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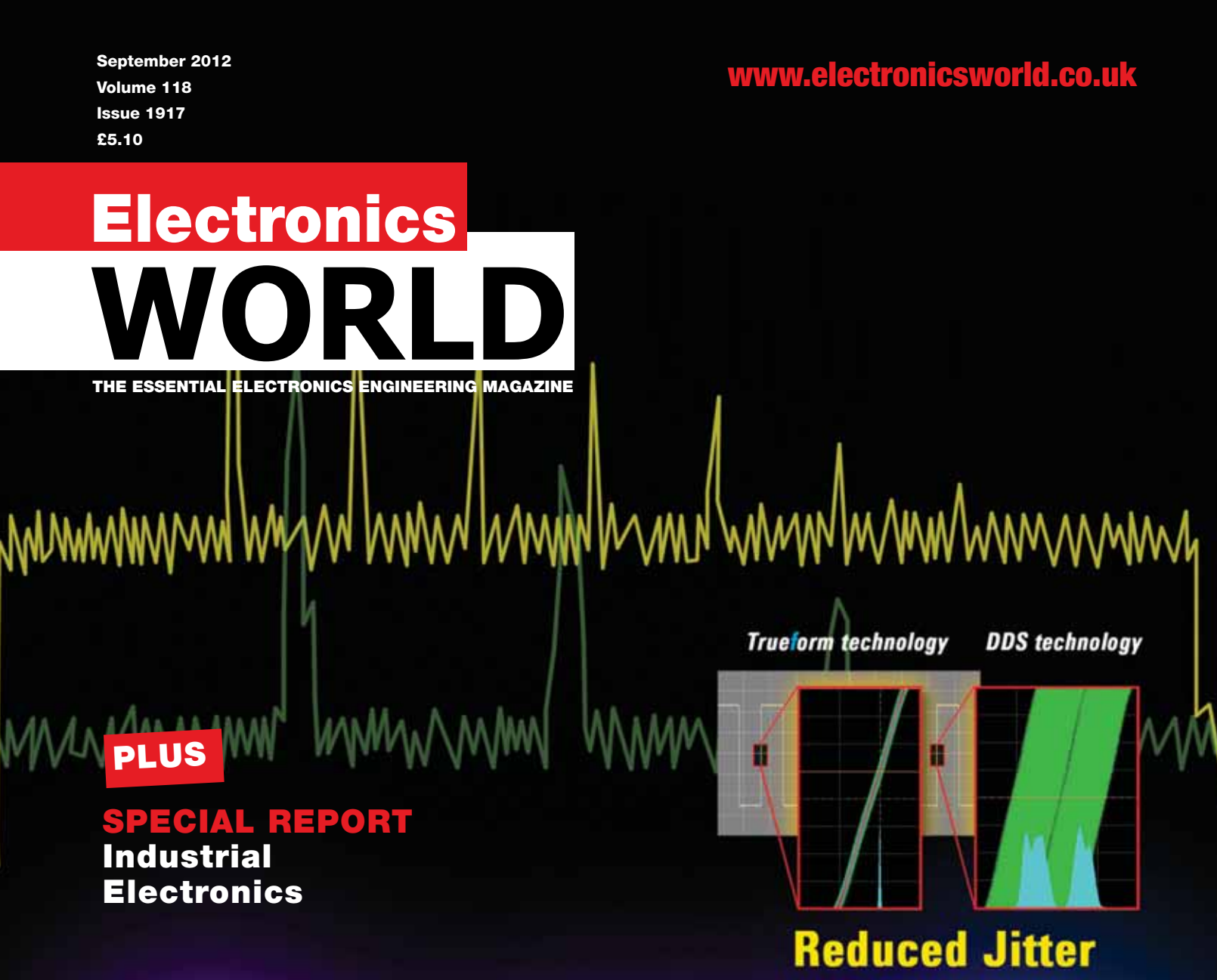
# Electronics WORLD

THE ESSENTIAL ELECTRONICS ENGINEERING MAGAZINE




PLUS

## SPECIAL REPORT
## Industrial Electronics

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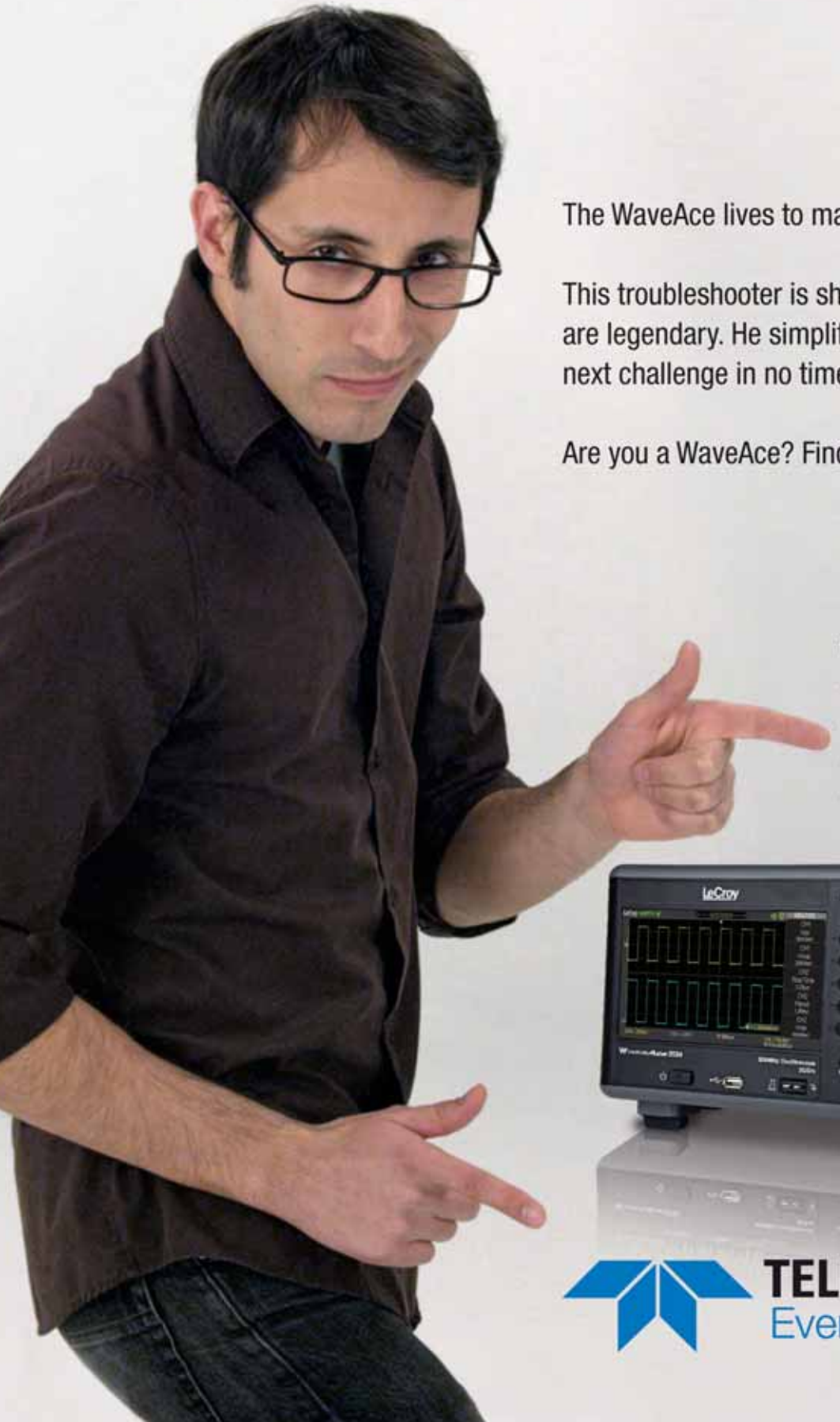

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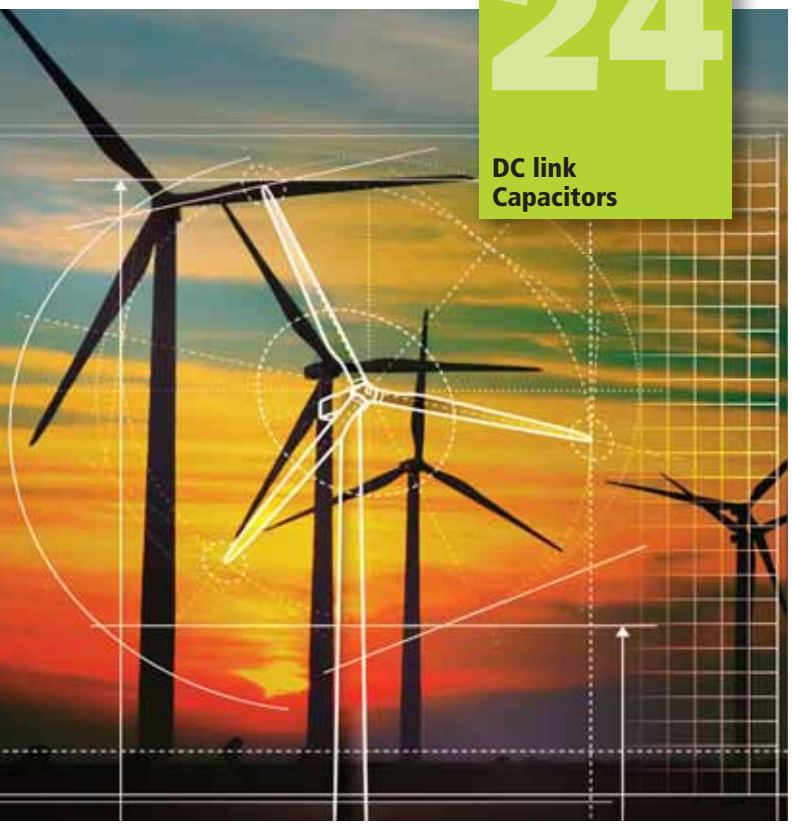

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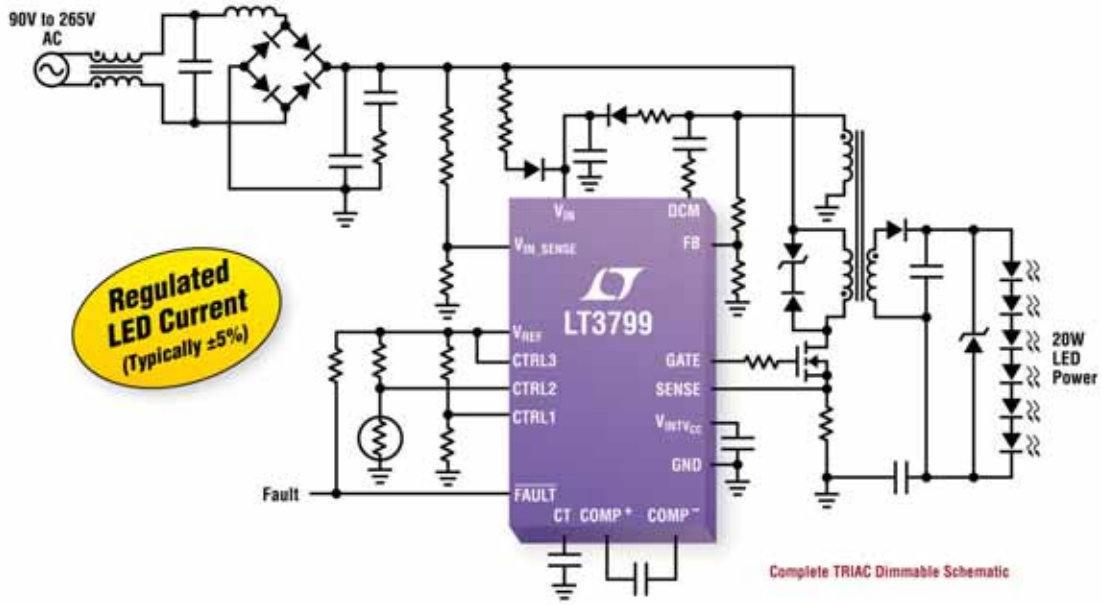
# Isolated LED Current Control with Active PFC



Complete TRIAC Dimmable Schematic

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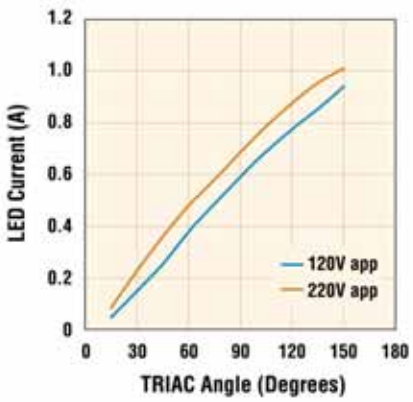
**LED Current vs TRIAC Angle**

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# THE GROWING SIGNIFICANCE OF IP PROTECTION IN AN INCREASINGLY COMPETITIVE PV MARKET

**DuPont Electronics & Communications Managing Director for Greater China, Walt Cheng, was a featured speaker at the Solarbuzz China Photovoltaics (PV) Conference in Shanghai last month. In addressing the importance of materials supply in PV manufacturing, Cheng emphasized the critical role innovation plays in advancing the solar energy industry and the growing significance of intellectual property (IP) protection in today's increasingly competitive PV market.**

"In the solar industry today, cost pressures are intensifying throughout the value chain and companies are looking harder than ever to gain competitive advantage," said Cheng. "Technological innovation remains the lifeblood of this industry and the key means of achieving lower level cost of energy. Intellectual property (IP) theft is widespread and the issue seems to be growing in the current climate of this industry."

"IP theft, left unchecked, has the potential to threaten the PV industry broadly at a critical time in its development," he continued. "Everyone at every level in the industry benefits from vigorous competition that spurs innovation, bringing cutting-edge products to the global market. IP theft diminishes competition and reduces innovation. If there is no longer an incentive for companies to deliver new innovations, the progress we've made together to accelerate the growth of solar energy can stall."

DuPont has succeeded as the leading materials supplier to the photovoltaic industry (excluding silicon) through bringing innovations including DuPont Solamet photovoltaic metallizations that have almost doubled the efficiency of solar modules over the last dozen years.

DuPont spent $2bn last year on R&D, with a significant portion focused on reducing global dependence on fossil fuels through advanced materials and technologies that improve the efficiency, lifetime and cost-competitiveness of solar energy.

Solamet PV17x, for example, outperformed four competing products, demonstrating its ability to contact 100 Ohm/sq emitters on multicrystalline cells – the first time this had been achieved – with lightly doped phosphorous surface concentration. This enabled an efficiency increase of one full percent versus the homogenous emitter base line, and 0.4 percent higher efficiency was confirmed versus laser doped selective emitter technologies. RWTH-Aachen University recently published a comparative study involving Solamet PV17x and four competing metallization pastes.

"We presented a characterization of POCl3 parameters influencing the electrically active phosphorus concentration profiles by electrochemical capacitance voltage measurements," said Ali Safiei, PhD researcher at the Institute of Semiconductor Electronics, RWTH Aachen University. "For the first time we could demonstrate a successful direct contacting of an optimized high sheet resistance emitter at 100Ω/sq by increasing the $n^{++}$ layer and at the same time reducing the dead layer. Multicrystalline silicon solar cells were fabricated using five different silver pastes resulting in an absolute efficiency gain of $\Delta\eta = 1\%$ in comparison to a standard 55Ω/sq emitter. Based on these investigations we evaluated a 160Ω/sq emitter and could successfully demonstrate by laser doping that a $n^{++}$ layer of up to 25nm depth (a lightly doped emitter) leads to high FF and an absolute efficiency gain of $\Delta\eta > 0.6\%$."

> ***Intellectual property (IP) theft is widespread and the issue seems to be growing in the current climate of the [photovoltaics] industry***

It is with such developments in mind that DuPont's Cheng called for a stronger stand against the growing issue of intellectual property theft and infringement in the solar industry.

"As DuPont continues to develop new technology, we need to ensure it is protected," said Cheng. "We do not ignore infringement and will pursue aggressively other points in the PV supply chain where IP infringement of our PV metallization pastes exists."

Cheng indicated this set of actions continues in the manner of previous DuPont actions involving IP protection in China and other countries. The company recently filed two lawsuits against PV metallization paste supplier Heraeus and one against its customer SolarWorld, for infringing on its patents for the Solamet PV metallization pastes.

Cheng asked for increased support from the industry to guard against infringement and stronger opposition to the use of "infringing" materials in the production and sale of downstream products by cell and module makers, PV system developers, installers and owners. The infringing companies expose themselves – and potentially others they do business with – to the full range of legal remedies.

"We have reached a point where we have to re-level the playing field. In a market that is fair, free and legal, we relish the opportunity to compete with the best technology providers to help [the] solar [industry] succeed, and we look forward to your support in this critical endeavor," added Cheng.

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# SUPERCOMPUTERS WILL GIVE UNPRECEDENTED PROCESSING POWER TO BUSINESSES AND ACADEMICS

*Computing superpower: Emerald (above) and Iridis 3 (below) supercomputers promise a super-fast processing capability alongside each other*

**The UK's most powerful GPU-based supercomputer, "Emerald", has now entered into service alongside "Iridis 3". Emerald is a General-Purpose computing on Graphics Processing Unit (GPGPU) system that uses NVIDIA's Tesla accelerator technology. The combination of these two high-performance computing systems will give businesses and academics unprecedented access to super-fast processing.**

**Using the newly-available technology, researchers will be able to tackle areas ranging from astrophysics (real-time pulsar detection for the forthcoming Square Kilometre Array Project to deploy the world's most powerful radio telescope); bioinformatics (analysis and statistical modelling of whole-genome sequencing data); healthcare; climate change modelling; complex engineering systems; simulating 3G and 4G communications networks and developing new tools for processing and managing medical images.**

**Both supercomputers were unveiled last month at the Science and Technology Facilities Council's Rutherford Appleton Laboratory (RAL), which will host and operate Emerald; Iridis 3 is hosted by the University of Southampton.**

**The occasion was also used to launch the e-Infrastructure South Consortium which boasts four of the UK's leading universities – Bristol, Oxford, University College London and Southampton. The Consortium has collaborated with the Department of Scientific Computing at RAL to form the e-infrastructure South Centre for Innovation, which will own and operate both supercomputers. The Consortium will also share access to the supercomputers, providing an infrastructure for the development of data-driven applications, simulation and software, and offer training to the next generation of scientists and engineers.**

**"High-performance computers will enable better training and recruitment of world-class research talent, help develop new research ideas and speed up the rate at which complex data can be processed. These new supercomputers are crucial to maintaining the UK's leading science base and underpinning our national competitiveness and economic recovery," said Dr Lesley Thompson, Director of EPSRC's Research Base.**

**The supercomputers have been funded by a £3.7m grant from the Engineering and Physical Sciences Research Council (EPSRC), part of a £145m government investment in e-infrastructure.**

# IET Standards launches report on electric vehicle infrastructure deployment

IET Standards has launched a report to help local authorities install better, more cost-effective electric vehicle (EV) infrastructure schemes.

The "*Successfully Implementing a Plug-in Electric Vehicle Infrastructure*" report aims to address current confusion and misunderstandings about how to best deploy EV infrastructure.

"Local authorities are under pressure to enhance the sustainability of local transport and are increasingly turning to plug-in electric vehicle infrastructure," said Carolyn White, Director at IET Standards Ltd.

The report aims to help local authorities and their strategic partners optimise their approach to EV infrastructure schemes, plan better, save money and avoid wasted assets. Recognising the need for cost efficiency, the report also provides indicative development costs, with guidance for managing budgets as efficiently as possible.

The report has been developed by sustainable transport and EV infrastructure specialist Matthew Lumsden. It provides independent and expert technical guidance and practical case studies on all stages of EV infrastructure schemes, including strategy, planning and implementation.

"Local authorities are taking a lead position in developing recharging infrastructure to support the wider adoption of EVs. However, successful EV schemes depend on targeting infrastructure to key locations, making well-informed technical and investment decisions and establishing the right partnerships. If not, authorities could find themselves faced with the cost of installing and maintaining charge points that are left unused," said Lumsden.

# Triboelectric Generator Produces Electricity by Harnessing Frictional Forces Between Plastics

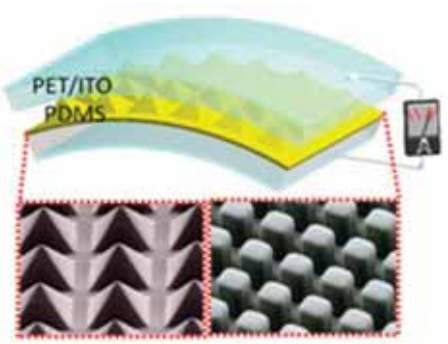
Researchers have discovered yet another way to harvest small amounts of electricity from motion – this time by capturing the electrical charge produced when two different kinds of plastic materials rub against one another. Based on flexible polymer materials, the so-called "triboelectric" generator could provide alternating current (AC) from activities such as walking.

The triboelectric generator could supplement power produced by nanogenerators that use the piezoelectric effect to create current from the flexing of zinc oxide nanowires. As these triboelectric generators are 75% transparent, they could offer a new way to produce active sensors for touch-sensitive displays.

"Transparent generators can be fabricated on virtually any surface," said Zhong Lin Wang, a Regents professor in the School of Materials Science & Engineering at the Georgia Institute of Technology. "This technique could be used to create very sensitive transparent sensors that would not require power from a device's battery."

The triboelectric generator operates when a sheet of polyester rubs against a sheet made of polydimethysiloxane (PDMS). The polyester tends to donate electrons, while the PDMS accepts electrons. Immediately after the polymer surfaces rub together, they are mechanically separated, creating an air gap that isolates the charge on the PDMS surface and forms a dipole.

"The fact that an electric charge can be produced through this principle is well known," explained Wang. "What we have introduced is a gap separation technique that produces a voltage drop, which leads to a current flow, allowing the charge to be used. This generator can convert random mechanical energy from our environment into electric energy."




*The diagram shows a new high-output, flexible and transparent triboelectric nanogenerator made from transparent polymer materials*
*(Image courtesy of Zhong Lin Wang)*

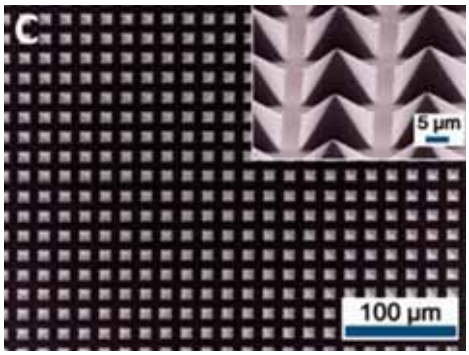
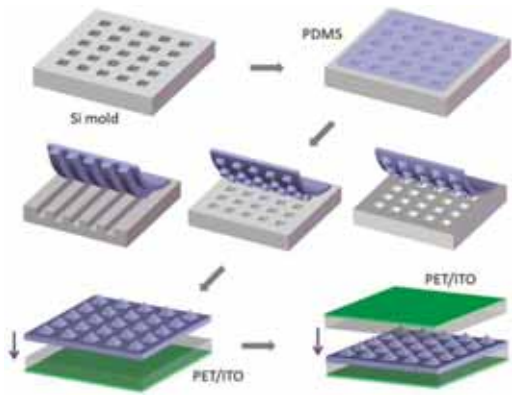



*Image shows pyramid patterns created in a polymer sheet to increase current production in the triboelectric generator*
*(Image courtesy of Zhong Lin Wang)*




*Schematic shows the fabrication process for the triboelectric nanogenerators and pressure sensors. A patterned silicon wafer serves as the mould for fabrication of PDMS thin films with micro-patterned features*
*(Image courtesy of Zhong Lin Wang)*

If an electrical load is connected between the two rubbing surfaces, a small current will flow. By continuously rubbing the surfaces together and then quickly separating them, the generator can provide a small alternating current. An external deformation is used to press the surfaces together and slide them to create the rubbing motion.

"For this to work, you have to use to two different kinds of materials to create the different electrodes," said Wang. "If you rub together surfaces made from the same material, you don't get the charge differential."

The technique could also be used to create a very sensitive self-powered active pressure sensor for use with organic electronic or optoelectronic systems. Some of these sensors can detect pressure as low as about 13 millipascals.

While smooth surfaces rubbing together do generate charge, Wang and his research team have increased the current production by using micro-patterned surfaces. They studied three different types of surface patterning – lines, cubes and pyramids – and found that placing pyramid shapes on one of the surfaces generated the most electrical current: as much as 18 volts at about 0.13 micro-amps per square centimeter.

Wang said the patterning enhanced the generating capacity by boosting the amount of charge formed, improving capacitance change due to the air voids created between the patterns, and by facilitating charge separation.

To fabricate the triboelectric generators, the researchers began by creating a mould from a silicon wafer on which the friction-enhancing patterns are formed using traditional photolithography and either a dry or wet etching process.

The next step in the research will be to create systems that include storage mechanisms for the current generated.

"Friction is everywhere, so this principle could be used in a lot of applications," said Wang. "We are combining our earlier nanogenerator and this new triboelectric generator for complementary purposes. The triboelectric generator won't replace the zinc oxide nanogenerator, but it has its own unique advantages that will allow us to use them in parallel."

The research was funded by the National Science Foundation, the Department of Energy and the US Air Force.

# AGILENT TECHNOLOGIES INTRODUCES NEW FAMILY OF WAVEFORM GENERATORS WITH UNRIVALED SIGNAL ACCURACY

## Instruments Deliver Lowest Jitter, Harmonic and Non-Harmonic Distortion in Class and True Point-by-Point Arbitrary Waveforms

Agilent Technologies Inc introduced on Aug 21st the 33500B Series waveform generators. The eight new one- and two-channel models, which generate waveforms up to 30 MHz, incorporate exclusive Trueform signal-generation technology. Trueform enables these models to offer unmatched capabilities for generating a full range of signals for the most demanding measurements required when designing electronic devices.

The 33500B waveform generators provide the lowest jitter and lowest total harmonic distortion in their class, giving engineers the ability to generate the exact signals they need. With better jitter performance, engineers can place edges more accurately, helping them reduce timing errors in their circuit designs. With total harmonic distortion less than 0.04 percent and non-harmonic spurs less than 75 dBc, the 33500B Series offers clean signals that don't introduce noise, enabling users to get more accurate results.

The 33500B Series' 8.4-ns rise and fall times and low jitter allow engineers to set trigger points more accurately as well. The instruments' 16 bits of resolution allows engineers to make output changes down to 1 uV – giving them the ability to test today's low-voltage circuits and designs.

With the 33500B Series, engineers can take advantage of easy software upgrades to expand the instruments' capabilities when they need to increase bandwidth and add true point-by-point arbitrary waveforms and deeper waveform memory.

### TRUEFORM TECHNOLOGY

Over the past two decades, direct digital synthesis has been the waveform-generation technology of choice in function generators and economical arbitrary waveform generators. Waveform generators built with DDS offer good frequency resolution, convenient custom waveforms and a low price. However, DDS has intrinsic limitations as well. Engineers with exacting requirements have had to either work around the compromised performance or spend up to 10 times more for a high-end, point-by-point waveform generator.

"Trueform technology offers a new alternative that blends the best of DDS and point-by-point architectures, giving engineers the benefits of both without the limitations of either," said Gary Whitman, vice president and general manager of Agilent's System Products Division. "Trueform technology uses an exclusive digital sampling technique that delivers unmatched performance at the same low price customers expect with DDS."

### UNIQUE CAPABILITIES

In addition to point-by-point arbitrary waveforms, the 33500B Series offers features not normally found on waveform generators in this class:

**Waveform summing and combining capability:** Allows engineers to easily add noise to signals for margin and distortion testing using only a single channel. On a two-channel model, engineers can sum and combine up to four signals.

**Variable-bandwidth noise:** Allows engineers to adjust the bandwidth of the built-in noise generator to control the frequency content of their signals.

**Waveform sequencing:** Allows engineers to create multiple configured waveforms with several common segments. Users can also build long, complex waveforms using minimal instrument memory.

**Pseudo-random binary sequence pattern generation:** Allows engineers to test digital serial buses by streaming standard PRBS patterns – like PN7 and PN19 – without the need for a separate pulse generator.

**Optional baseband IQ player:** Allows wireless communication engineers to economically play IQ signals without the need for an expensive signal generator. The IQ player provides the ability to make adjustments to the signal, including amplitude gain, channel offset and channel skew as needed for a more accurate representation.

Additional information about Agilent's new 33500B Series waveform generators is available at **www.agilent.com/find/33500B**.
Product images are available at **www.agilent.com/find/33500B_images.**
A product video is available at **www.agilent.com/find/33500BSeries_video.**
A backgrounder on Trueform technology is available at **www.agilent.com/find/33500B_backgrounder**

### ABOUT AGILENT TECHNOLOGIES

Agilent Technologies Inc. (NYSE: A) is the world's premier measurement company and a technology leader in chemical analysis, life sciences, diagnostics, electronics and communications. The company's 20,000 employees serve customers in more than 100 countries. Agilent had net revenues of $6.6 billion in fiscal 2011. Information about Agilent is available at www.agilent.com.

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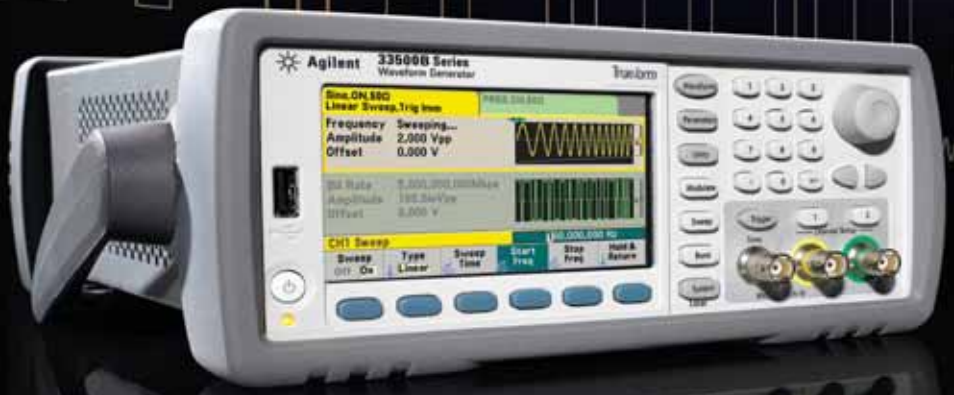


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*Anticipate ___Accelerate ___Achieve*

Agilent Technologies

# Quantifying the Business Value of Medical Device Connectivity

## TIMELY, INEXPENSIVE, ACCURATE DATA-CAPTURE ENHANCES A HOSPITAL'S COMPETITIVE ADVANTAGE, BUT NETWORKING MEDICAL DEVICES REQUIRES REAL EXPERTISE, SAYS **MARTIN POPPELAARS** OF LANTRONIX

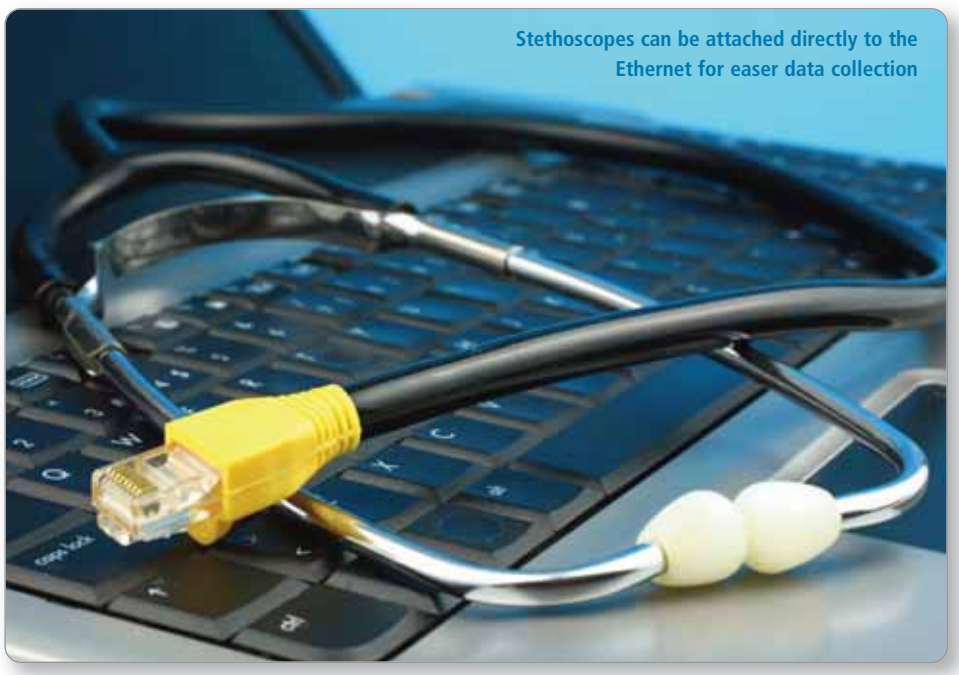
Connected Medical Devices (CMD) are invaluable to the medical industry. Each CMD saves from 4 to 36 minutes of nursing time and prevents up to 24 data errors daily. They can also save over 100 hours of nursing time per day in a typical hospital, giving nurses more time with patients and improving the quality of care. By stopping over 800 data collection errors each day, hospitals can offer greater efficiency and improved patient safety.

The benefits, therefore, are clear; but how can hospitals move easily to this type of environment, and what role does the product manufacturer play in making it happen?

The need for hospitals to connect their devices to an Electronic Medical Record (EMR) is increasing; too many still operate as independent "islands" of functionality and data. CMDs will play an increasing role in this, particularly outside the hospital, in the management of chronic conditions and prevention of hospital re-admissions.

> *The best practice for preventing hospital re-admissions includes the use of connected devices in care facilities and patients' homes*

It is the responsibility of medical device manufacturers to help translate data from devices into a format that can be read and understood by EMRs. They must also support industry standard wireless networking security protocols, dual-band wireless communications, and multiple interfaces, to help hospital customers realise the potential benefits of device connectivity.



Stethoscopes can be attached directly to the Ethernet for easer data collection

### The Effects of Data Requirements and Regulations

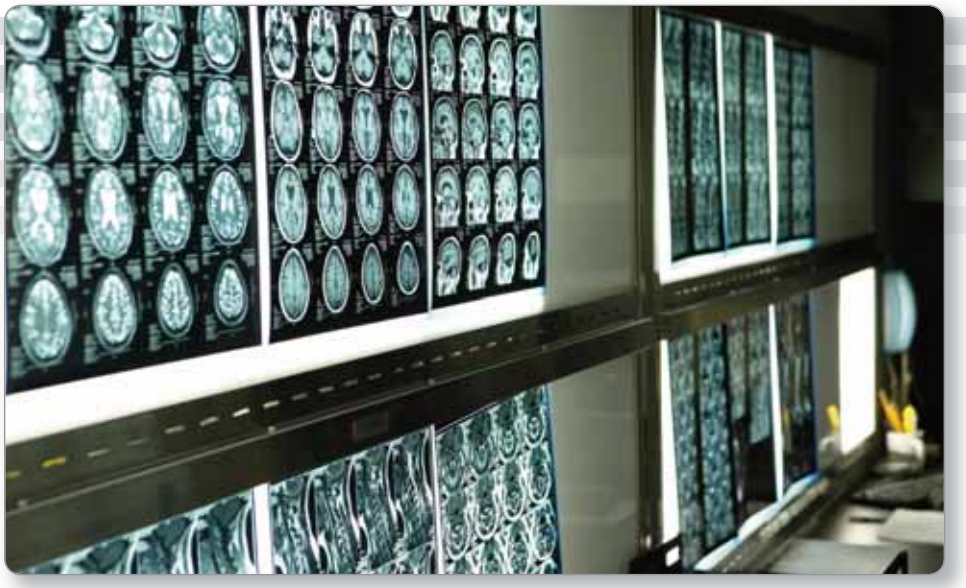
In order to deliver high-quality care and meet regulatory mandates, hospitals must collect increasingly detailed clinical data from inpatients, while reducing staff costs. In the near future, hospitals must also take responsibility for the data required to achieve measurably superior outcomes beyond their walls. Obtaining the additional data required to manage and coordinate care inside and outside the hospital, without spending a fortune on staff, requires the ability to automatically retrieve information from medical devices.

These devices come in many different forms and levels of complexity, from tongue depressors to artificial hearts. The number of medical devices that produce electronic data is growing, as sensors are added to devices that were formerly only mechanical in nature, such as the newly-developed e-Knee prosthesis for example.

While device connections can be used to remotely monitor, control and configure devices, it is their patient monitoring function that adds the greatest value. Patient physiology data; drug administration data, including dose, timing, rate, etc; ventilator therapy data; and many other key pieces of information can be recorded to help medics provide optimal care to patients.

When these devices are automatically connected to an EMR, the completeness, timeliness and accuracy of the data that becomes available is much greater than what could be manually

X ray computers are the perfect for medical device connectivity



charted by nurses. What is more, the potential quality and safety of care improves, while the time and cost required to collect and chart the data is greatly reduced.

In short, the best practice for preventing hospital re-admissions includes the use of connected devices in care facilities and patients' homes. By making use of remote device data, patients can be kept in the comfort of their own homes and, therefore, avoid unnecessary hospital care.

Today most electronic medical devices are found in hospitals (see Figure 1), with IV pumps, physiologic monitors and vital signs monitors, making up 85% of the total. However, very few of these devices are currently connected to a hospital network. As indicated in Figure 2, the number of connected medical devices in hospitals could easily grow by a factor of ten.

Reliable statistics are not available for the use of electronic medical devices outside hospitals, but their number is expected to grow even more dramatically. The need for more accurate, timely and efficiently collected data will increase the use of CMDs in nursing homes, doctors' offices and other healthcare facilities. However, the greatest growth is expected to be in patients' homes and other locations outside of formal care environments (see Figure 3).

## The Benefits of Hospital Device Connectivity

Research shows that nurses spend approximately 21.5 hours per shift on documentation activities, reducing the amount of time they spend on direct patient care and increasing job stress. CMDs can automate a significant amount of nursing documentation. This in turn can help increase time devoted to patient care, which can improve patient outcomes.

Clinical decision support (CDS) capabilities are the number one source of value from EMR systems. Basic CDS includes such things as drug selection and dosing alerts, electronic order sets and duplicate lab test alerts. Beyond these basics lies a world of value, much of which requires more detailed data, collected more frequently than most hospitals are able to afford.

Emerging, high-value, CDS applications include clinical surveillance systems that can review large volumes of clinical data and highlight patient risks when they occur, to guide real-time changes in care. CMDs can dramatically reduce the cost of data collection for these systems, making them a practical alternative for more hospitals.

Another of the CDS capabilities made possible by CMDs is to receive global alerts for each type of device. For example, networking older IV pumps without safety alerts could allow hospitals to create their own real-time alerts based on current data, which could be sent to nurses in time to avoid dangerous and costly errors – making "smart pumps" out of "dumb" pumps. Potential candidates for this type of CDS include IV pumps, ventilators and cardiac monitors.

Devices that connect to the network add analytical value too. If all of a hospital's smart pumps are connected to the network, then pump data can be aggregated to show trends in unsafe pump programming, which nurses need to be trained in, and determine whether certain times of day see greater number of errors, etc.

Electronic medical devices are not reimbursed separately, but many of them are associated with procedures which do have separate charges. Accurate, complete, timely data on device-use can be part of an audit to identify and capture missed procedure charges.

In addition, there's increased nursing satisfaction, as nurses don't like transcribing data from medical devices – it's tedious, error-prone work and it takes their attention away from patients. Hospitals that have implemented CMDs have found that their nursing staff greatly prefers reviewing imported data to transcribing them directly. One medical centre says "This [CMDs] application is the only time I have seen a nurse hugging an information systems employee."

"It is very difficult for device manufacturers to go directly to RF chip vendors to get the chips they need in the relatively small quantities they need"

As stated earlier, the operational benefits of device connectivity are greater outside of hospitals.

**Figure 1:** Number of electronic medical devices in hospitals

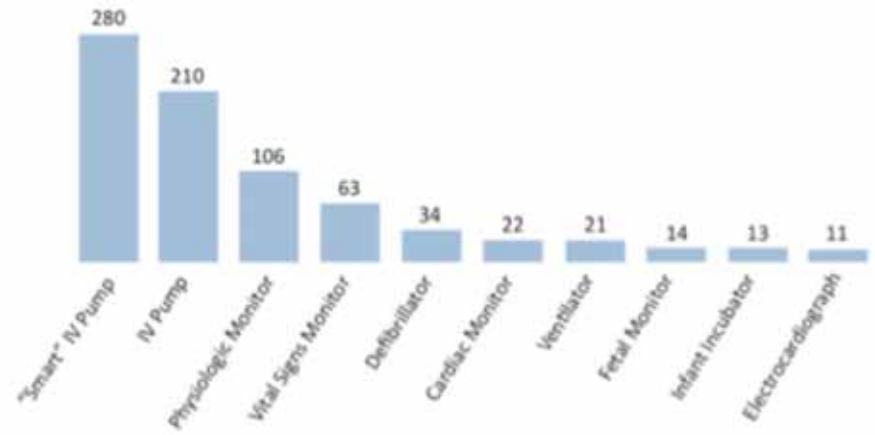



**Figure 2:** Percent of hospital devices connected to an EMR

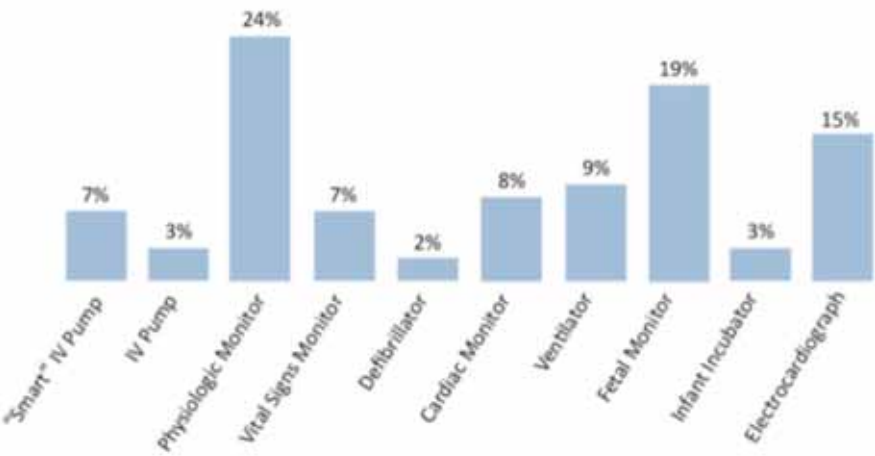
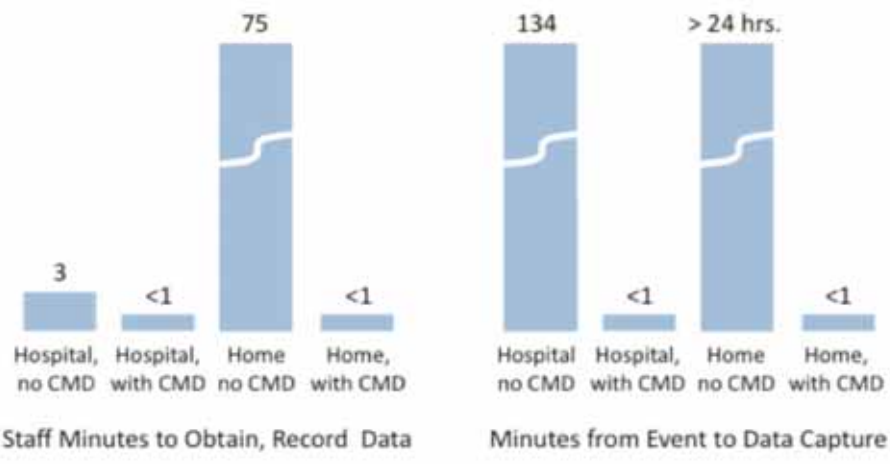



**Figure 3:** Minutes to obtain vital signs data
*Note: Includes travel time*




That's because physician offices, post-acute and long-term care facilities and, especially, the patient's home are not only less "wired" than hospitals, but have fewer staff available to collect data manually. So, it's more challenging to manually collect device data outside the hospital without remote patient monitoring (RPM) devices.

RPM devices will help mitigate the increasing need for nurses outside the hospital environment by automating data collection and reducing the number of home visits required.

## Meeting the Challenges of Device Connectivity

In spite of the substantial benefits of CMDs there is a great deal of frustration among hospitals and medical device vendors over the technical and operational challenges of connecting their devices. The key challenges include translation of device data from numerous proprietary device formats into something that can be read and understood by EMRs and other information systems, supporting industry standard wireless networking security protocols, supporting dual-band wireless communications, supporting multiple interfaces in addition to serial connections, and minimising the burden of testing to ensure that devices are compatible.

Device manufacturers must also balance their need for stable product designs that can last many years to earn back the high costs of device development, with the rapid evolution of technical capabilities and standards.

The primary reason for increased interest in CMDs in hospitals is the need to incorporate device data into EMRs. This helps to create a more complete and accurate picture of patients' conditions and enhances clinical decision support and analytics capabilities, improving care processes

## RECOMMENDATIONS FOR DEVICE MANUFACTURERS

- Fully understand the regulatory and strategic issues that affect wireless device connectivity and your devices specifically.
- Fully understand the secondary uses of the data from your devices and the potential business value of these data.
- Quantify the business benefits of wireless networking of your device – what's the financial, clinical, operational value-add?
- Fully understand the technical issues and costs associated with adding wireless connectivity to your devices.
- Quantify the tradeoffs of buying vs. building wireless connectivity into your devices.
- Develop a formal plan, budget and timeframes for executing the plan, and assign it to one of your best project managers.

## RECOMMENDATIONS FOR HOSPITAL EXECUTIVES

- Document the amount of time required to collect and enter medical device data in your hospital ICUs and medical/surgical units. Document or estimate your current error rate for manual device data transcription.
- Determine which devices require the greatest amount of charting time and which have the highest error rates. Estimate the hard benefits of CMDs, starting with those described in this report.
- Calculate the cost of purchasing new connected devices to replace the most costly and error prone device types, or connecting existing devices via standalone serial port device servers.
- Develop a business case based on your unique costs and benefits to support the purchase and implementation of CMDs.

and patient outcomes. Most hospitals have dealt with this issue one device at a time, since each device vendor has their own proprietary data format. Given the increasing data volumes and the growing number of networkable devices, this is becoming more difficult.

Some device connectivity vendors are designing translation software into their modules, to take the burden off device manufacturers and individual hospitals. These solutions can translate data into HL7 and other standard formats.

Cisco is the dominant infrastructure provider in hospitals and is known for providing very secure wireless access points. Cisco initially developed the LEAP standard, which was designed to provide increased security; its latest standard is EAP.

It's important that device manufacturers support a hospital's preferred security protocol (likely LEAP or EAP) to avoid costly work-arounds. In many cases, work-arounds are not feasible and the hospital will instead select another, compliant device vendor.

Support for EAP and other common wireless networking security protocols requires that wireless networking vendors add special software, memory to store and run the software and additional processing power.

The most commonly used wireless band is 2.4GHz, which doesn't require a specific FCC license. The 5GHz band, which was formerly restricted to government and military uses, is now an emerging standard for hospital device use, given its superior performance in an environment with lots of potential interference. During the transition from 2.4 to 5GHz device connectivity modules must include the RF chips and firmware to support both bands.

Serial UART is the traditional and stable network standard but serial ports are very slow, and have largely been replaced by USB ports, which are faster and smaller. Other common interface options include SPI, which is faster still, and I2C. Some devices, such as EKGs require the faster SPI interface to accommodate the high volume of data from the device.

### Testing Requirements

Hospitals assume that CMD vendors have tested the compatibility of their devices with all common wireless configurations; however, such testing requires expertise that most device manufacturers do not have. One alternative is to engage a specialized testing company to do detailed and specific testing, but this can be quite costly. Alternatively, the device manufacturer can incorporate a third-party wireless module into their device and rely on the module manufacturer's testing processes, which are typically robust.

One other consideration for device manufacturers is device life. Medical device models, which take much longer to get to market and have a more costly development cycle, need a longer life than consumer devices which are replaced yearly.

It is very difficult for device manufacturers to go directly to RF chip vendors to get the chips they need in the relatively small quantities they need. In addition, these chips are updated every year or two, and a medical device vendor can't afford to revise their hardware that often. The component isn't guaranteed for the long life of the device and frequent software changes require costly chip modifications. Purchasing and integrating a third-party networking module mitigates these issues because the connection from the device to the module does not change – the required changes are made inside the module.

These technical challenges are far from insurmountable. Device networking experts have identified optimal solutions that address each of these provider concerns. However, device manufacturers who are not experienced in providing wireless network connectivity and implementing connected devices in a complex hospital environment should seek expert partners to avoid compromising patient health and customer relationships. ●

# LOCATION, location, location

**MYK DORMER** IS SENIOR RF DESIGN ENGINEER AT RADIOMETRIX LTD
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In the arena of low power radio there is a very well-documented "disease" among users – let's call it "forget the aerial" syndrome. A lot of effort goes into the RF module itself, into understanding the regulatory environment, and into properly designing the communication architecture operating over the data link. Then a random bit of bent wire gets soldered to the aerial connector, and the chorus of "insufficient range" complaints begins.

Without a good aerial, the theoretical range capabilities of a radio system can never be realised. If compromises are made in the antenna, by limiting its size or shape for example, then it must be understood that compromises are being made in the radio link margin, and hence range versus transmit power as well.

These concepts are not difficult to explain and, in my experience, most customers will accept and act on them – even if a good aerial adds a few percent to their materials' cost. Where I have seen a good deal of misunderstanding and disappointment on the other hand is in aerial location and mounting.

A bad location, or incorrect mounting hardware, will ruin the performance of the best aerial.

In fact, there are three issues hidden in this statement:

- **Elevation.** The further "up" an antenna is placed, the lower the path loss and the longer the range. The commonly used Egli propagation model includes the term 10 x log ((Hr x Ht)^2), relating height above local ground level of the sending and receiving antennas to path loss in dB. The model assumes aerials to be mounted 1m off the ground by default. In other words, simply placing one of the aerials on top of a three meter high pole is worth *ten* dB, which roughly corresponds to doubling the range.

  Conversely, locating the aerial in a hole, valley or ditch, or "screening" it with bulk terrain features (hills, large solid buildings and metal structures) will reduce the operating range.
- **Proximity.** Despite the claims of some suppliers, all aerial types are in some respect influenced by objects in close proximity. Some aerial types are more or less susceptible to such "de-tuning", but all suffer from it to some degree. As a general rule of thumb, the higher the gain of an aerial and the narrower its operating bandwidth, the greater the effect, although it's risky to make absolute statements.

  What is safe to assume on the other hand is that any aerial you are considering will have been designed to give its best performance in "free air", and placing it next to a conductive or lossy object will have some negative effect. And (although I have seen this done), it shouldn't need to be stated that locating the aerial inside a conductive enclosure, such as the bodywork of a vehicle, will have serious consequences.
- **Mounting.** All aerials require some form of mechanical support. This can be as simple as screwing it onto a bulkhead RF connector or as complex as building a mast, but in all cases it needs to be done correctly. Many aerials – most simple monopoles and PCB mounted ceramic types for example – require a sufficient area of conductive ground plane. Some (such as dipoles) have a minimum stand-off distance from the mast/structure that they are fixed to, while others must be clamped to the top of a mast or pole.

  In all cases, no matter how diverse the aerial types, they must be mounted correctly. Insufficient ground plane area, or incorrectly fitted brackets, will compromise the aerial performance, with (by now) predictable results.

So, is there a "cure" for these issues?

1. **Design-in the aerial location at the start of the project.** Don't pretend that the aerial isn't there and then try to stuff it away in some available corner at the end of the job. Make the aerial a part of the "visual" and mechanical designs.
2. **Always follow the manufacturer's installation instructions.** Do not assume that "it'll be alright" with the wrong mountings or the wrong grounding. If the aerial needs to be tuned (cutting to length or other adjustment), then make sure it gets done. Get an antenna analyser (a simple one-port network analyser) or a VSWR meter, and use it.
3. **Don't guess the range.** Get early prototypes into the field, ideally on the customer's worst-case target site, and measure coverage. Then be prepared to change and/or re-position the antennas, increase power if possible or even change the overall architecture to allow for repeaters. This is possible early in a project, but is unlikely to be feasible at the end. ●

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# AC POWER SUPPLIES

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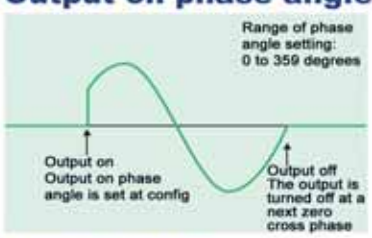
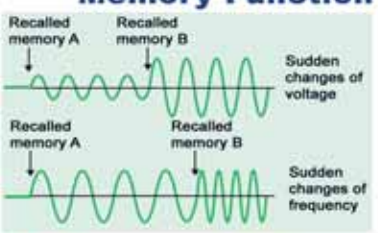



### Memory Function

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# INDUSTRIAL LANDSCAPE 2.0 – A VISION

THE CURRENT INDUSTRIAL LANDSCAPE IS AN OUTCOME OF THE INDUSTRIAL REVOLUTIONS OF THE 18TH AND 20TH CENTURIES, MARKED BY MASS PRODUCTION AND TECHNOLOGICAL ADVANCEMENT. FROST & SULLIVAN'S DIRECTOR FOR AUTOMATION AND PROCESS CONTROL **MUTHUKUMAR VISWANATHAN** AND SENIOR RESEARCH ANALYST **KARTHIK SUNDARAM** DEFINE THIS EXISTING ARCHITECTURE AS INDUSTRIAL LANDSCAPE 1.0

Over the past decade, we've seen considerable changes in the nature of industrial operation. The next stage in industrial revolution we refer to as Industrial Landscape 2.0 In this regard, we have tried to discern and foresee the technological framework shaping the future of industries.

The industrial milieu is marked by gradual transition. Innovation in an industry, whether it is a factory or process plant, is always marked by cautious optimism, and change in industrial dynamics is often marked by clear foresight and analysis. In fact, innovations that lack clarity have seldom been accepted or absorbed by the industry. In such a rigid yet rational environment, market participants are required to encourage innovation with well-defined outcomes for the customer.

At the outset, we have come to infer that enterprises in future will cease to exist in isolated silos, and transform into a singular organism with seamless interaction between various operational disciplines.

In course of our research, we have tried to factor in those trends that will have a sustained long-term impact on the dynamics of the industry.

Given below are some of the key assumptions used in our analysis.

- Convergence of applications will form crux of new advancements;
- Energy efficiency and sustainability will gain greater business focus;
- Greater presence of mobility and web-based information systems.

These assumptions constitute all the desired attributes of the influencing factors driving industrial evolution. With these fundamental precepts in mind, our research within the industry helps us define the following factors as decisive elements governing the next-generation enterprise.

## Enterprise Integration

The quest for integration within industries has immense benefits for the end-user in terms of productivity and profitability. The engine of industries is driven by different applications across the enterprise hierarchy. This includes enterprise resource planning (ERP), product life cycle management (PLM) and manufacturing execution systems (MES). By creating an exclusive network channel that facilitates convergence of these applications, customers can generate invaluable business intelligence that can be tapped for continuous process improvement. The outcome of this pursuit will provide the market with new applications that enable improved information access at multiple levels. For instance, in the coming years, the application of digital manufacturing – that bridges the gap between product design and manufacturing – is expected to receive wider acceptance among end-users. In the realm of sustainability, life cycle assessment is expected to emerge into a key application area spread across the enterprise hierarchy.

> The industrial wireless intelligence is currently in its nascent stages

## Wireless Intelligence

Industrial wireless intelligence is currently in its nascent stages. Standards wars, security concerns and reliability issues are key restraints impeding the growth of this high potential market. However, the benefits of wireless networks are far too high for any existing roadblocks to have a long-term impact. By using wireless networks in industries, customers can save considerable capital expenditure and improve overall profitability. Using highly advanced wireless mechanisms, customers can improve response time, increase efficiency and accelerate the production process considerably.

The advent of advanced mobility applications will set operators free from the confinement of control rooms. Smart wireless devices will provide operators the ability to monitor, control and pre-empt possible production events on the move. The scope for this market is extremely high and a wireless production plant provides infinite opportunities for both, end-users and market vendors.

## Cyber Security

Cyber-attacks are strategic crimes aimed at disrupting industrial activity for benefits spread across monetary,

competitive and political factors. In a post-Stuxnet world, the emphasis on cyber threats will transform from an optional initiative to one of strategic necessity. With talks of cyber wars, all critical infrastructure industries are expected to witness unprecedented investments in cyber security. Manufacturing industries are also expected to follow suit and to ensure a rigorous cyber security framework is adopted in their enterprise. In essence, cyber security will become the sine qua non of the next generation enterprise.

With cyber security becoming a fundamental aspect of industries, vendors in the manufacturing and process industries are expected to emerge with products and applications that meet the security needs of the end user. In our research, a section of the industrial community felt that the risk of cyber-attacks will discourage enterprise integration. But the pursuit of maximised efficiency and productivity leads us to believe that enterprise integration is an inevitable necessity for industrial existence and the risk of cyber attacks will be addressed by efficient security mechanism.

## Anticipating the Future

Envisioning the future of industries is a pre-requisite for market participants to devise well-formulated business strategies. With increasing competition, the next phase of industrial evolution will be marked by the emergence of new markets, and also the possible extinction of a few contemporary ones. In this stage of transition, the imperative to visualise the next-generation enterprise attains more prominence than ever before.

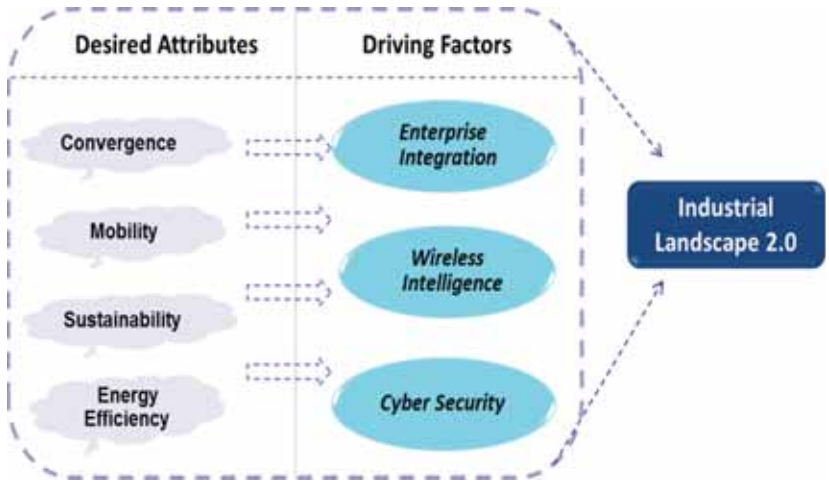



**Figure 1:** Industrial Landscape 2.0 – discerning evolution

# DESIGN AND SIMULATION OF A FULLY SOFT-SWITCHED AND BRIDGELESS POWER FACTOR CORRECTION CIRCUIT

**DR SEVILAY CETIN** FROM PAMUKKALE UNIVERSITY AND **DR HACI BODUR** FROM YILDIZ TECHNICAL UNIVERSITY, BOTH IN TURKEY, PRESENT THE DESIGN AND OPERATING PRINCIPLES OF A FULLY SOFT-SWITCHED AND BRIDGELESS POWER FACTOR CORRECTION CIRCUIT

Power factor correction (PFC) circuits have been used widely in various industrial applications, such as uninterrupted and switched power supplies (UPS, SMPS), electronic ballasts, electric vehicle and battery charging solutions and so on.

Supplying current to these devices from a full bridge rectifier with a large filter capacitor causes harmonics and, as such, distortions, which may cause damage to other devices in the same network. For electronic devices to be compatible with the EN61000-3-2 harmonic standard it is mandatory to avoid such situations.

The conventional PFC configuration consists of a four-diode front-end rectifier followed by a boost converter. In this configuration the mains current flows through at least three power semiconductor switches: two rectifier diodes and a boost converter switch. Bridgeless PFC circuits combine a rectifier and a boost converter. In this configuration, the mains current flows through only two semiconductor

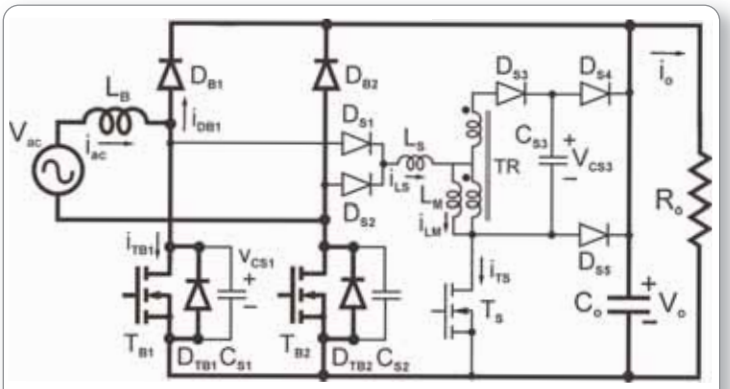



**Figure 1a:** Fully soft switched and bridgeless PFC circuit

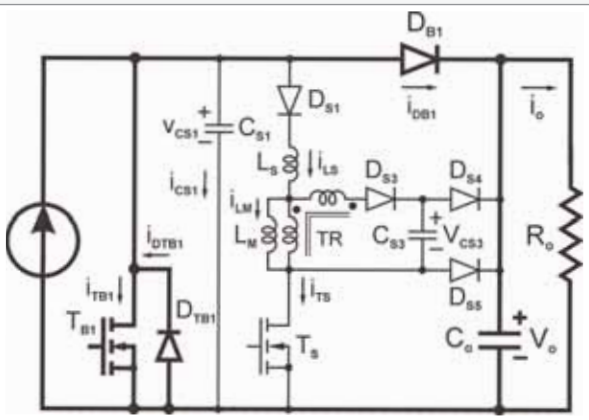



**Figure 1b:** The equivalent circuit diagram of the circuit in a positive half-cycle of the input voltage

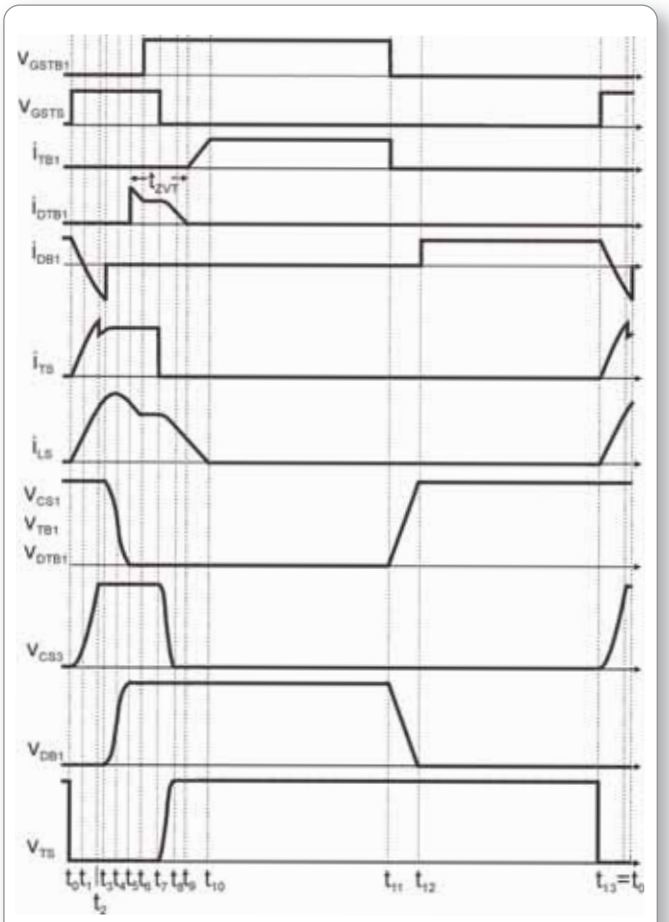



**Figure 2:** Theoretical waveforms of the proposed converter

devices, therefore the conduction losses of the PFC circuit decrease.

Boost converter topology is widely used in this topology due to its high power density, high efficiency, simple structure and ease of control. At high power levels, the continuous conduction mode (CCM) is preferred for the boost converter. In this case, the reverse recovery characteristic of the boost diode causes turn-off losses for the boost diode, turn-on losses for the boost switch, electromagnetic interface (EMI) and an overall decrease in efficiency. These problems can be eliminated only by using soft switching (SS) techniques implemented with snubber cells, instead of hard switching (HS) techniques.

A fully soft-switched and bridgeless PFC circuit is shown in Figure 1a. In this circuit the boost switches turn on with zero-voltage transition (ZVT) and turn off with zero-voltage switching (ZVS). The auxiliary switch turns on with zero-current switching (ZCS) and turns off with ZVS. The boost diodes and all other diodes work with SS. Most of the energy stored in the snubber inductor is transferred to the output by the transformer. Thus, the current stress (current stress is a maximum current level flowing through the switch, or rating of the switch) of the auxiliary switch is reduced significantly. In this converter no semiconductor device has an additional voltage stress (voltage stress is a maximum voltage level across the switch, or rating of the switch). In addition, the conduction losses are reduced by the bridgeless PFC circuit configuration.

## Principles of Operation

The topology of the fully soft-switched PFC circuit in Figure 1a is in two parts: the main and the auxiliary circuits. In the main circuit $V_{ac}$ is the input voltage, $I_{ac}$ is the input current, $V_o$ is the output voltage, $L_B$ is the boost inductor, $C_o$ is the output capacitor, $T_{B1}$ and $T_{B2}$ are the boost switches, $D_{TB1}$ and $D_{TB2}$ are the anti-parallel diodes of the boost switches, and $D_{B1}$ and $D_{B2}$ are the boost diodes.

The main circuit behaves like two boost converters, each one operating at half cycle of the input voltage. $L_B$, $T_{B1}$, $D_{B1}$ and $D_{TB2}$ form the boost converter for the positive half-cycle of the input voltage and $L_B$, $T_{B2}$, $D_{B2}$ and $D_{TB1}$ form the boost converter for the negative half-cycle of the input voltage.

In the auxiliary circuit $T_S$ is the auxiliary switch, $T_R$ is centre tapped transformer, $L_S$ is the snubber inductor, $C_{S1}$, $C_{S2}$, $C_{S3}$ are snubber capacitors and $D_{S1}$, $D_{S2}$, $D_{S3}$, $D_{S4}$, $D_{S5}$ are auxiliary diodes. The snubber

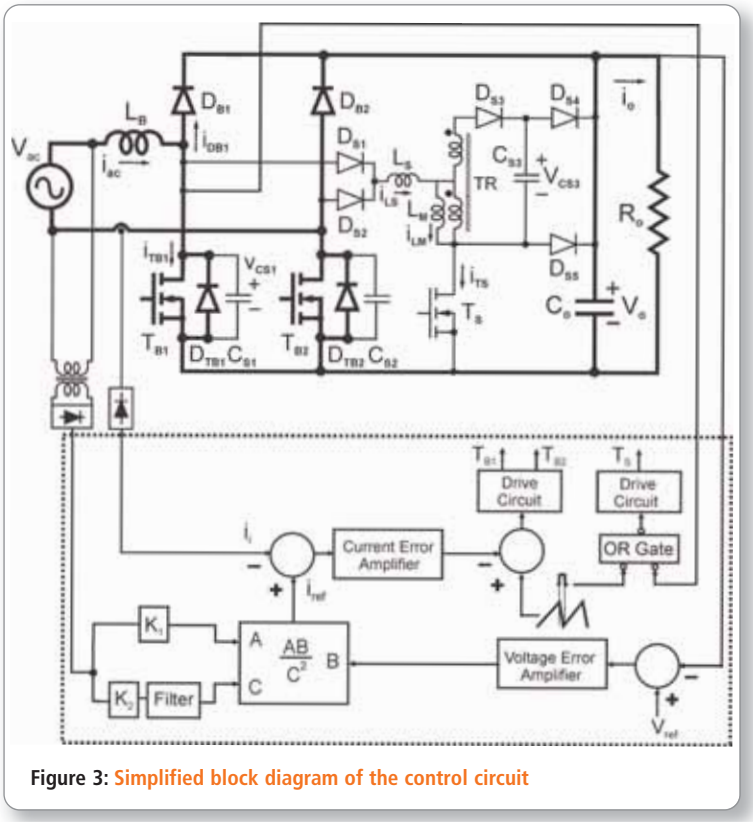



Figure 3: Simplified block diagram of the control circuit

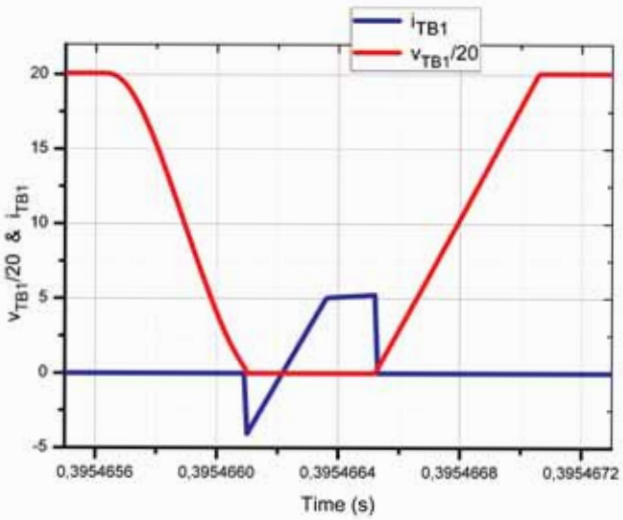



Figure 4: Voltage and current waveforms of the boost switch $T_{B1}$

capacitor $C_{S1}$ includes the parasitic capacitors of $T_{B1}$ and $D_{B1}$. Equally, $C_{S2}$ includes the parasitic capacitors of $T_{B2}$ and $D_{B2}$.

During operation, all semiconductor devices (except $D_{B1}$ and $D_{B2}$), inductors and capacitors are assumed ideal. It is also assumed that the $L_B$ inductor is large enough so its current is constant for the duration of one switching cycle. The equivalent circuit diagram for a positive half-cycle of the input voltage is given in Figure 1b and the theoretical waveforms related to its operation are in Figure 2.

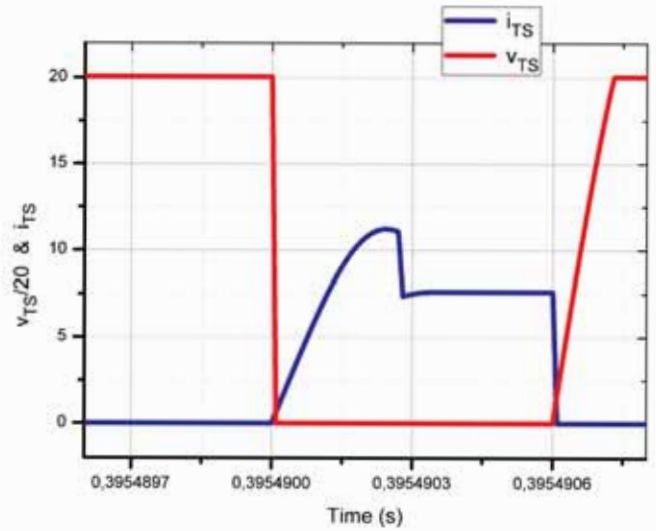



Figure 5: Voltage and current waveforms of the auxiliary switch $T_S$

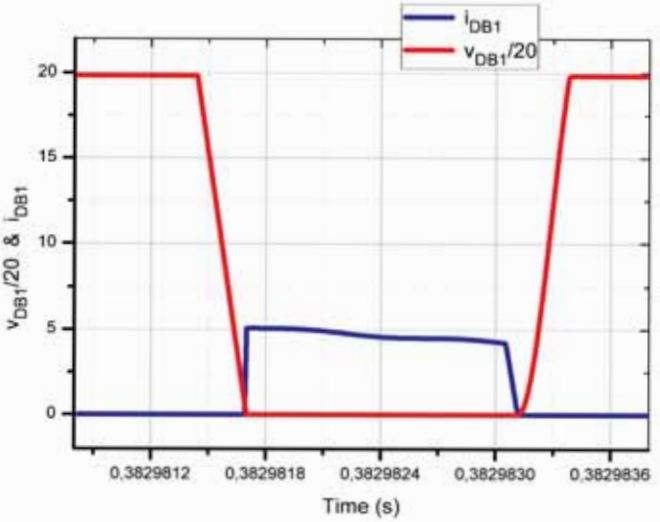



Figure 6: Voltage and current waveforms of the boost diode $D_{B1}$

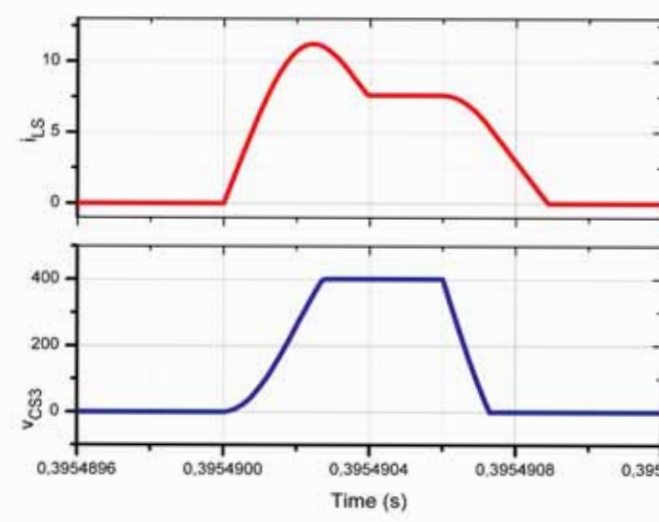



Figure 7: Waveforms of the $L_S$ current and $C_{S3}$ voltage

The operation starts when the control signal is applied to $T_S$ while $D_{B1}$ is in the on state and conducts the input current $I_i$. A resonance begins between $L_S$, $L_M$ and $C_{S3}$ by the turn on of $T_S$. In this resonant circuit, the $L_S$'s current rises, $D_{B1}$'s current decreases and capacitor $C_{S3}$ charges. The $L_S$ inductor provides SS turn-on of $T_S$ and SS turn-off of $D_{B1}$. The diode $D_{S4}$ turns on when $C_{S3}$ voltage reaches $V_o$. $D_{S4}$ transfers most of the stored energy in $L_S$ to the output and as such the current stress of $T_S$ decreases.

Resonance begins between $C_{S1}$ and $L_S$ by turning off $D_{B1}$. In this resonant circuit, $C_{S1}$ discharges and the energy of this capacitor is transferred to the output. $D_{TB1}$ turns on with SS when the $C_{S1}$ voltage falls to zero. The control signal is applied to $T_{B1}$ while $D_{TB1}$ is in the on state and so the main switch $T_{B1}$ turns on perfectly with ZVT. After this moment, the control signal of $T_S$ is removed and a resonance occurs between $L_S$, $L_M$ and $C_{S3}$. Capacitor $C_{S3}$ discharges with this resonance from $V_o$ to zero and so $T_S$ turns off with ZVS.

After the ZVT turn-on of $T_{B1}$ and ZVS turn-off of $T_S$, the remaining stored SS energy in the inductors is transferred to the output by the diodes $D_{S4}$ and $D_{S5}$. After this energy transfer is complete, the current of $T_{B1}$ reaches the input current and the 'on' stage of the conventional boost converter begins. The control signal of $T_{B1}$ is removed at the end of the determined time. The parallel $C_{S1}$ capacitor provides ZVS turn-off for $T_{B1}$. The main diode turns on when the $C_{S1}$ capacitor voltage reaches $V_o$ and one switching period is completed.

## The Design Processes

Here we discuss the design processes of the auxiliary circuit, main circuit and the control circuit for a fully soft-switched and bridgeless PFC circuit.

### *Auxiliary Circuit Design*

The following equations apply for the turn on of the auxiliary switch and the turn off of the boost diodes with ZCS, respectively.

$$L_S \geq \frac{V_o}{I_i} t_{rTS} \qquad (1)$$

$$L_S \geq \frac{V_o}{I_i} 3t_{rr} \qquad (2)$$

Here, $t_{rTS}$ is the rise time of the auxiliary switch and $t_{rr}$ is the reverse recovery time of the boost diodes. The magnetizing inductor of the centre tapped transformer is selected equal in size as the snubber inductor. It should be noted that diode $D_{S2}$ has an

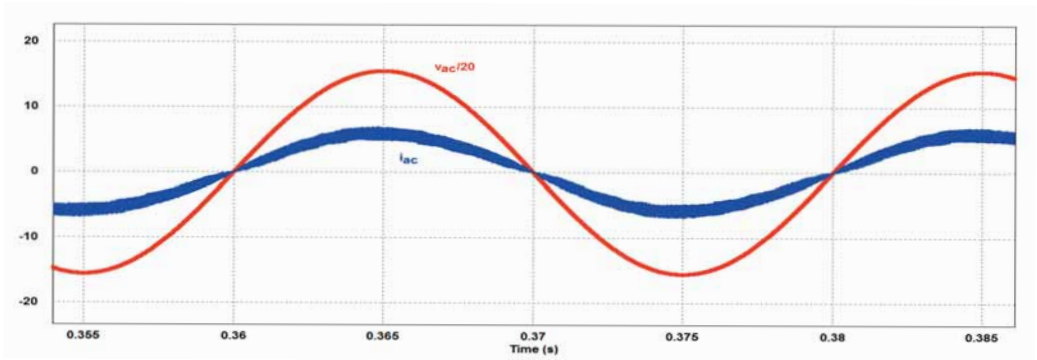



**Figure 8:** Waveforms of the mains voltage ($V_{ac}$) and current ($I_{ac}$)

additional voltage stress in the case of $L_M > L_S$ and the transfer of the transformer energy declines; the current stress of the auxiliary switch increases in the case of $L_M < L_S$.

The following equations apply for the turn off of the boost switches with ZVS.

$$C_{S1} \geq \frac{I_i}{V_o} t_{fTB1} \qquad (3)$$

$$C_{S2} \geq \frac{I_i}{V_o} t_{fTB2} \qquad (4)$$

Here, $t_{fTB1}$ and $t_{fTB2}$ are the respective falling times of the boost switches.

The $C_{S3}$ capacitor is discharged when $I_{LS7} = I_{LM7}$, as $C_{S3}$'s value is quite low due to the stored energy in the inductors $L_S$ and $L_M$. The following equation can be used to determine the value of $C_{S3}$ if the current is slightly higher than the input current $I_i$.

$$C_{S3} \geq \frac{I_i}{V_o} t_{fTS} \quad (5)$$

## Main Circuit Design

The boost inductor $L_B$ is designed to operate in CCM and to provide PFC according to Equation 6. Here $f_s$ is the switching frequency, D is the maximum operating duty at the low voltage $V_{ac(min)}$, and $\Delta I$ is the acceptable ripple current.

$$L_B = \frac{V_{ac(min)}.D}{f_s.\Delta I} \quad (6)$$

The maximum peak current at a low mains voltage is $I_{ac(pk)}$ and the acceptable ripple current is as follows:

$$I_{ac(pk)} = \frac{2.P_o}{\sqrt{2}.V_{ac(min)}} \quad (7)$$

$$\Delta I = I_{ac(pk)}.\%20 \quad (8)$$

The output capacitor $C_o$ can be calculated according to the output voltage ripple, output power and hold-up time.

The maximum voltage stress of the boost switches $T_{B1}$ and $T_{B2}$ in the proposed circuit is limited with the output voltage $V_o$ and the maximum current stress of the boost switches is equal to $I_{ac(pk)}$. Also, the voltage of the boost diodes $D_{B1}$ and $D_{B2}$ is equal to the output voltage.

## Control Circuit Design

Here we have applied the average current mode control method. A simplified control circuit block diagram is given in Figure 3.

In order to obtain a sinusoidal input current that is also in the same phase with the input voltage, a rectified sinusoidal signal must be detected from the output of the rectifier. This sinusoidal signal is multiplied by the output of the output voltage feedback loop and divided by the square of the input voltage feed forward loop to obtain the sinusoidal current reference signal. This multiplier/divider combination keeps the loop gain constant, and the output voltage error amplifier controls the power delivered to the load.

If the control loop does not have a squarer and divider, the gain of the control loop consisting of a multiplier and divider would change with the square of the input voltage. The obtained sinusoidal current reference signal is compared to the input current across the current sense resistor and then a compensating output is applied to the current error amplifier. The high gain current error is then compared to the sawtooth waveform signal to generate the PWM signal.

For soft switching of the main switch, its voltage is detected. The control signal of the auxiliary switch starts before turning off the main switch and ends after turning it on.

## Simulation Results

The simulation circuit was designed with a switching frequency of 100kHz, maximum output power of 1kW, output voltage of 400V and a universal mains range (85-265Vac).

The $L_B$ boost inductor is designed to operate in CCM and it was selected at 200µH. Output capacitor $C_o$ is selected as 940µF. According to design criteria, $L_S$ = 6µH, $L_M$ = 6µH, $C_{S1}$ = $C_{S2}$ = 3.3nF and $C_{S3}$ = 2.2nF. The average current mode control method is used to control the circuit. The simulation results of the proposed circuit, operating at 220$V_{ac}$, are shown in Figures 4 to 6.

The main switch $T_{B1}$ turns on with ZVT and turns off with ZVS, as shown in Figure 4. The ZCS turn-on and ZVS turn-off operations of the auxiliary switch are shown in Figure 5. There is no additional voltage and current stress on the main switch. Also, the auxiliary switch has no additional voltage stress and its current stress is low compared to other soft switched topologies.

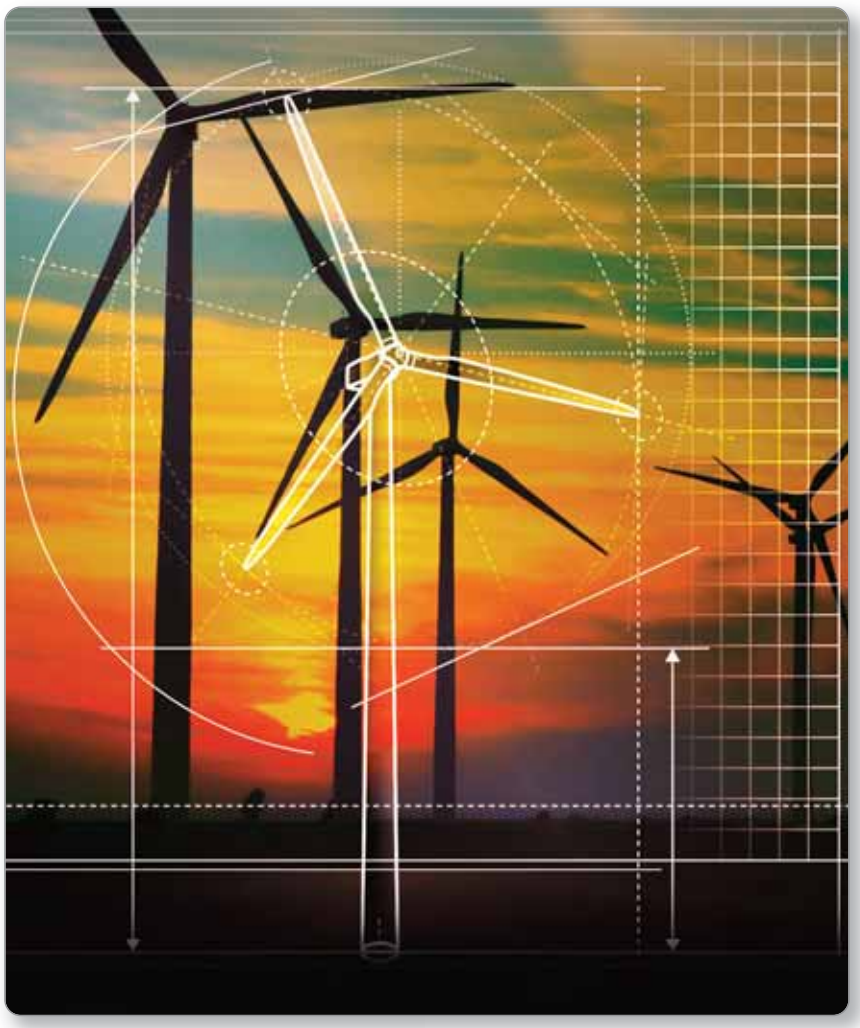
The boost diode $D_{B1}$ turns on with ZVS and turns off with ZCS as shown in Figure 6. Also, there is no extra voltage and current stress on $D_{B1}$.

The $L_S$ inductor current and $C_{S3}$ capacitor voltage are shown in Figure 7. The $L_S$ inductor provides ZCS turn-on for the auxiliary switch and turn-off for the boost diodes. Also it discharges $C_{S1}$ and $C_{S2}$ and provides ZVT turn-on for the boost switches. As shown in Figure 6, at the on and off time durations of the auxiliary switch, $C_{S3}$ charges to $V_o$ and discharges to zero, respectively. As such, a ZVS turn-off for the auxiliary switch is achieved.

The input voltage and current waveforms are shown in Figure 8 for operating at 220Vac/50Hz. The power factor is measured over 0.99. ●

# DC LINK CAPACITORS FOR THE MICROGENERATOR AGE

CERTAIN CAPACITORS CAN BE USED TO REMOVE VOLTAGE SPIKES CREATED BY FAST SWITCHING IGBTS AND MOSFETS IN POWER CONDITIONING. **ANDREW BELLAVIA**, DIRECTOR OF PRODUCT MARKETING FOR FILM & ELECTROLYTIC CAPACITORS AT KEMET, EXPLAINS



The EU's goal of satisfying 20% of energy requirements from renewable sources by 2020 is just one commitment among numerous green energy initiatives worldwide, which are not only driving large renewable installations by utility companies but also encourage home energy generation, or microgeneration. The emergence of consumer protection schemes such as Solar Keymark and the UK's Microgeneration Certification Scheme (MCS) for products and installers confirm the maturing of this new market. In fact, over 7500 solar PV panel types are now certified under MCS alone, as well as more than 20 small wind turbines spanning power ratings from 6kW to 22kW.

For equipment producers, success in consumer markets and utility-grade applications depends upon continuous innovation to reduce generator size and cost while enabling increased energy efficiency. These imperatives apply equally to power-conditioning components such as DC/DC converters and DC/AC inverters as to energy harvesting equipment such as solar PV panels and wind turbines.

## Power Conditioning Circuitry

Power conditioning in a wind or solar generator is needed to remove fluctuations typically present in the raw output from the PV panels or turbine, to produce a sinusoidal AC line output to drive local loads and feed into the grid. In a wind installation the turbine-driven generator produces an alternating power output, which contains constantly varying harmonics and voltages due to factors such as frequently changing wind speed. This noise is substantially removed by filtering at the input to an AC/DC converter that feeds a DC link connected to an inverter.

The inverter produces a high-quality

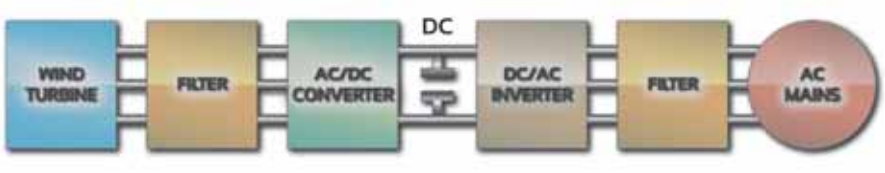



**Figure 1:** Generic power conversion architecture in wind-powered applications

sinusoidal AC output at the desired line voltage, but quite often an AC filter is also installed in the output of the inverter. This arrangement is shown in Figure 1.

In a solar installation, individual PV cells producing a typical voltage of 0.5-0.6V are connected in series to produce a higher voltage. This may be connected to a DC/DC converter feeding a microinverter mounted directly on each panel, or a centralised inverter via a DC link at a voltage typically between 450V and 1500V depending on the application.

The DC/DC converter may be a full or half-bridge, typically built using IGBTs switching at a fixed frequency of up to around 20kHz. Conventional MOSFETs, although able to switch at higher frequency, which can help improve efficiency and reduce solution size, cannot withstand the high DC operating voltages normally required. More advanced types such as super-junction or silicon-carbide (SiC) substrate technology devices can withstand higher operating voltages around 600-1200V within the dimensions of industry-standard package types, thereby providing valuable new design options for engineers.

Fast switching of the IGBTs or MOSFETs in the bridge can produce voltage spikes of up to 4000V. These spikes can be removed using a capacitive snubber connected close to the output of the bridge. Double-metallised or metallised film/ aluminium foil polyester and polypropylene film capacitors, which have the necessary ability to provide high stability and withstand harsh thermal conditions, may be used in this role.

Ripple currents are present in the DC link line after the output of the bridge. This line is connected to the system's inverter, and the currents are caused by voltage switching and voltage fluctuations due to factors such as circuit inductance and unfiltered effects from the PV panel or wind turbine output. To absorb potentially damaging ripple currents and ensure a stable voltage on the DC link, a bank of capacitors is typically connected. High-voltage film capacitors or aluminium electrolytic capacitors are suitable for this task.

## DC Link Capacitors

Although using a bank of capacitors adds weight as well as cost, this approach has been necessary to minimise the effects of the ripple currents passing through, as the capacitors perform their task to stabilise the DC link voltage. A major effect of these ripple currents is to cause internal I2R heating due to each capacitor's parasitic resistance, or Equivalent Series Resistance (ESR).

New generations of capacitors are emerging from companies, including Kemet. These are designed specifically for DC link duties in applications such as renewable energy generation and other high-power applications, such as electric lifting mechanisms and traction drives for electric vehicles. The design of optimised DC link capacitors aims to increase ripple current handling by reducing ESR, increasing the ability to withstand high operating temperatures and ensuring safe failure modes in the event of prolonged exposure to excessive ripple current.

Such improvements in device design enable equipment designers to achieve the required ripple current handling capability using fewer individual capacitors. This can help to reduce system size as well as the bill of materials. By lowering the internal heating of DC link capacitors, designers can also simplify thermal management and cooling, such as by specifying a smaller or lower-cost heatsink.

## Improving the Breed

At the heart of the latest devices lie innovative materials and processes such as self-developed, high-conductivity electrolytes. Used in electrolytic capacitors such as those manufactured by Kemet, these are known to reduce ESR and hence effectively lower internal heating.

Combined with improvements in device design and construction, advanced manufacturing equipment enables precision control of winding processes used to assemble electrolytic capacitors. Extra precision at this stage allows higher operating voltages for a given dielectric thickness. In addition, high-accuracy vision-guided automatic welding machines are capable of producing terminations accurately, and with high repeatability, making a further contribution to consistently low ESR.

Other avenues of research include proprietary electrode metallisation techniques that effectively increase the ripple current handling capability in film capacitors, and various collaboration with film suppliers to create new types of film capacitors capable of operating safely prolonged times at high temperatures.

## Key Factors

The emergence of markets for home electricity generating equipment will unleash the full force of consumer power in the green energy sector. Utilising the best performing capacitors in key areas such as the DC link enables designers to simplify thermal design and increase energy efficiency while reducing solution size and achieving a competitive overall price.

**NEW FAMILIES OF DEVICES OPTIMISED FOR DC LINK DUTIES IN APPLICATIONS SUCH AS SOLAR/WIND-POWERED GENERATORS INCLUDE THE C4AE RADIAL FILM DC LINK CAPACITORS (SEE BELOW).**

These are metallised polypropylene film (MKP) capacitors, which deliver advantages such as high DC voltage ratings from 450V to 1100V and the ability to operate in ambient temperatures up to 105°C. Moreover, the devices are suitable for direct PCB mounting, allowing the use in compact home generating equipment.

For medium- to high-power applications, C44U metallized polypropylene capacitors in aluminium cans with screw terminals provide high ripple current capability, high capacitance density and long operating lifetime. This device family spans the voltage range 700V to 1300V.

These devices offer high capacitance in relation to outside dimensions. Alternatively, if enclosure height is critical, C4DE low-profile metallised polypropylene film capacitors provide capacitance up to 380µF/400V or 100µF/1000V within a maximum case height of only 64mm. Custom configurations may be considered if special capacitance, voltage, size or other requirements prevent the use of standard devices.

**Figure 2:** PCB-mount capacitors such as KEMETs C4AE radial film devices for low to medium-power applications are ideal for use in domestic microgenerator applications

# HIGH POWER, HIGH BRIGHTNESS LED DRIVERS IN THE LIMELIGHT

**TONY ARMSTRONG**, DIRECTOR OF PRODUCT MARKETING FOR POWER PRODUCTS AT LINEAR TECHNOLOGY, DESCRIBES THE AVAILABILITY OF DRIVERS FOR HBLEDS THAT ARE FINDING THEIR WAY IN AUTOMOTIVE APPLICATIONS

An LED is a semiconductor device that emits incoherent narrow-spectrum light when electrically forward-biased, resulting in a form of electroluminescence. Effectively, it's a direct conversion of electric energy to light by a solid phosphor subjected to an electric field. The color of the emitted light depends on the chemical composition of the semiconductor material used and can be near ultraviolet, visible or infrared.

## Modern-Day LED Technology

LED technology has improved significantly over the past couple of years. Higher brightness levels, higher efficiencies, longer lifetimes and decreasing costs have spun out from the many advances made in terms of heat dissipation, packaging and processing. Unlike incandescent light bulbs, LEDs do not have a filament that will burn out and they tend to run cooler. Furthermore, incandescent light bulbs waste 95% of the energy they consume as heat.

A high power, or high brightness (HB) LED's light output has already exceeded the critical milestone of 100 lumens per Watt (lm/W). In fact, some manufactures are already claiming 200lm/W in the laboratory. As such, LEDs have surpassed an incandescent light bulb (15lm/W for a typical 60W bulb) in terms of luminous efficacy. It is projected that within the next 12 months, LEDs with 150lm/W output will be readily available in the marketplace.

Another added benefit is LED lifetime. Depending on how it is calculated, a white LED bulb has at least a 50,000-hour lifetime and some even claim up to 100,000 hours, while an incandescent bulb's life is around 1,200 to 1,500 hours.

The cost of HBLED lighting has also come down very quickly. The cost of individual white-light diodes, several of which go into an LED-based bulbs and make up much of the cost, have come down in price from about $4 a few years ago to less than $1 now. Many LED industry analysts predict that over the course of the next twelve months, LED bulb replacements for the incandescent light bulb will be priced at a level acceptable for the consumer.

> It is projected that within the next 12 months, LEDs with 150lm/W output will be readily available in the marketplace

Some LED manufacturers have already claimed that they have designed light-emitting chips that could power an LED bulb producing light output comparable to a 75W incandescent bulb commonly used in most homes. This type of LED chip usually only requires about 9W of power to produce the same amount of light.

## Key Features of LED Drivers

One key performance feature that an LED driver IC must have today is the ability to adequately dim LEDs. Since LEDs are driven with a constant current to vary the LED brightness (where the DC current level is proportional to LED brightness), there are two methods of dimming the light by controlling the LED current.

The first method is analog dimming, in which the LED DC current level is reduced proportionally by reducing the constant LED current level. Reducing the LED current can result in a change in LED color or inaccurate control of the LED current.

The second method is digital or pulse-width-modulation (PWM) dimming. PWM dimming switches the LED on and off at a frequency at or above 100Hz, which is not noticeable to the human eye. The PWM dimming duty cycle is proportional to LED brightness, while the on-time LED current remains at the same level (as set by an LED driver IC), maintaining constant LED color during high dimming ratios. This method of PWM dimming can be used with ratios as high as 30,000:1 in certain applications.

Specifically in the case of driving high brightness (HB) LEDs, an LED driver ICs must be capable of delivering sufficient current and voltage for many different types of LED configurations – in a conversion topology that satisfies both the input voltage range and required output voltage and current. Thus, HBLED driver ICs should ideally have the following features:

- Wide input voltage range – up to 100V;
- Wide output voltage range – up to 100V;
- High efficiency conversion – up to 98%;
- Tightly regulated LED current matching – less than 2% over temperature;
- Low noise, constant frequency operation – as high as 2.5MHz;
- Independent current and dimming control;
- Wide dimming range ratios – up to 30,000:1;
- Multiple conversion topologies including buck, boost, buck-boost and SEPIC;
- Many protection features, such as protection for open LED strings, LED pin to VOUT shorts and accurate undervoltage lockout thresholds;
- Small compact solution footprint with minimal external components.

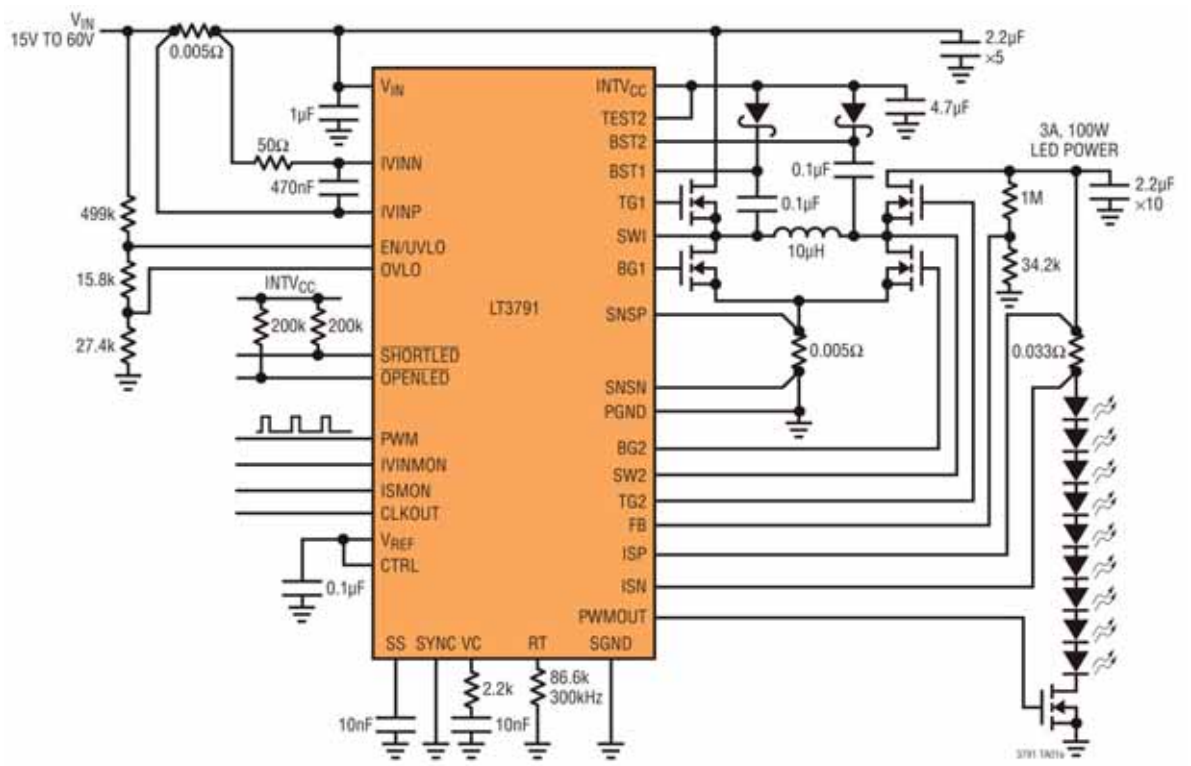



**Figure 1:** The LT3791 driving a 3A LED array at up to 100W

## HBLED Examples

In automotive applications the majority of automotive headlights are still incandescent light bulbs. However, this monopoly is increasingly coming under pressure from both high intensity discharge (HID) lamps and HBLED headlights.

HID lamps include all high intensity discharge lamps used in general lighting, such as High Pressure Mercury Vapor, High Pressure Sodium, Low Pressure Sodium and Metal Halide. General lighting sources are sufficiently bright to enable working or living environment in a room, building or external space. This includes residential lighting, commercial and industrial lighting, street lighting and automotive headlights.

HID Xenon lamps were first introduced for use as an automotive headlight in the late 1990s. However, they are very expensive to make, so their use has been limited to high-end vehicles only. Going forward, due to the recent introduction of HBLED s, the use of such HID Xenon lamps will quickly decline. Thus, it is expected the HBLED headlight will have the largest growth rate in the next decade.

One of the biggest obstacles facing automotive lighting systems designers is how to optimize all of the features and benefits provided by this newest generation of LEDs. Since LEDs generally require an accurate and efficient current source and a means for dimming them, an LED driver IC must be designed to address these requirements under a wide variety of operating conditions. Further, their power supply solutions must be highly efficient, rugged and reliable while also being compact and cost-effective.

Arguably, one of the most demanding applications for driving LED growth will be the headlamp assembly (consisting of high and low beams, daytime running lights, fog lights and turn signal lights), since they are subjected to the rigors of an automotive electrical environment, while simultaneously having to accommodate a wide variation of temperature conditions. And all the while, they must fit in a very space-constrained area and have an attractive cost structure.

## New LED Driver ICs for Automotive Headlights

The recently introduced LT3791 from Linear Technology is a synchronous 4-switch buck-boost LED driver and voltage regulator controller for driving HBLEDs in automotive headlamp applications.

The controller has a wide 4.5V to 60V input and 0V to 60V output range, and offers seamless transitions between its operating modes. Furthermore, its unique synchronous buck-boost topology enables operating efficiencies as high as 98%, which significantly reduces the size and weight of the heat sinking necessary to dissipate power lost as heat.

A ground-based reference voltage feedback pin (FB) serves as the input for several LED protection features and makes it possible for the converter to operate as a constant-voltage source (see Figure 1). Fault protection is provided to survive and report an open or shorted LED condition, while a timer allows the LT3791 to continue to run, latch off or restart when a fault occurs. It also has proprietary current-mode topology and control architecture and uses a current sense resistor in both buck or boost modes.

## Solutions Out Now

Despite the long list of performance characteristics necessary in HBLED drivers, the LED being driven by the LED driver has to be capable of delivering the necessary lumens of light output from the lowest possible level of power without causing significant thermal design constraint. Fortunately for the designers of high power HBLED products, there are both high efficacy LEDs and high performance LED drivers to drive them. ●

# SNR MEASUREMENTS FOR CAPACITIVE TOUCHSCREENS

**PATRICK PRENDERGAST**, TECHNICAL PRODUCT MARKETER AT CYPRESS, DISCUSSES WHAT SNR REALLY MEANS TO A TOUCHSCREEN SYSTEM'S PERFORMANCE AND ALTERNATIVE METRICS THAT CAN REPRESENT IT BETTER

Touchscreen controller manufacturers often cite an array of varying specifications and metrics to help their products stand out from others. One of those frequently mentioned differentiators is signal-to-noise ratio (SNR). However, even if the numbers are impressive, that doesn't necessarily mean SNR is a good indicator of system performance in the presence of noise. This article will discuss what SNR is, how it is calculated, what it really means to your system's performance, and alternative metrics that better represent touch performance.

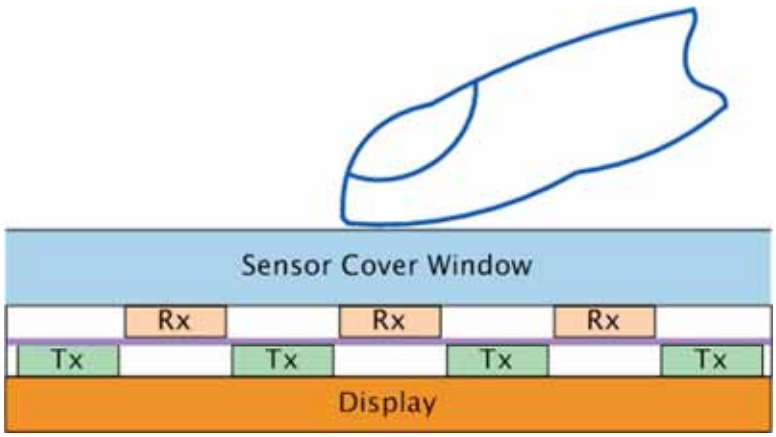



**Figure 1:** Touchscreen stack-up with touch

## What is SNR?

Signal-to-noise ratio (SNR) is a performance metric for touchscreen controllers accepted as an industry-wide standard. The problem with SNR is that there are no industry standard methodologies for measuring, calculating and reporting it, especially when considering the high variability of noise contributing components in a typical system, such as a mobile phone for example.

The two components (signal and noise) of this measurement and calculation are highly dependent on the device under test (DUT), typically a mobile phone. It's important to note that, although the legitimacy of SNR as a measure of performance is widely accepted, experts in the industry understand that most of the marketing claims of extremely high SNR don't hold up when put to real-world use cases. Additionally, delivering high SNR is not nearly as important to performance as meeting functional specifications in noisy conditions.

In capacitive touchscreens the signal in SNR is the measured amount of change in mutual capacitance as a direct result of finger capacitance. Finger capacitance depends on the sensor cover thickness, finger size, DUT stray capacitance to ground, and sensor pattern (see Figure 1 for an example touchscreen stack-up). The noise component is dependent on internal controller noise and external noise sources, as will be discussed in this article.

In projected capacitive touchscreens – the touch technology used in every new smartphone – noise bombards the touch sensor whenever it is in use. Noise from the display, which can be either an LCD or AMOLED (active-matrix organic light-emitting diode) type, to the touch sensor will get greater as the distance between the display and the touch sensor shrinks. Without analog display synchronization, the type of noise generated by LCDs is typically spiky. Noise generated by USB chargers is also spiky in nature. It is also the most variable, as the construction and the components in the AC/DC converter are different for every device.

> With so much variance in measurement conditions, it's a wonder that SNR is still used as quantitative metric

Third-party, low-cost chargers are particularly prone to such noise spikes. As such, USB chargers at present create the biggest headaches for OEMs when the touch controllers don't use noise cancellation technology. The touch controller is expected to operate without reporting false finger touches or a jittery finger position, with all of these external noise sources present simultaneously. None of them can be characterized as having a normal, or Gaussian, distribution. This presents a problem for engineers who are used to specifying the SNR of ADCs in the absence of noise.

With so much variance in

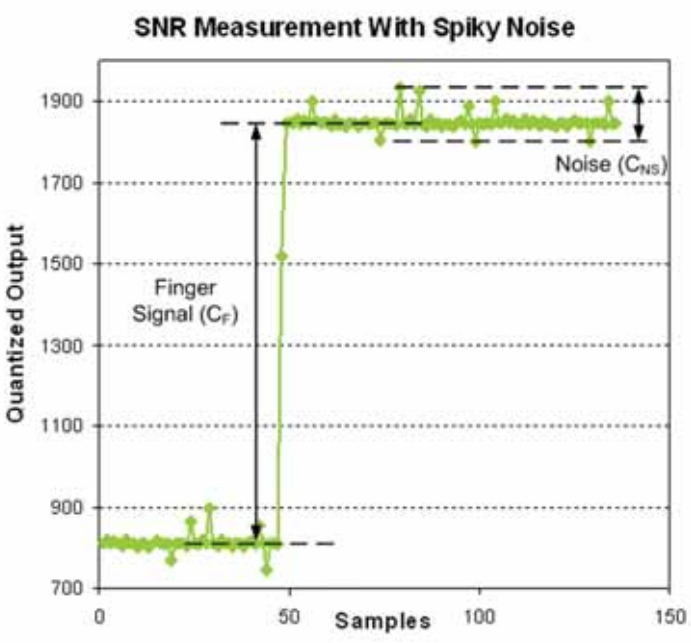



**Figure 2:** SNR measurement data for a mutual capacitance intersection with touch

measurement conditions, it's a wonder that SNR is still used as quantitative metric. Additionally, SNR cannot indicate the most important – and quantifiable – noise-related performance parameters of a touchscreen system: jitter (also known as noise free resolution) and false touch reports. Fortunately, there is an SNR measurement technique that can depict jitter in the presence of non-Gaussian noise.

## How Noise Affects Touchscreen Systems

SNR affects system robustness to false touches and positional jitter. A finger in close proximity to the touchscreen interferes with the fringing electric field at the intersection of two transparent electrodes. This capacitance is known as the mutual capacitance and it changes the capacitance of the sensor.

The intersections occur where orthogonally aligned transmit and receive electrodes cross. There are hundreds of such intersections on a mobile phone touchscreen. The touchscreen controller measures the change in capacitance for all of the intersections and converts the measured data into a quantized array of raw data. By measuring each intersection rather than an entire electrode, the controller is able to create a two-dimensional map of the touchscreen sensor capacitance.

If a large noise spike occurs on one of the intersections near the finger, an error term is added to the position calculation algorithm. The algorithm then converts raw data to coordinates; depending on the size of the noise spike, the coordinates of the reported finger-position may jitter, or alternate between two coordinates, when the finger is stationary. Chances are that you've noticed this in the form of unintended input or selection while using the touch interface on your smartphone, when plugged into a USB wall charger.

While it may not be very noticeable at low levels, jitter can create a variety of problems for a user interface. As the finger coordinates change, the move decoding algorithms may misinterpret a swipe or pan gesture in a way that is not only noticeable, but can for example cause a misfire whilst playing a game.

Worse yet, in extreme cases the noise generated by a charger can cause the touchscreen controller to report multiple fingers when only one finger is touching the sensor. This creates a condition often referred to as 'ghost fingers'. The consequences of ghost fingers can be an inoperable interface for mobile apps that are only designed for use with one finger, or they may render a gesture decoding algorithm inoperable.

The application of extensive intellectual property, diligent analog design and advanced signal processing algorithms allow modern touch controllers like the 4th generation TrueTouch (TMA440) controller, to be immune to charger noise.

## Specifications and Noise

Calculating and reporting SNR is even trickier than setting up the conditions for representative measurement. The severity of spiky, temporal, noise-based problems indicates that the SNR reported in a datasheet should adequately represent spiky noise. So what kind of measurement should be used to quantify SNR?

There are two possibilities here based on the way that we count noise. One way is to use standard deviation, or RMS; the other way is to use peak-to-peak (pk-pk) measurements. In a system with Gaussian noise, it is safe to use the standard deviation to calculate SNR because we can use a scalar conversion by multiplying the standard deviation noise value by six to calculate the pk-pk value (with 99.7% confidence). Since the noise in a touchscreen system is only Gaussian when the display is off and there are no chargers present, we don't care what the SNR is in this condition. We only really care about the SNR when the touchscreen is integrated into a device like a mobile phone.

Peak-to-peak is another way to analyze noise in an SNR calculation. The following is a closer look at both methods with a raw dataset (no digital filters applied) that exhibits a typical noise level with a charger and LCD in the system.

As you can see in Figure 2, the finger signal (CF) is measured by taking the difference of the mean value of 100

| Calculation | Noise | SNR | Calculation Difference |
|---|---|---|---|
| Peak-Peak | 154 | 6.7 | |
| Standard Deviation (stdev) | 20.6 | 49.9 | 6.8X |
| stdev * 6 | 124 | 8.4 | 25% |

**Table 1:** Noise estimation

samples (about 1 second worth) of data before a finger touchdown and the mean value of 100 samples after a finger touchdown:

$$C_F = Mean(Finger) - Mean(NoFinger) = 1850 - 813 = 1037$$

Next, we determine the amount of noise present in the system (CNS). System noise is the difference in the maximum and minimum capacitance measured at a sensor for a one-second interval. This value represents the amount of measured noise, but it does not include quantization error; we restore quantization error by adding one LSB worth of noise. This is especially important for systems with lower resolution.

We take the noise measurement when the finger is touching, so that we can reproduce the condition that is of most concern. Here is where we have the option of taking the standard deviation or the pk-pk value. The standard deviation when the finger is touching is 20.6 counts, while the pk-pk noise is 155 counts as calculated by the equation:

$$C_{NS(pk-pk)} = (Max(NoFinger) - Min(NoFinger)) + 1 = (900 - 746) + 1 = 155$$

The SNR calculated using pk-pk noise is 6.7, while the SNR calculated using standard deviation is 49.9. It is clear which one most people would rather put in their products' datasheet – but which one is more representative of the functionality of the system?

With standard deviation, you can have a quiet set of data with a single large spike (that is large enough to look like a finger), and get the same noise as a data set with a low-amplitude Gaussian distribution. Here you would see very high SNR, even though the touch controller would not meet the functional specifications of the user interface. If you measured the same dataset using pk-pk noise, your SNR would be close to one, and you could tell right away that there is a problem in the system.

> In extreme cases the noise generated by a charger can cause the touchscreen controller to report multiple fingers when only one finger is touching the sensor

Earlier it was noted that to convert standard deviation to pk-pk, we can scale by a factor of six to get to a 99.7% confidence interval. If we apply the same thinking to this dataset, we can see that the error in pk-pk noise estimation is off by 32 counts, or 20%.

When reading a datasheet, remember that without the dataset used for the calculation, the standard deviation method of calculating SNR gives no quantitative or qualitative representation of the performance or functionality of the touchscreen system. It is clear that by using the pk-pk SNR calculation you can qualitatively determine if there is a significant level of noise and if it will affect the performance.

## Beyond SNR

We can conclude that SNR is a poor performance metric in the absence of a standardized measurement procedure. There are defined performance metrics with measurement procedures and calculation steps that touchscreen controller suppliers (see Cypress Spec 001-49389) and mobile device OEMs use to thoroughly quantify touch performance. These specs are necessary for ensuring repeatable test outcomes, proving touchscreen performance, and regression-testing changes to touchscreen hardware or firmware.

A typical performance test setup requires metal finger emulators and jigs, an oscilloscope, a function generator and a robot, in addition to the touchscreen hardware and an interface to the controller. For example, a standard jitter measurement procedure is a seven-step process for recording the temporal noise in the reported coordinates that represent the position of the finger.

Here the measurement indicates how much movement, in units of distance, you should expect from a stationary finger. This is a relatively simple measurement of a parameter that has a direct and immediate effect on the user interface. By contrast, the effect of SNR on touch performance is less direct. Digital filters and position calculation algorithms are capable of removing jitter even in the presence of noisy conditions, reducing the value of SNR as a performance metric. Relying on SNR as an indicator of performance is not advisable, as it ultimately doesn't give a true sense of system functionality.

This article has attempted to show that just like the thread count in linens doesn't reflect the quality of the bed sheet, SNR does not indicate how well a system will respond to touch. That's why leading touch controller manufacturers, like Cypress TrueTouch, have a vetted suite of tests and measurements that are used to evaluate the performance of new touchscreen designs. ●

# TEN THINGS TO REMEMBER ABOUT WIRELESS COMMUNICATIONS

**MIKE FAHRION**, DATA COMMUNICATION EXPERT AND DIRECTOR OF PRODUCT MANAGEMENT AT B&B ELECTRONICS, GIVES A VERY USEFUL PRACTICAL GUIDE ON THE DESIGN OF RF SYSTEMS

## I. Basic logarithms.

Radio Frequency (RF) power is measured in milliwatts (mW) or, more usefully, in a logarithmic scale of decibels (dB), also referenced to 1mW of power (dBm). Since RF power attenuates as a logarithmic function, the dBm scale is most useful. In Table 1 are some examples of how these scales relate.

| | |
|---|---|
| 1mW = 0dBm | A 2-fold increase in power yields 3dB of signal |
| 2mW = 3dBm | A 10-fold increase in power yields 10dB of signal |
| 4mW = 6dBm | A 100-fold increase in power yields 20dB of signal |
| 10mW = 10dBm | |
| 100mW = 20dBm | |
| 1W = 30dBm | |

**Table 1:** Since RF power attenuates as a logarithmic function, the dBm scale is most useful. This table gives examples of how these scales relate

## II. The higher the frequency, the more multipath propagation you will encounter.

Industrial applications typically operate in "license free" frequency bands, also referred to as ISM (Industrial, Scientific and Medical) bands. The frequencies and power of these bands vary from country to country. The most common frequencies encountered are:

- 2.4GHz band – nearly worldwide;
- 915MHz band – North America, South America, some other countries;
- 868MHz band – Europe.

As frequency rises, available bandwidth rises as well, but the range and ability to overcome obstacles decrease. For any given distance, a 2.4GHz installation will have roughly 8.5dB of additional path loss when compared to 900MHz. Note that lower frequencies require larger antennas to achieve the same gain.

## III. Long range reception is not completely dependent upon transmit power.

The more sensitive the radio, the lower the power signal it can successfully receive.

You can often improve your receive sensitivity and, therefore, your range, by reducing data rates over the air. Receive sensitivity is a function of the transmission baud rate. As baud rate goes down, the receive sensitivity goes up. Many radios give the user the ability to reduce the baud rate to maximize range.

The receive sensitivity of a radio also improves at lower frequencies, providing another significant range advantage of 900MHz (vs 2.4GHz). The improvement can be as much as 6 to 12dB.

## IV. Knowing the noise floor can be as useful as knowing the receive sensitivity.

RF background noise can come from sources like solar activity, high-frequency digital products or competing forms of radio communications. The background noise establishes a noise floor below which the desired signals are lost in the background ruckus. The noise floor will vary by frequency.

The noise floor will often be lower than the receive sensitivity of your radio, in which case it won't be a factor in your system design. But if you're in an environment with lots of RF noise in your frequency band, use the noise floor figures rather than the radio receive sensitivity to make your calculations. Doing a simple site survey to determine the noise floor can pay off down the road.

Sources of interference aren't always obvious. When in doubt, look about. Antennas are everywhere. They're on the sides of buildings, water towers, billboards and chimneys. Some are even made to look like trees.

## V. Everything from rain to solar flares can affect wireless communications.

Establishing a fade margin of no less than 10dB in good weather conditions will help assure that the system will continue to operate effectively when conditions

**Figure 1:** Wireless access point

degrade due to weather, or solar and RF interference. There are some creative ways to estimate the fade margin of a system without investing in special gear. Pick one or more of the following and use it to ensure that you've got a robust installation:

1. Some radios have programmable output power. Reduce the power until performance degrades, then dial the power back up to a minimum of 10dB. Remember that doubling output power yields 3dB, and an increase of 10dB means a ten-fold increase in transmit power.
2. Invest in a small 10dB attenuator. (Use the correct one for your radio frequency.). You don't have enough fade margin if you lose communications when you install the attenuator in-line with one of your antennas.
3. Antenna cable is lossy, and more so at higher frequencies. Specifications vary by type and manufacturer, so check them yourself. At 900MHz, the loss of a coil of RG58 in the range of 50 to 100 feet (15 to 30m) will be 10dB. At 2.4GHz, a cable length of 20 to 40 feet (6 to 12 m) will yield 10dB loss. If your system still operates reliably with the test length of cable installed, you've got at least 10dB of fade margin.

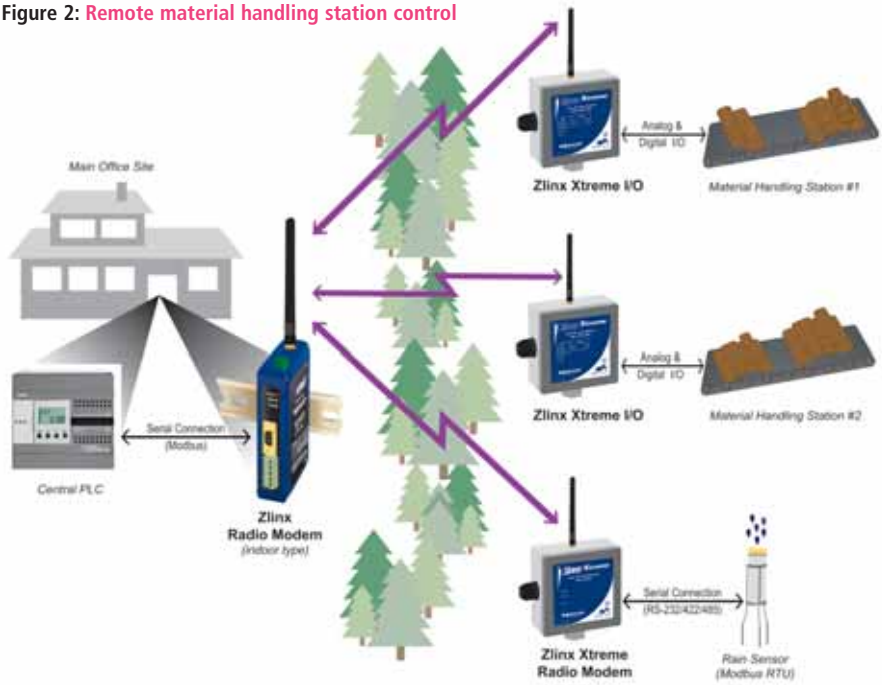
## VI. Simple maths can help specify the right wireless equipment.

Predicting the range of a given radio signal isn't a black art. There are some simple rules of thumb. The equation for successful radio reception is:

**TX power + TX antenna gain – Path loss – Cabling loss + RX antenna gain – 10dB fade margin > RX Radio sensitivity or (less commonly) RF noise floor**

Note that most of the parameters are easily gleaned from the manufacturer's data. That leaves only path loss and – in cases of heavy RF interference – RF noise floor as the two parameters you must establish yourself.

Figure 2: Remote material handling station control




## VII. Antenna placement makes a big difference.

In a clear path through the air, radio signals attenuate with the square of distance. Doubling range requires a four-fold increase in power, so:

- Halving the distance decreases path loss by 6dB.
- Doubling the distance increases path loss by 6dB.

Indoors, paths tend to be more complex, so use a more aggressive calculation:

- Halving the distance decreases path loss by 9dB.
- Doubling the distance increases path loss by 9dB.

Radio manufacturers advertise "line of sight" range figures. Line of sight means that you can see antenna B from antenna A. Just being able to see the building that contains antenna B doesn't count as line of sight. For every obstacle in the path, de-rate the "line of sight" figure specified for each one. The type of obstacle, its location and the number of obstacles all play a role in path loss.

Visualize the lines radiating between the antennas as an elliptical path. The center of the RF path is wide, with many pathways. A single obstacle here will have minimal impact on path loss. But as you approach each antenna the RF field narrows. As such obstructions near the antennas can cause dramatic path loss.

Figure 3: USR602 heavy duty USB to serial converter with port-to-port isolation

It's easy to underestimate the distance between antennas: if it's a short-range application, pace it off; for a long-range application, establish the actual distance with a GPS or Google Maps.

The most effective way to reduce path loss is to elevate the antennas. At 6 feet (2m) the line of sight is only about 3 miles (5km). Anything taller than a well-manicured lawn will be an obstacle.

Weather conditions matter: Increased moisture in the air increases path loss; the higher the frequency, the higher the path loss.

Beware of foliage! A few mid-path saplings are tolerable, but it's very difficult for RF to penetrate significant woodlands. If you're crossing a wooded area your antenna must be higher than the tree-tops.

Industrial installations often include many reflective obstacles. These will create numerous paths between the antennas. The received signal is the vector sum of each of these paths. Depending on

| | Loss per 10 feet (3 meters) of cable length | |
|---|---|---|
| Frequency | RG-58U | LMR-400 |
| 900MHz | 1.6dB | 0.4dB |
| 2.4GHz | 2.8dB | 0.7dB |

**Table 2:** Typical attenuation figures for two popular cable types

**Figure 4:** Wireless connectivity remote pump app

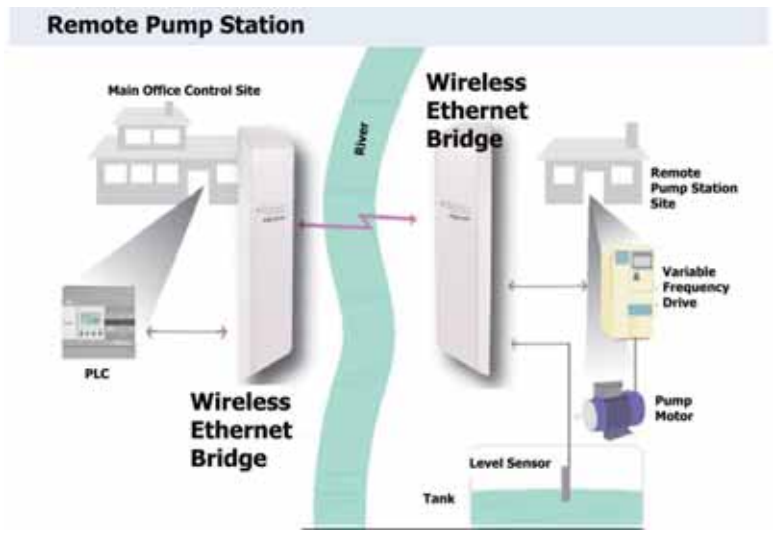



**Figure 5:** Solar-powered transmitter


the phase of each signal, they can be added or subtracted. In multiple-path (typically urban) environments, simply moving the antenna slightly can significantly change the signal strength.

Some obstacles are mobile. More than one wireless application has been stymied by the likes of a stack of containers, a parked truck or material handling equipment. Plan for that.

Remember that metal is not your friend. An antenna will not transmit from the inside of a metal box or through the walls of a storage tank.

***Path Loss Rules of Thumb:***

- Never exceed 50% of the manufacturer's rated line of sight distance. This alone yields a theoretical 6dB fade margin – a big step on the way to the required 10dB.
- De-rate more aggressively if you have obstacles between the two antennas, but not near the antennas.
- De-rate to 10% of the manufacturer's line-of-site ratings if you have multiple obstacles, obstacles located near the antennas, or if the antennas are located indoors.

## VIII. Competing antennas can interfere with your own.

Proper antenna choice and location will have a big impact on your wireless connectivity. Antennas can increase their effective power by focusing the radiated energy in a desired direction. Using the correct antenna not only focuses power, it reduces the amount of power broadcast into areas where it is not needed.

But one symptom of the increasing popularity of wireless is the fact that everyone seeks out the highest convenient places to mount their antennas. It's common to arrive at a job site and find that other antennas are already sprouting all over your installation point. Even if you suspect that these systems are spread-spectrum and likely to be using other ISM or licensed frequency bands, you'll still want to maximize the distance between their antennas and your own.

Most antennas broadcast in a horizontal pattern, so vertical separation is more meaningful than horizontal. Try to separate antennas with like-polarization by a minimum of two wavelengths, which is about 26 inches (0.66m) at 900MHz, or 10 inches (0.25m) at 2.4GHz.

## IX. Use good cable in the shortest possible lengths.

High frequencies don't propagate well through cable and connectors. Use high quality RF cable between the antenna connector and your antenna. Ensure that all connectors are also high quality and that they are carefully installed. Factor in a 0.2dB loss per coaxial connector, in addition to the cable attenuation itself. Typical attenuation figures for two popular cable types are listed in Table 2.

While long cable runs to an antenna create signal loss, the benefit of elevating the antenna another 25 feet (7.6 m) can more than compensate for it.

## X. Consider latency and packetizing before issuing purchase orders.

Bit error rates for wireless communications are orders of magnitude higher than those for wired communications. Most radios handle error detection and retries for you, but at the expense of throughput and variable latencies. When using wireless your software must be well designed and your communication protocols must be tolerant of variable latencies.

Protocols that are sensitive to inter-byte delays may require special attention or specific protocol support from the radio. Do your homework up front. Confirm that your software won't choke, that the intended radio can get along with your protocol, and that your application software can handle it as well. ●

# SIGNAL PROCESSING FOR DETECTING WEAK LIGHT SIGNALS WITH GRADUAL VARIATIONS

**ZHENHAO YANG** AND **HONGZHI JIA** FROM THE UNIVERSITY OF SHANGHAI

PRESENT A NOVEL METHOD OF DETECTING WEAK LIGHT SIGNALS WITH GRADUAL VARIATIONS IN POLARIZATION MEASUREMENT

Detecting weak signals is of great importance to hi-tech development and many scientific fields, including optics, electronics, material chemistry, biomedical engineering, test and measurement, instrumentation and so on.

The condition of weak optical signals buried in noisy environments is often encountered in optronics, especially in photoelectric detection; sources could be background light and/or electrical noise.

In general, the techniques used to detect weak signals consist of extracting the desired signal from the noisy environment by electronic means and/or by signal processing, which can be used to suppress noise and restore signals. In this article, we introduce a novel method of detecting weak light signals with gradual variations in polarization measurement.

> This method, in addition to modulating the light to improve the sensitivity of the signals, is also used to enhance the detection accuracy

In a common polarization measurement system, light from the source is polarized by a polarizer, it passes through an analyzer and is then received by a photoelectric sensor, which converts the light signal into an electric one.

For this study, light from the light source is modulated, whilst the electric signal is demodulated by a filter circuit, following amplification by a preamplifier and a secondary amplifier. The electric signal is then processed by an envelope detection circuit, a clamping and clipping circuit, and then fed to a digital signal processor (DSP), see Figure 1. The DSP is used to improve the detection accuracy and to suppress any residual noise.

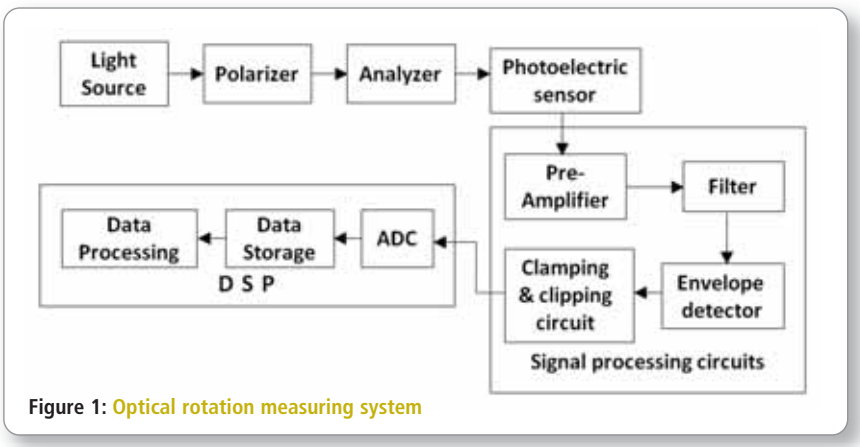



**Figure 1:** Optical rotation measuring system

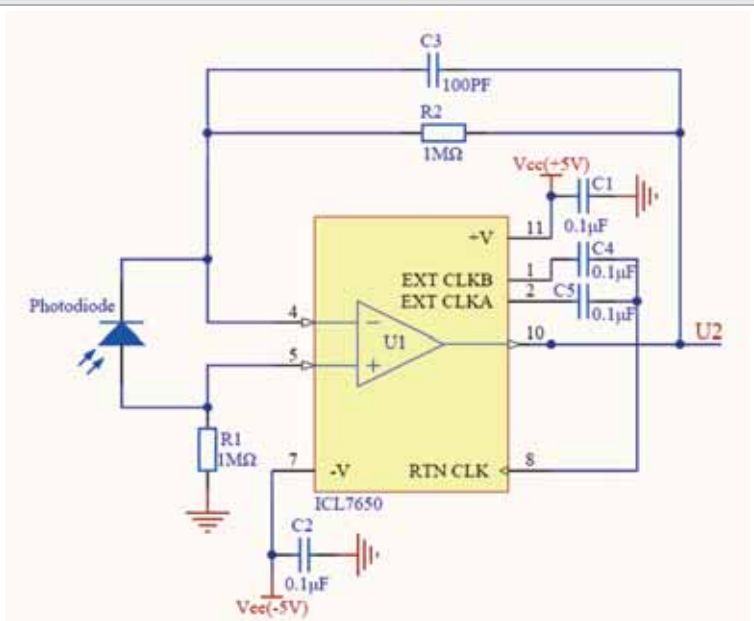



**Figure 2:** The photoelectric sensor and preamplifier

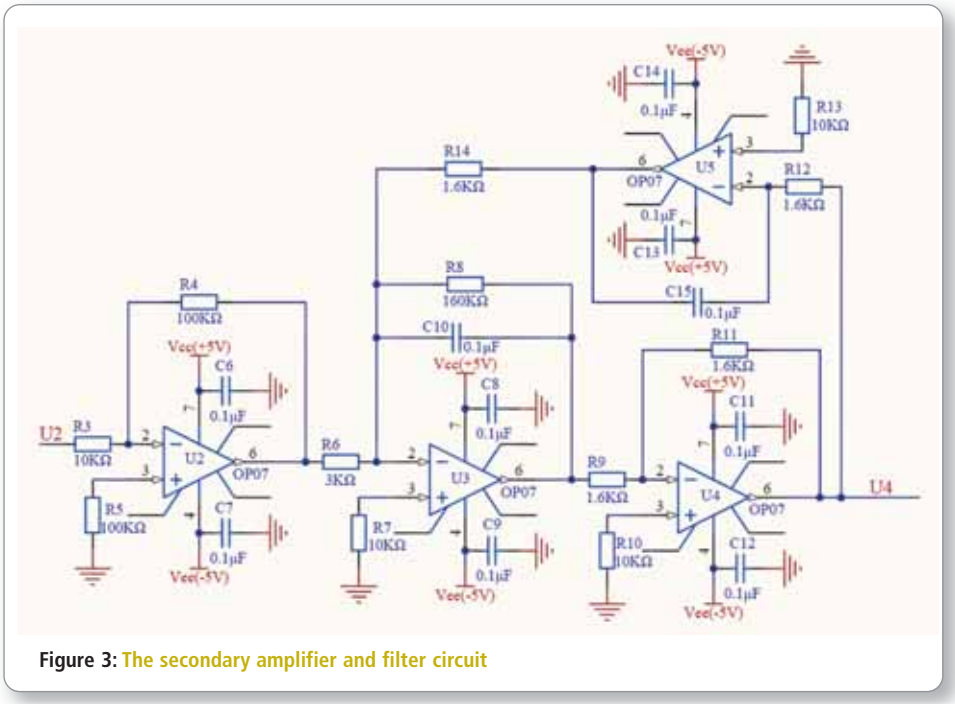



**Figure 3:** The secondary amplifier and filter circuit

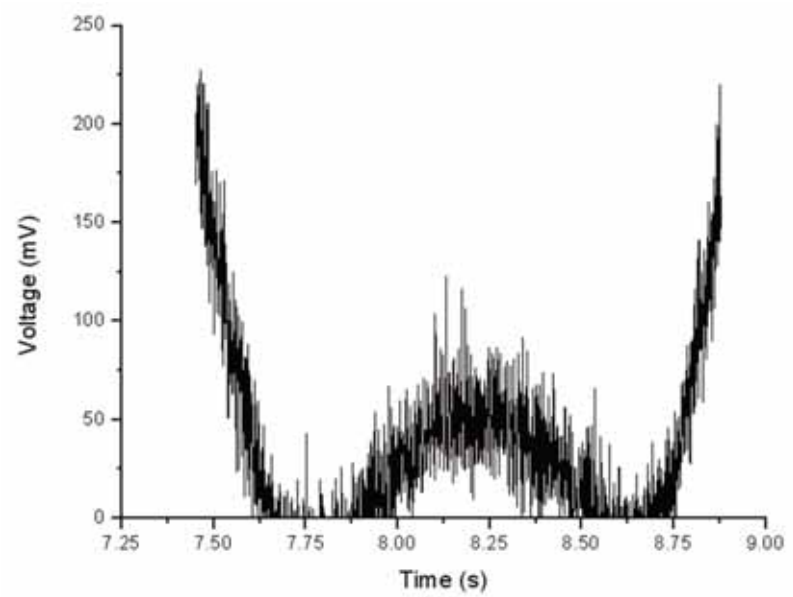



**Figure 4:** The output signal of the filter circuit, sampled by a DSP

## Designs and Experiments

In our experiments, a modulating laser diode with a wavelength of 650nm is used as the light source. The modulating signal is a 0V-5V square wave with frequency of 1kHz and a duty cycle of 50%. A photo diode is used as the photoelectric sensor. The converted electrical signal passes through the preamplifier and is demodulated by a filter circuit, see Figures 2 and 3.

When taking polarization measurements, the analyzer rotates at a constant speed to align in the position with minimum light intensity – when the polarizer and analyzer are orthogonal to each other. The rotation speed is 5rpm. The filter's output signal during the analyzer's rotation is shown in Figure 4, obtained by a DSP at a sampling rate of 1kHz.

Although the light signal is changing slowly with small variations (since the analyzer rotates at a slow speed), the output signal is still noisy, due to the signal modulation by the laser diode.

The input signal in Figure 2 is 1kHz AC. Even though both – the frequency of the light and the sampling – come from one source, there is still a small phase deviation that causes sampling variation in each period, hence the noise. If we raise the sampling frequency, the high frequency noise elements will increase too, and it is difficult to calculate an accurate trend line through an AC signal with high frequency noises. So, we've added an envelope detection circuit. Figure 5 shows the envelope detection circuit (before point C), as well as the clamping and clipping circuit (after point C).

In Figure 5, point A is connected to the output of the filter circuit. The circuit between A and C is a half-wave envelope detector. The first part is a half-wave rectifier with a gain of 1. It only outputs the negative half period of the signal. The rest is a low-pass filter which further amplifies the signal with a gain of 20, and converts it to a DC signal. This way, a valid light intensity signal with gradual variation is separated from the noise environment and reconstituted.

As for the circuit after point C, when the polarizer and analyzer are

> Although the light signal is changing slowly with small variations (since the analyzer rotates at a slow speed), as a result of the signal modulation by the laser diode the output signal is still noisy

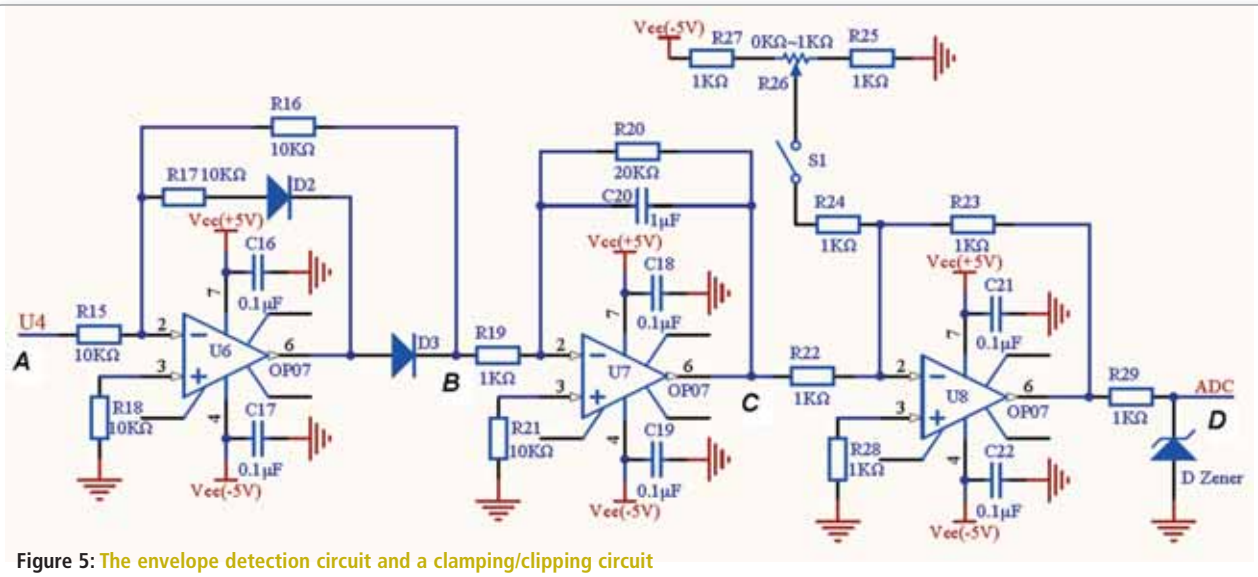



Figure 5: The envelope detection circuit and a clamping/clipping circuit

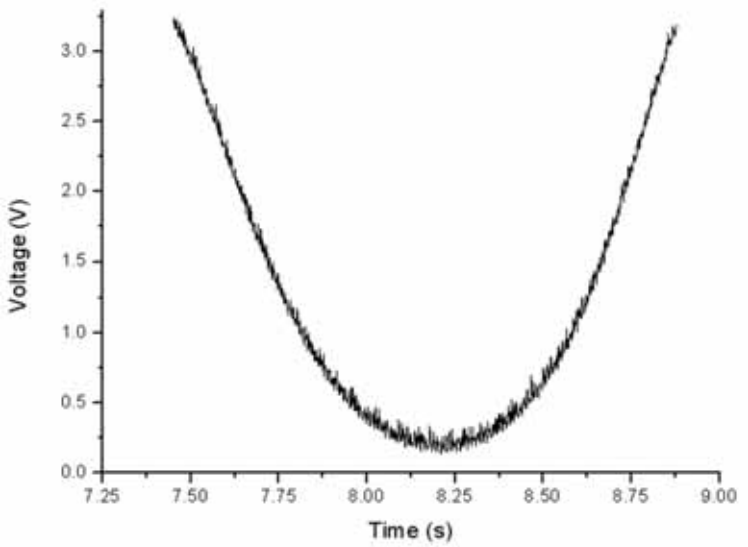



Figure 6: The final output signal sampling by DSP

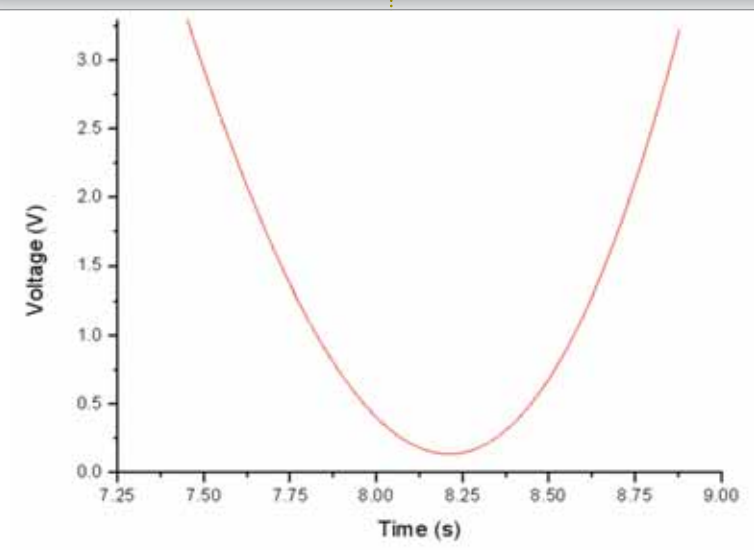



Figure 7: The conditioned final output signal

orthogonal to each other, the transmitted light intensity is theoretically zero. However, there is always some light leaking through, and sometimes the background light becomes a disturbance too, so the minimal signal to the DSP will deviate a lot from zero and reduce the range of valid data. To prevent this deviation, switch on S1, so a negative voltage signal fed into the circuit does the clamping.

The maximum input voltage of the 12-bit ADC contained in the DSP (TI's TMS320F2812) is 3.3V, so a zener diode is placed just before the output to clip the signals that are above that voltage level. An amplifier is set to adjust those expected weak signals to a voltage range from 0V to 3V. Finally, the signal is sampled through an ADC (see Figure 6).

From Figure 6 it is obvious that the signal is more distinct than before and, moreover, the high-frequency noise elements are strongly suppressed. Only a low level of noise remains. This noise can still affect the accuracy of the measurements, however.

Based on the Malus Law, $I = I_o cos^2\theta$, the signal must fit the profile of the sine-cosine function, therefore the signal is conditioned with the help of a DSP.

Figure 7 shows the original, weak, gradual signal. It can be seen that the influence of the high-frequency noise elements is minimized. ●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# WHAT THE READERS SAY

## GROWING THE SPACE INDUSTRY?

In reply to the news item on the UK investment in space exploration, addressed in the July issue on page 50: I'd like to point out that supporting a £7.5bn annual business with £2.5m amounts to 0.033%.

With research budgets in high-tech industries often exceeding 10% of revenue, this programme will not make any perceptible difference for the overall development of the UK space industry.

**Jan Didden**

## Misrepresenting The Catt Question

In the June 2012 issue, page 38, Raymond Boute misrepresents "The Catt Question": http://www.ivorcatt.co.uk/cattq.htm.

He writes: "[Catt] concludes that classical theory is wrong".

There is no such conclusion, only a question about classical theory. This question is answered in contradictory ways by accredited experts. Until this is resolved, we do not have a wrong theory – we have no theory at all!

For thirty years no one has addressed the problem – that something at the centre of classical theory is unstated, and students are not warned.

In the July issue, page 40, Ray Lee makes the same error. He writes: "...the objections raised by Catt...". No objections are raised. Merely, a question is asked. Lee further says: "Scientists and engineers have over the years worked out usable models...".

However, in the case of electromagnetic theory, the model does not exist, and nobody cares.

The model has to include a consistent story as to where the charge comes from on the bottom conductor when a battery lights a lamp, or we have to be told that there is disagreement. All we get is deafening silence.

**Ivor Catt**

**IF YOU WOULD LIKE TO COMMENT**
on these subjects or any others mentioned in Electronics World, please write to the Editor at the address below

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# Wireless DAQ

IN THIS SERIES, **MAURIZIO DI PAOLO EMILIO**, TELECOMMUNICATIONS ENGINEER, SOFTWARE DEVELOPER AND DESIGNER OF ELECTRONIC SYSTEMS, PRESENTS A TUTORIAL ON DATA ACQUISITION SYSTEM DESIGN

What if you could lower your infrastructure and operating costs, improve quality and eliminate cable maintenance, all whilst helping your operators be more productive? The same technology that gives you a fully functional telephone service can make all of that – and a lot more – possible.

Today with the swift rise of Wi-Fi and Bluetooth technologies, the wireless data acquisition network is becoming a distinct possibility. This is why a number of users are moving towards a wireless system. The block diagram of such a data acquisition system might look the same as one for a wired network, considering all that the wireless data acquisition network replaces is the wired network. It works in exactly the same way; the only difference being data is transmitted over a wireless data acquisition network.

Wireless data acquisition systems can eliminate costly and time-consuming wiring of sensors in the field. These systems consist of one or more wireless transmitters, sending data to a wireless receiver, connected to a remote computer. Wireless transmitters are available for ambient temperature and relative humidity, within the 4-20mA range, and they already exist for thermocouples, resistor temperature detectors (RTDs), pulse output sensors and so on. Receivers can be connected to a PC's USB or Ethernet port.

**Figure 1:** Wireless data acquisition system

The need to readily connect at any time, anywhere, particularly for data purposes, has increased manifold over the years and it has triggered extensive research activities in the wireless domain. Factors that have accelerated the usage of wireless data transfer include the vast improvements made in digital signal processing, the establishing of new standards such as the IEEE 802.11, the Wireless Application Protocol (WAP) and Bluetooth, and others.

These developments are creating a revolution in wireless data capabilities, products, and user interest. Wireless technology is extensively used at home and in the office. Many sectors have started using wireless data transfer considering the advantages it offers. Among them are:

- General laboratories;
- Industry and manufacturing;
- Automotive, marine and aerospace;
- The military;
- Seismic, geotechnical and meteorology;
- Medical and biomedical fields; and so on.

All these sectors use data for analysis and statistics. Data used to be collected using input/output devices and sensors, and then passed on to a data processing centre. This process was called remote data acquisition or data collection. However, this method had some drawbacks, including huge setups, extensive cabling, and the high costs for the infrastructure.

Wireless data acquisition systems (Figure 1) were implemented to overcome the limitations of conventional data collection setups. The advantages of these systems are:

- Customized software interfaces and applications;
- Significant savings in installation and infrastructure costs;
- Reduction in time spent making contact measurements in

*Wireless data acquisition systems can eliminate costly and time-consuming wiring of process sensors in the field*

hard-to-reach locations and in plugging and unplugging sensors.

- Increased safety by making it possible to maintain a safe distance from dangerous equipment and hazardous locations whilst taking measurements;
- Speed-critical applications requiring fast, easy setups. One example is new-product test and development in manufacturing companies;
- Mobile applications, such as the transport of food and other perishable goods;
- Wireless networks can provide an effective method for monitoring environmental conditions.

Typically, a wireless transmitter is fitted on to a transducer. This transmitter will be synchronized to the standard communications protocols used. The Wi-Fi or Bluetooth enabled transmitter may be placed within the transducer itself, which will allow the signal to be received over the wireless network.

Before using it at the destination point, the RF signal is isolated and its value taken. If an analog to digital converter is used at the transmitting end, the signal is generally transferred in its digital format. Design engineers have realized that the standard forms of transmission carry more weight and the data they convey is easy to use. As such a suitable design for the Wi-Fi or Bluetooth protocols is used and many of these devices come with a plug-in for the Ethernet port, which allows easy setup and connectivity to a computer network. In addition, the software programs used to capture the input from Ethernet ports are very simple to use as well. ●

## High Reliability 3-Row Datamate Connectors Are Now Available COTS

Popular high-reliability and high-performance, 3-row Datamate connectors from Harwin are now available from stock – 'Commercial Off the shelf' (COTS).

Stocked in five different configurations of PCB and cable variants and in six standard 'most popular' sizes from 18 to 96 ways, the 2mm pitch, 3A per contact connectors are ideal for use in board-to-board or cable-to-board applications where a high number of contacts is required in a small space. The three-row design provides a smaller PCB footprint, saving real estate on the PCB, and the compact cable version saves space within the equipment.

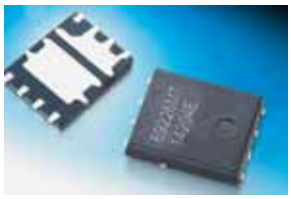
A high density connector system, these 3-row connectors feature up to 96 high performance signal contacts in standard sizes of 18, 27, 36, 54, 60 and 96 signal contacts arranged in three rows. Designed for mating with 22 AWG and 24 – 28 AWG wire sizes, the devices are available with vertical or horizontal PCB tails.

**www.harwin.co.uk**

## NEW DUAL MOSFET SIMPLIFIES SYNCHRONOUS BUCK CONVERTER DESIGN

Advanced Power Electronics Corp (USA) has announced the new AP6922GMT-HF-3, a space-saving dual MOSFET for synchronous buck converter applications, with both the high-side (control) FET and low-side (synchronous) FET in one single 5 x 6mm PMPAK package.

AP6922GMT-HF-3 is a rugged device combining fast switching, low on-resistance and cost-effectiveness. The control MOSFET (CH-1) has a drain-source voltage rating of 30V, a maximum on-resistance of 8.5mΩ, and a continuous drain current rating at 25degC of 15A; it has been chosen to optimise switching performance. The synchronous MOSFET (CH-2) also has a drain-source voltage rating of 30V and a continuous drain current rating at 25degC of 25.7A, with a maximum on-resistance of 3.8mΩ to minimise conduction losses. The reduced parasitic inductances – a result of the short internal conduction paths – also contribute to improved performance.



The devices are RoHS-compliant and halogen-free to meet today's environmental requirements.

**www.a-powerusa.com**



## A COMPREHENSIVE RANGE OF MID POWER AC DC CONVERTERS FROM RELEC

Relec Electronics has introduced a comprehensive range of Mid Power (150W-3000W) AC DC converters for industrial applications from Taiwanese manufacturer of switching power supplies Cotek Electronic Ltd. The UP series consists of open frame, U Channel PSUs which can be used in air-convection cooled applications up to 500W, and will fit 1U subrack systems.

The AK series converters have integrated fans and are available in power ranges from 350W-3000W. The AK series offers efficiencies of up to 91%; allows control of the output voltage from 30% to 100%; and an output current limit from 40% to 105% of rated values.

Features include:

- 1U Profile up to 1kW;
- Operation up to 70degC;
- Short-circuit/overvoltage/over-temperature protections as standard;
- Efficiency range of 87%-91%;
- Temperature and load dependant fan speed (AK Series);
- Very high volume density;
- Parallel operation for high power and redundant applications.

**www.relec.co.uk**

## LED Illuminated Pushbutton Switches From knitter-switch Can Display Two Different Messages

An illuminated panel-mounted pushbutton Tact switch that uses LEDs to display two different symbols or messages is available from knitter-switch. Each LP10 "double legend" pushbutton switch contains a combination of two coloured LEDs – red/blue, red/green and several single colours and one of two messages is visible depending on which LED is illuminated. As an example, an "ON" message can be displayed if the green LED is powered, while an "OFF" message is shown if the red LED is powered.


According to knitter-switch, LP10 pushbutton switches are through-hole mounted, SPST (Off-Mom) switches with a minimum lifetime of 500,000 cycles. Actuation force is 160gf ±20gf and actuation travel is just 0.25mm +0.2/-0.1mm.

Measuring 10mm x 10mm with a height off the PCB of just 11mm, LP10 pushbutton switches feature silver-plated contacts and terminals rated at 24VDC/50mA and a maximum contact resistance of 100mΩ. Operating temperature range is -25°C to +70°C.

**www.knitter-switch.com**

## FULL-BRIDGE DMOS PWM MOTOR DRIVER IC

An automotive version of the A4950 full-bridge motor driver IC is now available from Allegro MicroSystems Europe. The A4950 is designed for pulse width modulated (PWM) control of DC motors, and is capable of peak output currents to ±3.5A and operating voltages to 40V. The device is AECQ100 Grade 1 qualified and is rated over an extended ambient operating temperature range of -40°C to 125°C.


The new device is tested across extended temperature and voltage ranges to ensure compliance in both automotive and industrial applications, and is particularly suited to use in automotive HVAC systems.

A simple logic interface is available to control the speed and direction of a DC motor with externally applied PWM control signals. Internal synchronous rectification control circuitry is provided to reduce the power dissipation during PWM operation.

Internal circuit protection includes over-current protection, motor-lead short-circuit to ground or supply, thermal shutdown with hysteresis, undervoltage monitoring of load supply voltage and crossover current protection.

**www.allegromicro.com**

## STRAIGHT D-SUB SURFACE-MOUNT CONNECTORS

Harting has launched a range of straight D-Sub surface-mount connectors to complement its established angled products portfolio.

The new connectors feature an optimised design that ensures a high level of dependability and optimal processing characteristics. Their surface-mount capability significantly simplifies PCB assembly and broadens their range of applications.

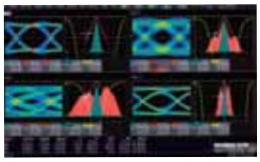
A co-planarity of 100% is achieved by using stamped contacts and a specially designed insulator. This robust solution is capable of withstanding all normal handling processes.

Two variants are available: a connector for standard applications with flat solderable pads to withstand plug-in and withdrawal forces and a variant for more demanding requirements with a solderable assembly pin in addition to the flat pads.

The black insulator, which is designed for improved camera detection, includes two positioning pegs for improved pick & place process reliability. Also included is a large removable cover for a 10mm vacuum pipette.

**www.harting.com**

## SDAIII-CompleteLinQ Multi-Lane Serial Data Analysis Products for High-Bandwidth Oscilloscopes



LeCroy Corporation has announced SDAIII-CompleteLinQ – the only serial data analysis package that simultaneously performs eye, jitter, vertical noise and crosstalk analysis on up to four lanes, with quick and easy lane-to-lane comparisons.

With multi-lane analysis, engineers can quickly view eye diagrams on all lanes, or use the multi-lane capability to analyze a single lane at multiple points using LeCroy differential probes or the VirtualProbe option.

SDAIII-CompleteLinQ can also show multiple analyses of a single serial data signal – ideal for either comparing different equalization schemes with the Eye Doctor II option.

Users can store and display the complete analysis of a lane into the Reference Lane, and use a LaneScape display mode to compare the analysis of 1, 2 or all lanes simultaneously.

The Crosstalk and CrossLinQ packages that are part of the SDAIII-CompleteLinQ product family provide vertical noise measurements and crosstalk analysis tools for complete aggressor/victim analysis.

**www.lecroy.com**


## RF SAVVY SERIES NONA-BAND SMART METER RF COUPLER

Featured for the first time at Autovation 2012 will be the RF Savvy Series, patent-pending Nona-band radio frequency (RF) coupler from Alpha Micro Wireless. The high 10kV electrical isolation enables safe routing of the RF signal from the network interface card (NIC) or wireless modem to a remote external antenna via a bulk head RF connection in the meter base.

Unlike other inefficient RF coupling schemes and isolator solutions on the market, the RF Savvy series Nona-band RF coupler offers an ultra-low loss (less than 0.5dB @915MHz), extremely high electrical isolation (> 10kV) and operates universally over nine frequency bands.

RF input and output terminations are via gold plated 50-Ohm MMCX jack connectors for rugged and easy installation. The RF coupler has been designed with a low profile (1.0mm) generic form-factor, suitable for use within the enclosure of most residential and commercial/industrial electric utility meters.

**www.alphamicrowireless.com**

## HIGH-BANDWIDTH ACCESSORIES FOR MORE DURABLE OSCILLOSCOPE PROBING

Agilent Technologies introduced economical semi-permanent solder-in probing solutions for its InfiniiMax III oscilloscope probing system. Engineers can use these accessories for high-speed digital system design, component design/characterization and differential serial bus measurements.

Agilent N2838A 25-GHz ZIF (zero insertion force) tips come with plastic sporks to aid in soldering the tips to the

device under test. The tip uses a PC board substrate, making it a highly durable and convenient probing solution.

The Agilent N2836A InfiniiMax III 26-GHz solder-in head provides up to 26GHz of system bandwidth. The ZIF tip and solder-in head come pre-attached with a pair of damping resistors for eliminating the distortion and loading that affect probes with in-band resonances.

InfiniiMax III differential active probes offer up to 30GHz of high-bandwidth performance for measuring differential signals, with superior signal integrity and flexible connectivity solutions for today's high-density integrated circuits and circuit boards. They are compatible with Agilent's Infiniium 90000 X- and Q-Series oscilloscopes.

**www.agilent.com**

## Atego Launches Aonix Perc Ultra SMP 6.1

Atego, a supplier of industrial-grade, collaborative development tools for engineering complex, mission and safety-critical architectures, systems, software and hardware, has launched Aonix Perc Ultra SMP 6.1, its next-generation embedded virtual machine and compilation technology for symmetrical multi-processor systems. With this release Atego introduces multi-core support for the Java 6 language for the first time in its Aonix Perc Ultra SMP product.

In addition to multi-core support for the Java 6 language, Aonix Perc Ultra SMP 6.1 provides new compilation technology producing tighter, more efficient code that executes up to 200% faster on average. An important feature added in this

release is automatic generation of native method call marshalling code that yields up to 14x improvement in Java-to-native call speed compared to prior versions. And a graphical console called PConsole, with new support for multi-processor execution, is provided together with this release at no additional cost.

**www.atego.com**

## THE R&S ESR REDUCES EMI TESTING TIMES AND MORE RELIABLY DETECTS EMI

Rohde & Schwarz has introduced the new R&S ESR EMI test receiver whose broadband architecture allows standard-compliant EMI measurements

up to 6000 times faster than other solutions. Comprehensive diagnostic tools such as spectrogram display, real-time spectrum analysis and IF analysis help developers detect and eliminate EMI. The R&S ESR is impressively easy to use thanks to its intuitive touchscreen interface.

The new R&S ESR test receiver is available in two different models for frequencies of between 10Hz and 3GHz or 7GHz to meet the requirements of all users who perform EMC certification on commercial equipment. The R&S ESR covers all commercial standards relevant for test houses and EMC labs used by electrical equipment manufacturers and their suppliers.

The R&S ESR opens up totally new analysis capabilities. The spectrogram function seamlessly displays the analyzed spectrum over time and records measurements for up to five hours, allowing developers to detect sporadic interferers.

**www.rohde-schwarz.com**

## New Wireless Operator Interface Pushbutton Controller from Honeywell

Honeywell announced the release of the new Limitless Wireless Operator Interface, WOI Series, which expands Honeywell's Limitless wireless switch and receiver portfolio by providing a packaged pushbutton controller for manufacturers and OEMs. The WOI Series adds a human interface device to the product-driven interfaces of the Limitless portfolio. With both momentary and maintained contact options, the Limitless Series now offers wireless control from both person and position.

Honeywell's Wireless Operator Interface is a controller designed to wirelessly turn on and off equipment (pumps, motors, drives, conveyors, and other industrial equipment), open or close gates/doors, or provide notification to remote locations. The WOI Series can be used in rugged industrial environments to notify appropriate departments when there are quality, machine, material out-of-stock, or other manufacturing issues.

Designed for flexibility, the user can choose and install a desired operator (22mm rotary switch, key switch, key) or utilize one of Honeywell's pushbuttons.

**www.honeywell.com**

## ULTRA-LOW IR SCHOTTKY BARRIER DIODES PREVENT THERMAL RUNAWAY AT HIGH TEMPERATURES

Rohm Semiconductor has recently announced the development of the RBxx8 series of ultra-low IR Schottky barrier diodes capable of operating at high temperatures, enabling support for automotive and power supply devices. Power consumption is reduced by approximately 40% compared to conventional automotive rectifier diodes, making them ideal for energy-saving circuits in electric vehicles (EVs) and hybrid electric vehicles (HEVs).

Rectifier and fast recovery diodes (FRDs) are commonly used in circuits for automotive and power supplies exposed to high temperature environments due their strength against thermal runaway. However, they often feature high VF, making it difficult to reduce power consumption to the levels required for EVs and HEVs. As a result, there has been an increasing demand for low-VF Schottky barrier diodes that can support operation at high temperatures.

ROHM has utilized high temperature-resistant metals to achieve the industry's lowest IR – approximately 100 times smaller than that of conventional SBDs, ensuring compatibility with high temperature environments.

**www.rohm.com/eu**

## HERMETICALLY SEALED MINIATURE MICROWAVE SMP CONNECTORS

Just announced by specialist RF & Microwave component distributor, Admiral Microwave Ltd, is an innovative hermetically-sealed SMP subminiature connector specifically designed for manufacturers of high frequency microwave modules in the wireless communications, defence, avionics, medical and test sectors.

The Aaren Technology model AT37H-6483-FD is a male thread-in connector ideally suited for incorporation into microwave modules needing multiple coax inputs/outputs in the minimum smallest possible space. Overall dimensions are 6.7 x 3.95mm. Offering excellent performance from DC to 26GHz, the connector features a glass bead hermetic seal over the gold-plated Kovar centre contact.

The Aaren SMP connector is a high frequency push-fit design, fully compatible with the well-established GPO range from Corning Gilbert. The SMP Male thread-in is specified with a 'full detent' interface which requires a high mate/de-mate force. This delivers a more positive mating action, thereby ensuring a higher reliability interface, which is essential for high performance microwave module applications.

**www.admiral-microwaves.co.uk**

## SPELLMAN INTRODUCES NEW 6KW HIGH VOLTAGE POWER SUPPLY PRODUCT FAMILY

Spellman High Voltage Electronics Corporation has introduced its new STR Series of 6kW high voltage power supplies.

The STR is available in positive or negative polarities in 19 different models with outputs ranging from 1kV to 150kV. A full featured front panel allows easy local control, an extensive analog interface provides comprehensive remote capability, and standard Ethernet digital interface simplifies system integration.

The STR's robust IGBT inverter is inherently fault-tolerant and is ideal for demanding applications like semiconductor processing and vacuum deposition. Many operational features can be configured by the user to suit their particular requirements. For additional technical information on the STR Series, contact Spellman at:

**www.spellmanhv.com**

## New Rigol DS2000 Series 2GS/s Oscilloscopes Perform Analogue-Plus-Decodes

Engineering today's control and power systems increasingly demands low-noise measurements such as serial-plus-power signals amidst interfering noise. Rigol's new DS2000 series of scopes perform 500uV/cm analogue plus advanced digital trigger functions, with connectivity for convenient LAN, USB-to-stick/PC screen grabbing and so on.

The award-winning Rigol DS2202 (200MHz), DS2102 and DS2072 low-noise analogue, digital-decoding oscilloscopes handle more applications: 16 trigger functions as standard, optional serial, SPI and I2C-bus decodes to its generous 8" screen (pictured). Uncompromising specifications from front-end onwards mean DS2000s capture smaller signals linearly; analyse longer streams of data (56Mpts option); deliver exceptional t-axis resolution, and at 50,000 waveforms/s.

**www.rigol-uk.co.uk**

## RAYTHEON HONOURS AVX WITH 4-STAR SUPPLIER EXCELLENCE AWARD

AVX Corporation was recently presented with the 4-Star Supplier Excellence Award from Raytheon's Integrated Defense Systems (IDS) business unit. Raytheon IDS instituted the annual Supplier Excellence Awards program to recognize suppliers who have provided outstanding service and partnership in exceeding customer requirements. Award candidates are judged on certain criteria, including overall quality, on-time delivery and demonstrated commitment to continuous improvement.

"AVX has maintained a successful relationship with Raytheon for many years because of both partners' commitment to providing customers with the best quality products," said Pete Venuto, vice president of sales at AVX. "This means staying ahead of the curve by advancing technology while continuing to supply components that meet safety, performance and cost expectations, yet go beyond the minimum requirements and specifications found across the marketplace. Receiving the 4-Star Supplier Excellence Award from Raytheon Integrated Defense Systems demonstrates AVX's continued dedication to these goals."

**www.avx.com**

# CBI COMMENTS ON NEW ROUND OF HIGHER APPRENTICESHIPS FUNDING

**Recently the UK government announced 4,230 new Higher Apprenticeships in sectors including aviation, low carbon engineering, legal services and space engineering, as part of the £25m Higher Apprenticeships Fund.**

The CBI followed with a comment. "Businesses know that building our higher-level skills base has to be an essential part of a successful plan for growth in the long-term," said Neil Carberry, CBI Director for Employment and Skills. "Future skills shortages in key sectors could hold back our economic performance, so boosting higher level apprenticeships now is the right thing to do. Sectors like high technology and science-based advanced manufacturing and IT are a good place to start.

"Young people need to know that Higher Apprenticeships are a great route to a successful career, as they can build higher level skills while learning on-the-job with an employer."

The CBI is the UK's leading business organisation, representing around 240,000 businesses that together employ around a third of the private sector workforce. With offices across the UK as well as representation in Brussels, Washington, Beijing and Delhi, the CBI communicates the British business voice around the world.

**MAURIZIO DI PAOLO EMILIO, Telecommunications Engineer, INFN – Laboratori Nazionali del Gran Sasso, Italy:** The jobs market, as you will have heard or experienced, is tough these days. More people are competing for fewer job vacancies, making it more important than ever to make yourself stand out from the crowd.

So what are employers looking for? Qualifications, sure, but when you're competing against other, well qualified, candidates you'll want to give yourself the edge, and a Higher Apprenticeship could help. The Higher Apprenticeship benefits students and the younger generation by equipping them with great qualifications.

High-quality apprenticeships are vitally important for developing high-level skills, experience and knowledge required in today's workplace. They are also helping to bridge skills gaps and train workers for a wide range of sectors, from engineering, manufacturing and construction to health, business, law and IT, as well as emerging areas such as green technologies.

**BARRY MCKEOWN, RF and Microwave Engineer in the Defence Industry, and Director of Datod Ltd, UK:** The good news is that this initiative is to be welcomed as it is targeted at specific sectors. The bad news is that health is omitted and the fact that the UK apprenticeship system was destroyed as result of successive previous governments' drives to establish a 50% target of degree level qualifications. Whereas Germany retained its dual education system thus enabling the retention of its manufacturing base and current export success.

The fundamental problem here is the lack of engineers and scientists in Parliament compared to Germany, and providing too much theory at the expense of practical experience and foreign language skills in secondary schools.

I note also that Spain has recently entered into an agreement with Germany to give on-the-job training with German firms. I would challenge the UK government to follow likewise, but of course that would be political suicide.

**JAN DIDDEN, Audio expert and Publisher of Linear Audio, UK:** This is an excellent initiative for several reasons. The obvious one is building higher-level skills. It is nigh well impossible for the educational system to keep up with the advancements and developments in the high-tech industry in this fast-paced world.

Apprenticeships are an indispensible step for young professionals to connect to the cutting technology edge.

But, I believe there is another good reason to foster the apprenticeship system. First-time immersion in the highly competitive world of modern technology business can be a scary experience. An apprenticeship with its mentoring can soften that blow, and can help the apprentice to identify with a company and its goals, and understand the value of contribution and belonging. This is clearly a win-win situation!

**PROFESSOR DR DOGAN IBRAHIM, Near East University in Nicosia, Cyprus:** It is very welcoming to hear that the government is to fund 4,230 new Higher Apprenticeships in important sectors, such as aviation, space and low carbon engineering. This has come at the right time when investment and skilled people are in need more than ever to boost the current UK economy.

High level skills are the key to long-term economic growth. Young people learn such skills by practice while working with employers under the apprenticeship schemes.

**HAFIDH MECHERGUI, Associate Professor in Electrical Engineering and Instrumentation, University of Tunisia:** In the need to adapt to deep socio-economic changes, the development of professional competences becomes an absolute necessity. This process ensures the contribution to the cultural and economic development and social advancement. Thus, the British government's proposal to finance the competences in several active sectors comes with the aim to promote and reinforce the competence of the British people.

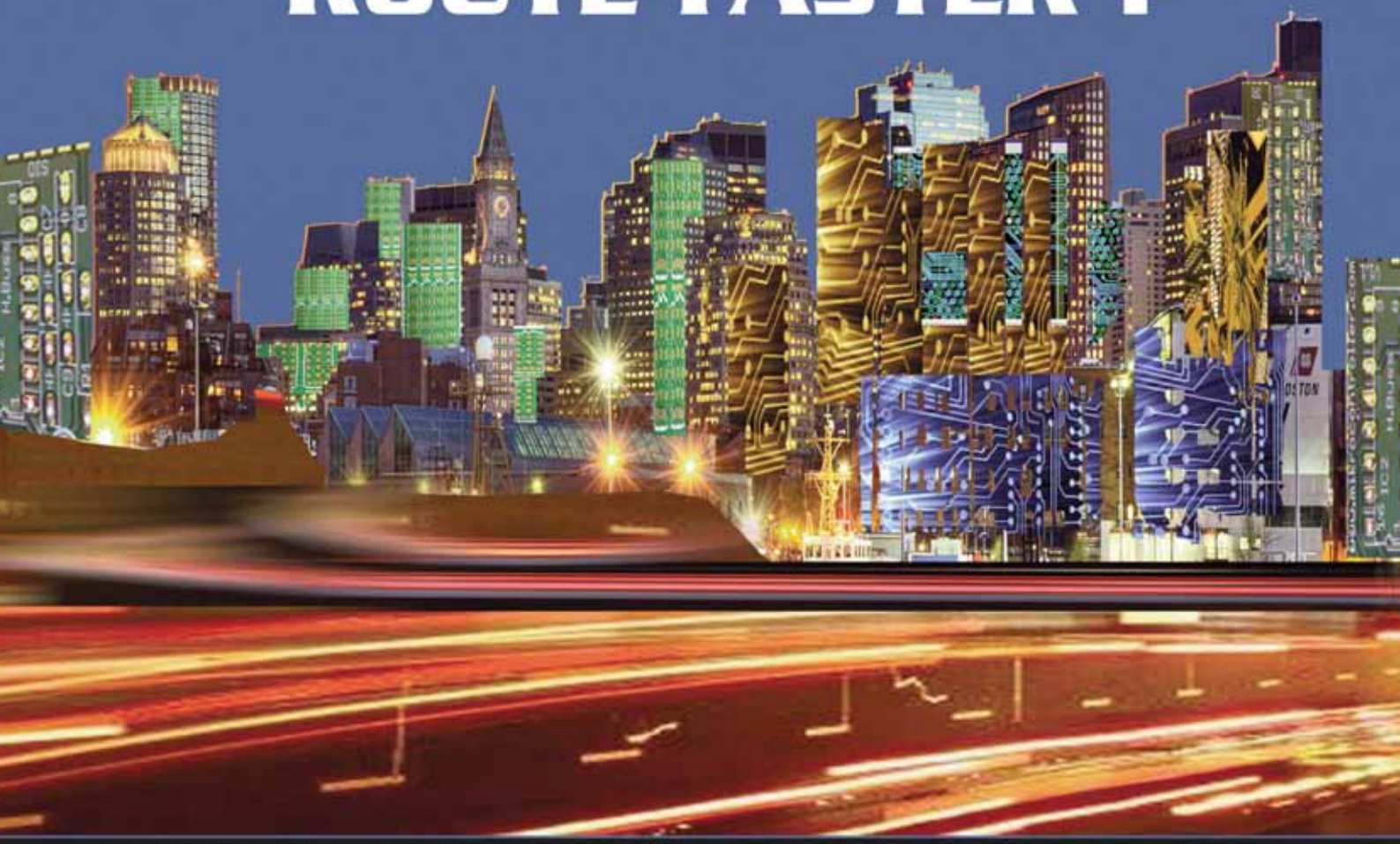
In my opinion, this is an excellent idea as the development of professional competences will make it possible to have a dynamic structure of formation while taking into account the environment and the system in which these actions are placed.

To meet the technology challenges and guarantee a favourable place in global competitiveness, it will be necessary to create the right development strategies, combining new technological capacity and investments in a large variety of economic sectors.

One notes that the concept of competence refers to the ability to mobilize resources to successfully tackle a range of professional challenges and that is, indeed, the objective of the British government.

**If you are interested in becoming a member of our panel and comment on new developments and technologies within the electronics sector please register your interest with the Editor by writing to Svetlana.josifovska@stjohnpatrick.com**

# ROUTE FASTER !



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