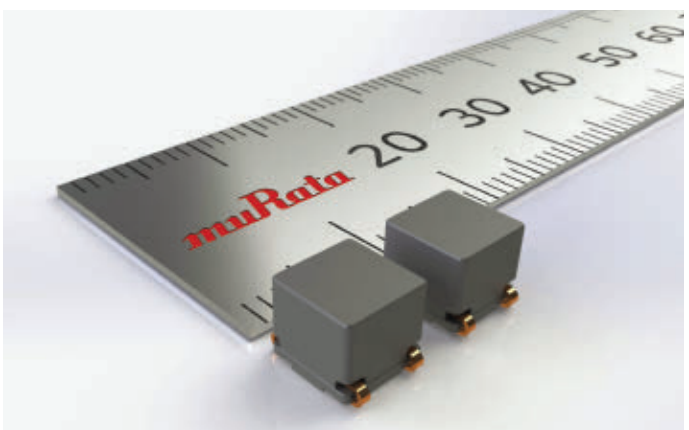
Signal Processing & Power Management Devices Provide Wireless and Recharging Features

ON Semiconductor, driving energy efficient innovations, further underlines its leadership position in assisting next generation hearing aid development with the introduction of two new products: HPM10, a Power Management Integrated Circuit (PMIC); and Ezairo® 7150 SL, a wireless-enabled audio processor.

Ezairo® 7150 SL uses the company's widely-implemented proprietary digital signal processing (DSP) technology and brings wireless connectivity to hearing aids and cochlear implants. The compact hybrid module is based on the powerful Ezairo 7100 open-programmable 24 bit mixed-signal DSP platform. This System in Package (SiP) solution provides wireless multi-protocol operation and is optimized for 2.4 gigahertz (GHz) band applications, including Bluetooth® Low-Energy (BLE). Ezairo® 7150 SL integrates EA2M, a low power 2 Mb serial CMOS EEPROM used for storing hearing aid firmware and important parameters.

For more information, visit www.onsemi.com.

Common Mode Choke Coils Designed For Automotive Noise Suppression Applications



Murata Americas announced the release of the PLT5BPH Series of common mode choke coils for automotive noise suppression applications. In recent years, designers have placed a great deal of importance on improving efficiency and the ability to withstand severe environments. To achieve more precise control, many manufacturers are positioning electronic components closer to the engine or transmission in denser circuits. Murata developed this wire wound-type common mode choke coil for power line noise suppression capable of handling large currents (up to 5.6A) and wide operating temperature range (-55°C to 150°C) to meet this demand.

For more information, visit www.murata.com.

Q: What wireless networking challenges do you forsee with the onset of IoT?

Jay Torgerson, Wireless Business Development Manager, Anritsu

Flexible and cost-effective test solutions will play an important role to ensure products work as designed, without impacting other users and the network. They must efficiently analyze RF signals and communication protocol exchanges, along with security features, as they interface with the network and each other. Everybody involved in the standards-making process knows that one size will not fit all when it comes to test and certification, due to multiple evolving technologies.

Many IoT product designers may not have wireless technology experience, and therefore will rely on intelligent, easy-to-use test equipment to meet their broad and changing testing needs. Features such as simple test setup wizards and auto-ranging parameters, and good technical support allow developers to be operational quickly. Additionally, testing must be meaningful, fast and repeatable. Unattended, automated testing allows engineers to conduct repeatable tests while they perform other product development tasks that can help bring products to market faster.

Yuna Shin, Leviton Senior Product Manager, Copper Solutions

Wireless devices are a significant contributor to the rise of IoT, and with the increasing demand for wireless connectivity it's important to have a flexible, scalable, and reliable structured cabling backbone to support the required bandwidth. Existing cabling infrastructures may not be capable of providing the bandwidth needed for optimal performance. Many enterprise and mission-critical networks already rely on more powerful 10GbE speeds over Category 6A infrastructures, with an eye toward future 40GbE networks over Category 8 cabling.

Power requirements for devices communicating over wireless networks have also increased, placing considerable energy demands on supporting infrastructures. Structured cabling technology advancements such as Energy Efficient Ethernet (EEE) and port intelligence, as well as improvements in Category 6A cable and connector designs, have reduced power usage. EEE also sets the stage for implementing wake-on-LAN (WoL) and power back-off features to further reduce power consumption and increase energy efficiency.

Greg Fyke, Marketing Director, IoT Wireless Products, Silicon Labs

There are three key areas of improvement in IoT applications: interoperability, complexity and security. Connected devices must be able interpret the same set of data and be controlled by a single application. This can be achieved by either using a common application layer or by interworking in gateways or the cloud. Connectivity is becoming simpler with advances in software, development tools and hardware reference designs, but it needs to reach a state "plug-and-play" simplicity to be adopted on a broader scale. The need for security is ever paramount; sharing data between connected devices requires trust and access requires authentication. When all of these elements come together, the IoT reaps the benefit of the network effect. Seamlessly interconnected devices can accomplish so much more than a collection of connected silos.

David Hall, Principal Product Manager, National Instruments

The increasing data throughput requirements – combined with increasing device density – is a key challenge driving the development of new wireless technologies. For example, the next generation of Wi-Fi, 802.11ax, is explicitly aimed at solving some of these network density challenges – and is billed as high efficiency WLAN (HEW). To address density challenges, one of the proposed features of 802.11ax is dynamic clear channel assessment (CCA). Using this feature, an access point can dynamically sense other nearby transmitters and adjust its own output power to avoid interference.

In addition to 802.11ax, the requirement for higher data throughput is also introducing new wireless technologies at millimeter wave frequencies. For example, present-day 802.11ad and a future 802.11ay specification will enable higher data throughput at 60 GHz.

Looking toward the future, the use of evolving wireless networking technologies – from 802.11ac to 802.11ax – inherently adds greater product complexity and higher test cost. As wireless devices evolve to address the requirements of the IoT, NI is committed to solving the challenges of wireless test with a platform-based approach that lowers the cost of wireless test.

Suma Madapur, Technical Marketing Director – RF, Avnet Electronics Marketing

Lower power to ensure longer lasting battery, low latency and high-reliability communication at moderate data rates are essential to achieve the level of connectivity that IoT is promising. A future cellular standard could present a unified solution that jointly optimizes the wireless access network for both IoT and M2M communications.

Security is also a critical issue for Internet connected systems. Since IoT cuts across different sectors and embraces multiple devices and networks, the threats are at many different levels. Every new interface between devices, networks, platforms and users, is the potential for a new weak link. IoT by definition relies on lots of data with high levels of search-ability and analysis which also means that the data must exist in plain text, which presents multiple threats. To ensure the privacy of the end users, security has to be built in at device level with sensors and microcontrollers and continues through the networks, platforms and into the cloud.

Roger Schroder, Engineering Manager, Stahlin Non-Metallic Enclosures

IoT is a major driver for deploying wireless hubs and routers in a variety of environmental conditions.

Since many of these wireless hubs will be located in corrosive or harsh environments, designers need to investigate and determine the best protective enclosure material to ensure uninterrupted communication.

Many designers have discovered that non-metallic enclosures are a good option when faced with the need for compact housing because it protects the wireless device without having to add antennas or extensions. Another key benefit—non-ferrous aspects ensure reliable wireless signals to mobile assets and data handling devices. Plus, the insulated properties of non-metallic enclosures protect electronics against lighting strikes and external arc-flash sources.

Non-metallic materials are easily modified (simple to drill cutouts for audio/video connections) and withstand extreme cold and heat. Finally, non-metallics provide the user with a strong and durable enclosure that performs in a variety of challenging environments.

To ensure success, as the population of these wireless hubs grows exponentially, it makes sense to utilize non-metallic enclosure material properties for wireless IoT applications.

Alan Grau, President, Icon Labs

One of the biggest challenges for IoT device and system developers is providing security for the very small endpoints that will make up the majority of IoT devices and sensors. Traditional approaches of isolating them using a secure gateway or other partitioning mechanism won't work because these Things are often sensors that can exist anywhere in the world – often not

behind traditional security perimeters.

Even the smallest of these devices need to have security built in. Due to cost, size, battery and performance constraints, many of these devices will not have built in hardware based security. But that does not mean that designers should just ignore security. We are providing software based security solutions for very small devices, down to 8 bit MCUs, requiring as little as 8Kb of memory. Providing a scalable security solution that will support these devices is critical. Obviously the security capability will scale with the device, but it is important that it still be included.

Security, like the IoT, is an inherently complex topic that encompasses protecting data at rest and in transit, ensuring secure boot, securely updating firmware, intrusion detection, and certificate management. Consideration must be given to the selection of encryption algorithms, secure key storage and hardware security features.

Against this backdrop of complexity, users expect devices that are intuitive to use and reliable, or put more bluntly, NOT complex.

To successfully manage this complexity, developers can leverage IoT ready platforms, security solutions and software stacks. Engineer's jobs are not getting any easier, but fortunately there are tools and solutions to help.

Cees Links, CEO and Founder, GreenPeak

For many device developers who want to select a wireless technology to connect their sentrollers (sensors, actuators, and controllers) to the IoT, the biggest challenge is deciding what wireless networking technology they should use.

A lot depends on the application, how the device is to be used, how it has to be networked, and how it has to be powered. To answer these questions, there are three proven and reliable options that can be explored.

WiFi is the recognized standard for high data rate, streaming content applications like entertainment, video, music, speech and other types of content where data flow is important. WiFi is a proven standard with many different suppliers of wireless radio chips, modules and software. Plus end users understand it. The downside of selecting WiFi is that it is a power hog and is best suited for applications with access to AC power. For example, security cameras are usually powered anyhow, so they can easily fit into a WiFi connected home security network.

Bluetooth is another established standard and is perfect for cable replacement and use in wearables where one-to-one connectivity is critical. Less power hungry than WiFi, Bluetooth is well suited for battery powered applications. However, Bluetooth does not have the range of WiFi or ZigBee to cover a full home and does not offer effective networking and meshing capabilities.

For other low power, low data rate applications, especially where networking capabilities, low latency and range are important, ZigBee needs to be considered. In many ways, ZigBee is essentially low power WiFi and shares many of the same networking features but requires much less power. ZigBee is perfect for battery powered and energy harvesting applications.

Confusing the issue are recent technology announcements regarding application frameworks like Apple's HomeKit, Intel and its Open Internet Consortium, Qualcomm's AllJoyn, Huawei LiteOS and others. All of these are battling each other for market acceptance and dominance. Interestingly, some are compatible with one or more of the existing wireless networking standards. For example, ZigBee and other IEEE 802.15.4 based protocols can work with these frameworks.

So for every sentroller device development project, it makes sense to look at one of the big three established technologies and decide which best suits your application's specific requirements and use cases.

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For more information, visit: www.EmpowerRF.com.

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The White Board

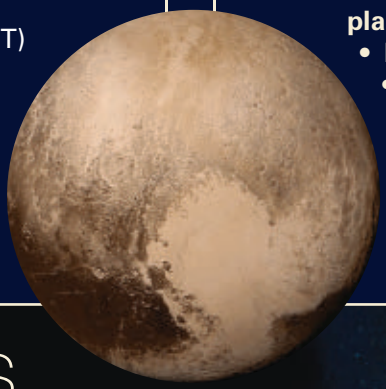
New Horizons

By Kasey Panetta, Editor

THE MISSION

Explore the Pluto System, Kuiper Belt, and deep space. Learn about ice dwarf planets.

- **Space Craft/Launch Vehicle:** New Horizons/Lockheed Martin Atlas V
- **Launched:** January 19, 2006 at 2pm (EST)
- **Launch Pad:** Space Launch Complex 41 at Cape Canaveral Air Force Station, FL
- **Launch Attempt:** 3 (the first two were cancelled after high winds and a power outage)
- **Arrived:** Early 2015 for 5 months of studying Pluto



PLUTO

- **Discovered:** February 18, 1930 by Clyde W. Tombaugh at the Lowell Observatory
- **Downgraded from planet to dwarf planet:** 2006
- **Largest moon:** Charon
- **Known moons:** Charon, Nix, Hydra, Styx, and Kerberos
- **Distance from sun:** 3.6 billion miles
- **Time to orbit sun:** 248 Years
- **Width:** 1,400 miles

THE INSTRUMENTS

- **Visible and Infrared Spectrometer (a.k.a. Ralph):** color, composition, thermal maps
- **Ultraviolet Imaging Spectrometer (a.k.a. Alice):** Analyzing the atmosphere of Pluto, Charon, and Kuiper Belt Objects
- **Radio Sciece Experiment (a.k.a. REX):** Measuring atmospheric composition
- **Long Range Reconnaissance Imager Telescopic Camara (a.k.a LORRI):** Maps data for parts of Pluto that are far away
- **Solar Wind and Plasma Spectrometer (a.k.a. SWAP):** Observes Pluto's interaction with solar wind and atmospheric "escape rate"
- **Pluto Energetic Particle Spectrometer Science Investigation (a.k.a. PEPSSI):** Takes measurements of plasma escaping from the atmosphere
- **Venetia Burney Student Dust Counter (a.k.a. SDC):** Measures space dust hitting the probe while traveling (built by students)

KUIPER BELT

- A disc-shaped region of icy bodies beyond Neptune
- **Discovered:** August 30, 1992 by astronomers David Jewitt and Jane Luu
- **First named object:** 1992 QB1
- **Distance from sun:** 3 billion miles
- **Named For:** Astronomer Gerard Kuiper

KUIPER BELT CONTAINS:

- 1 trillion+ comets (estimated)
- 100,000+ bodies
- **Quaoar:** the first large KBO; 1,300km in diameter
- **1992 QB1:** 250 km in diameter
- **Haumea:** Dwarf planet, egg-shaped
- **Eris:** Kuiper Belt world
- **Sedna:** Transneptunian object; 10,500 year solar orbit
- **Makemake:** A.k.a. Easter Bunny; Dwarf Planet

designed by Larry Corby, Digital Artist

Image credit: NASA

...SOME THINGS CHANGE...

IN 1983 MPD
FILED THEIR FIRST
PATENT WHICH WAS SOON
TO BE DECLARED THE
INDUSTRY STANDARD.

IN 2011 MPD
FILED ANOTHER PATENT
THAT IS STILL TODAY
AN INDUSTRY STANDARD.

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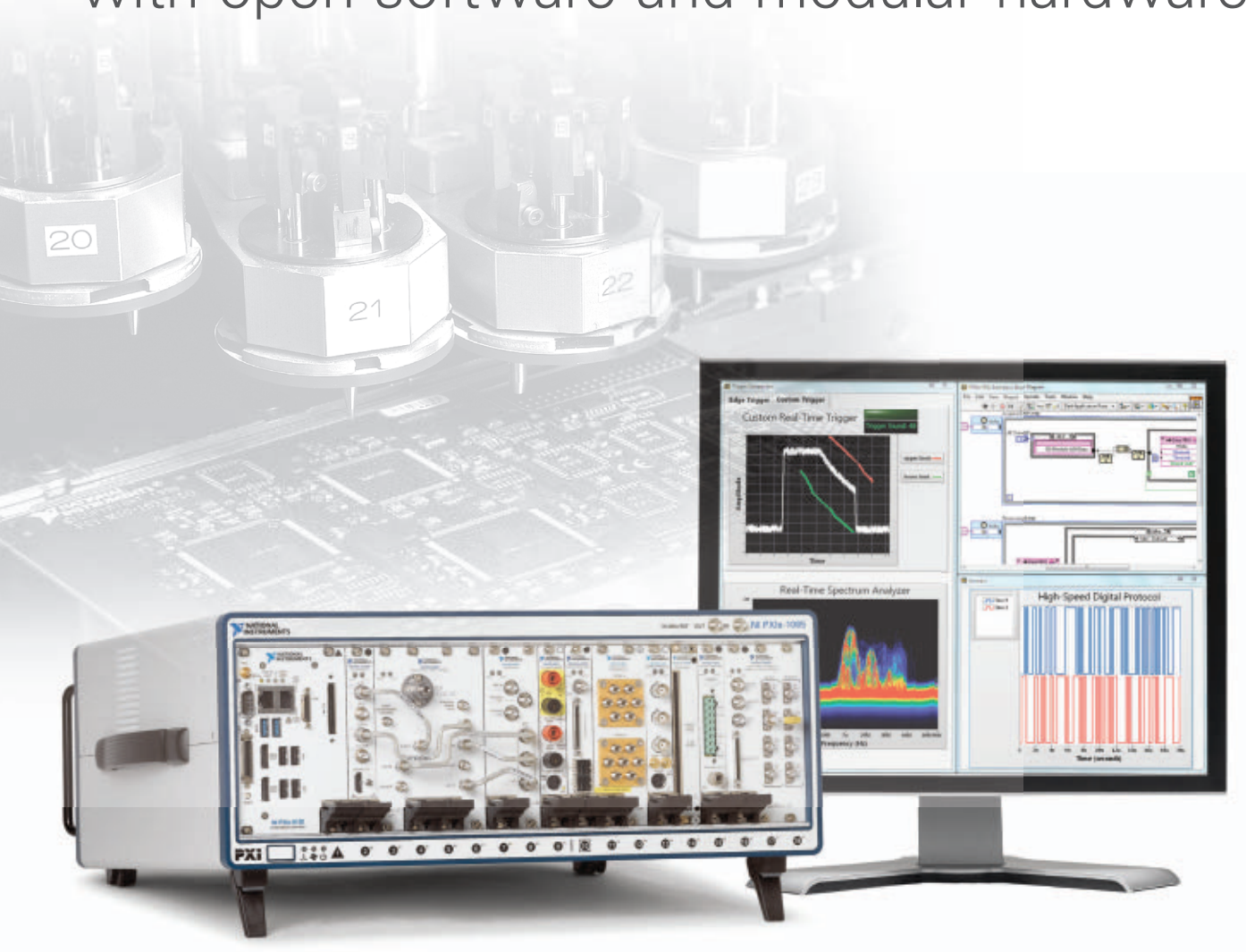

How we interact with devices is changing. As the world becomes more software oriented, what we can accomplish increases exponentially. This shift should apply to our test equipment, too. Unlike traditional instruments with predefined functionality, the NI automated test platform provides the latest technologies to build complex systems while reducing development time and cost.

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