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FEATUREURING: • Telecommunications, Wireless, IoT, RF & Microwave
• Optoelectronics, Photonics, Displays & Lighting • Interconnection, Switches, Relays, Cables & Keypads
  Passive Components
Altron Arrow offers TE Connectivity’s (TE) connectivity and sensor solutions that have enabled advancements in transportation, industrial applications, medical technology, energy, data communications, and the home for the South African market.

As a global technology and manufacturing leader for more than 75 years, TE manufactures 120 billion products annually and generated $14 billion USD in sales revenue for fiscal year 2018. Large and small companies alike can now turn their ideas into technology that can transform how the world works and lives tomorrow through TE’s focus on reliability and durability, commitment to progress and an unmatched product portfolio.

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on the cover

As part of its ‘iCorp of Things’ offering, iCorp Technologies has adopted the new slogan ‘create | connect | communicate’. Find out more about some of the company’s offerings by reading CEO Bradley Agallio’s article on page 14 and checking out the advert on page 15.

For more information contact iCorp Technologies, +27 11 781 2029, enquiries@icorptechnologies.co.za.

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Making an aaS of ourselves

First of all, I must extend the sincere apologies of Technews Publishing to Hi-Q Electronics. We have worked closely with Hi-Q for many years and yet still managed to get its address and contact details wrong in our Electronics Buyers’ Guide (EBG) 2020.

You will find a bookmark inside your copy of this month’s magazine with the company’s correct details. Please insert it into the copy of EBG 2020 you received together with last month’s magazine, so that you have the correct details if and when you need to contact Hi-Q. We have also corrected the online version of the buyers’ guide.

Now, to elaborate on the meaning of this column’s title, the as-a-Service (aaS) phenomenon has been on my mind a lot lately. The first exemplar of the species that I became aware of was Software-as-a-Service (SaaS), whereby software is hosted in the cloud and licensed on a subscription basis. Fast forward just a few years, and Wikipedia now classifies no less than 45 as-a-Service models. Some of the most familiar include banking, infrastructure, mobility, payments, security and transportation.

I was privileged to attend a fascinating talk by tech entrepreneur Stafford Masie at an AREI (Association of Representatives for the Electronics Industry) business breakfast recently. Among the things I took away from that was his emphasis on the fact that when a technology truly flourishes and delivers its true potential is when it becomes invisible.

A good example of this is GPS. The first time I ever heard of it was when my father’s friend, who was a keen hunter, had one specially imported from the USA, at an astronomical cost. I can’t remember why exactly he felt he needed it but presumably it was a convenient way of keeping track of the best spots to murder animals for his personal amusement.

I come from a generation when you dared not drive a car without having a map book in the cubby hole. To any millennials who might be reading this, it would take too long for me to explain what a ‘map book’ was; you’ll have to google it. For those of us who travelled a lot, like I did, it could be the difference between life and death, so I bought an updated one every year at a not insignificant cost. And that only covered the Johannesburg area, so some people would have needed different map books for more than one area if they travelled widely.

Before setting out on my first ever road trip from Johannesburg to Cape Town, I decided to buy a Garmin – I would be traversing completely unfamiliar parts of the country and I only had a small car, so there just wasn’t enough space to store all the map books I would have needed and still have room for luggage. My Garmin, by comparison, was about the size of a modern smartphone.

Now we all have that same GPS technology (only better) packaged into our phones, and it’s given us access to things like Uber and Mr D Food at our fingertips. Some Uber drivers multitask by driving for other ride hailing services too, and deliver food on the side. You can even hire a chef to cater for your dinner party, or a musician to entertain your guests, using similar as-a-Service models.

Some experts are saying that this ‘gig economy’, this offering of ourselves and our skills as a service, is going to be one of the most transformative aspects of our lives and our jobs in the years to come. While that sounds like an exciting future in some ways, we also risk deepening the ‘digital divide’ separating those with access to technology and those without. Which makes it even more imperative that government stops paying lip service and addresses the challenges of delivering broadband Internet access to all citizens, and soon.

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South Africa

- Canadian technology company Sciencetech is now distributed in South Africa by Intercal. For over 33 years, Sciencetech’s products have been exported to countries around the world, within a variety of applications and fields, including medical research, biotechnology, space, food sciences, environmental and academic research, aerospace, and photovoltaic testing. Its main product categories are solar simulators, photovoltaic test systems, light sources, monochromators and spectrographs, modular optical systems and components, with full system customisation on all products.

Overseas

Business

- Infineon Technologies reported results for the third quarter of the 2019 fiscal year, the highlights of which were revenue of 20,015 million Euros, segment result of 317 million Euros, and segment result margin of 15.7 percent. Based on an assumed exchange rate of US$1.15 to the Euro, revenue for the fourth quarter is expected to grow by 1 percent (plus or minus 2 percentage points) quarter-on-quarter.

- Maxim Integrated Products reported net revenue of $557 million for its fourth quarter of fiscal 2019 ended 29 June, a 3 percent increase from the $542 million revenue recorded in the prior quarter, and a 12 percent decrease from the same quarter of last year. Diluted earnings per share (EPS) in the June quarter were $1.33.

- Cypress Semiconductor achieved $532.2 million in second-quarter revenue, down 1.3 percent sequentially, but up 4.8 percent sequentially after adjusting for the divestiture of its NAND business, which was completed on 1 April. The company’s connect and compute solutions continued to gain strong momentum, including in IoT where revenue was up 30 percent sequentially in Q2, driven by strength in Wi-Fi/Bluetooth combos as well as standalone Bluetooth.

- For its second quarter, NXP Semiconductors’ revenue of $2.2 billion was down 3 percent year-on-year, but 6 percent up on the first quarter of 2019. For the latest quarter, net income was $41 million (or $0.14 per diluted share), compared with net income of $54 million (or $0.16 per diluted share) in the same quarter a year ago.

- STMicroelectronics reported second quarter net revenues of $2.17 billion, gross margin of 38.2 percent, operating margin of 9.0 percent, and net income of $160 million or $0.18 diluted earnings per share. Looking at the third quarter, the company expects strong sequential revenue growth of about 15.3 percent at the midpoint. This growth will be driven by engaged customer programmes and new products in a softer than expected legacy automotive and industrial market.

- Texas Instruments reported second quarter revenue of $3.67 billion (a 9 percent year-on-year decrease), net income of $1.31 billion (down 7 percent) and earnings per share of $1.36 (down 3 percent). Its third quarter outlook is for revenue in the range of $3.65 billion to $3.95 billion, and earnings per share between $1.31 and $1.53.

Companies

- Antenna specialist Taoglas announced the acquisition of Firmwave, an IoT product design and engineering company, to deliver next-generation technology to applications such as healthcare, energy and utilities, supply chain and logistics, transportation, agriculture and construction. According to Taoglas co-CEO Ronan Quinlan, the move aims to satisfy demands from customers looking for a one-stop-shop for IoT engineering services.

- u-blox has acquired Rigado’s Bluetooth modules business in an asset purchase agreement. Rigado is a leading provider of edge-as-a-service gateway solutions for commercial IoT, and began offering certified wireless modules in 2015. The Rigado Bluetooth modules portfolio will be rebranded under the u-blox name and integrated into its short-range radio offering.

Industry

- The Semiconductor Industry Association announced that worldwide sales of semiconductors reached $98.2 billion during the second quarter of 2019, a small increase of 0.3 percent over the previous quarter, but 16.8 percent less than the second quarter of last year. Cumulatively, year-to-date sales during the first half of 2019 were 14.5 percent lower than they were through the same point in 2018. On a year-to-year basis, sales were down across all regional markets: Europe (-10.9 percent), Japan (-12.8 percent), Asia Pacific/All Other (-13.7 percent), China (-13.9 percent), and the Americas (-29.5 percent).

www.dataweek.co.za
What can sport teach us about MRO procurement?

By Brian Andrew, RS Components managing director for South and sub-Saharan Africa.

Have you ever tried getting out of a tight-fitting wetsuit after a long swim? It’s something I am still working on, but it already shaves valuable time off the main events. It’s also a frugal way to gain an edge: instead of paying R1000 to get my bike 100 grams lighter, I could easily lose another kilo or two by adjusting my diet. That weight reduction can cut valuable seconds from my bike leg.

In business, this is called marginal gains. It has its roots in the Japanese word ‘kaizen’, meaning ‘continuous improvement’. It’s a philosophy that states change, no matter how big or small, is for the better. This was touted as the reason for the success of the British cycling team, according to their coach Dave Brailsford. He took the team, and British cycling as a whole, to some of the best results in the Olympics as well as the Tour de France.

In triathlon and any other high-performance sport, the difference between winning and not can be a couple of seconds. Those transitions between swimming, biking and running are the thin wedges that widen the opportunity for victory. In business, particularly manufacturing, marginal gains hold the same promise of staying ahead of the competition. This is most evident in MRO procurement.

MRO procurement creates the winning lead

Collectively, manufacturers make MROP purchases – Maintenance, Repair, Operations and Production. These can be split into two categories: direct and indirect goods.

Direct goods fall under Production. These form parts of a final product, such as the screen on a smartphone or the battery in a notebook. This definition can also include raw materials that go into the production process to create the final product. On average, direct goods account for 75% of the value of MROP purchases.

Indirect materials are part of MRO. These are consumed in the process of manufacturing products. It could be solvent to clean machinery, a replacement switch on the production line, even a new screwdriver or light bulb on the factory floor. Even though such bits and bobs only account for a quarter of the value of MROP purchases, they total on average 80% of the transaction volume.

This makes the MRO part of the equation ripe for marginal gains. But many companies don’t take advantage of that. Why? It’s because they don’t distinguish the two at a price and discount level.

Find marginal gains with the right partner

Direct commodities are easier to plan: you can anticipate production requirements and schedule demands. Like the main disciplines of a triathlon, you can apply a lot of forward-thinking. But when things are in a pinch – when you have to change to cycling shoes or when a display breaks – you need to act quickly. In that scenario, price is not the driving concern. Overcoming the barrier is often done at any cost (instead of losing a few kilograms, I buy a much more expensive bike). But did I really gain as much as I could have?

Indirect goods are unpredictable. In most cases, the product may not have been bought before or it might have been purchased years earlier. That makes negotiating price a challenge. Why would a supplier commit to discounts and low prices without the customer committing to a certain volume or predictability in demand (which they cannot)? Yet if this synergy isn’t struck, many marginal gains stay out of reach.

What is the solution? MRO procurement should be a multi-stakeholder approach; a combination of strategies each delivering a small cost saving. Those marginal gains add up and could deliver up to a 35% cost saving. This requires a partner that you can collaborate with to uncover such benefits.

The best supplier is not just one that can compete on price, but understands the importance of gains made through good delivery channels. For example, they can provide digital order platforms that your staff can easily access, through vetted channels, for immediate order satisfaction.

Not all suppliers can do this. They are still happy to treat customers’ emergencies as lucrative opportunities. But this doesn’t walk the road with their customers and certainly doesn’t help realise marginal gains in the MRO space. It frankly also doesn’t show respect for the discipline of modern manufacturing.

Just like triathlon transitions, if you don’t respect the details and aren’t supportive about making manufacturing flexible, as a supplier you aren’t contributing to your customers’ success. For MRO procurement, this should be an absolute requirement for their supplier partners.

For more information contact RS Components, +27 11 691 9300, sales.za@rs-components.com.
The purpose of electrostatic discharge (ESD) packaging is to protect ESD-sensitive objects from ESD damage; especially when items are being transported outside of the designated ESD protected area. ESD packets, boxes and containers safeguard objects from ESD in three key ways:

1) By preventing direct ESD impact on the item contained within.
2) By dissipating static charge from the package surface.
3) By providing a robust exterior for protection against physical impact, as well as dust and humidity.

Antistatic bags
ESD bags are ideal for small electronic components, such as PCBs. ESD bags can be categorised into antistatic (low charge), conductive, and shielded material. The resistivity standards governing your industry and application will determine the type of material to be used. Most bags consist of a polyethylene and polyester layer with a black, pink or metallised tint for identification.

Antistatic boxes
Cortronic boxes feature an impervious static dissipative skin and conductive core. It is classified as ESD shielding material suitable for use in ESD protected areas. Applications include component boxes, PCB transit boxes, IC tube boxes, and in-plant handlers for PCBs.

Conductive containers
Utz is the world leader in material-handling solutions. Utz offers an extensive range of static conductive containers, bins and trays for safe handling, transport and storage of ESD-sensitive components and assemblies.

Tip: ESD foam and moisture barriers, such as desiccants, should be used within packaging for added protection.

For more information contact Altico Static Control Solutions on +27 11 608 3001 or email sales@actum.co.za to discuss your static control requirements.
Wits University to feature at AI Expo Africa

Wits University will be sending a high-level delegation to this year’s AI Expo Africa, where it will launch a major research initiative that is intended to bring about a step change in scientific research and commercialisation in Africa. The AI Expo Africa is the largest business-focused artificial intelligence (AI) and data science community event in Africa, and takes place on 4 and 5 September in Cape Town.

Professor Zeblon Vilakazi, deputy vice-chancellor: research and postgraduate affairs, will be leading the delegation that includes Professor Brian Armstrong, head of the BCX Chair in digital business at Wits Business School and the first secretary of the 4IRSA-initiative, and Professor Dean Brady, director of the Molecular Science Institute.

In addition to launching the initiative, Professor Vilakazi will participate on a Fourth Industrial Revolution (4IR) panel to discuss how this new initiative will serve as a model for 4IR innovation and growth in Africa.

The AI Expo was chosen as the launch event for the initiative due to its collaborative nature spanning academia and industry throughout Africa. Some of the attendees to join the Wits delegation at this year’s conference include the ambassador of France to South Africa, Christophe Farnaud, and the head of the AI for Good Global Summit.

For more information about AI Expo Africa, or to register to attend, visit http://aiexpoafrica.com

Win a Microchip evaluation kit

Dataweek readers are being offered the chance to win a SAM L21 Xplained Pro evaluation kit for evaluating and prototyping with Microchip Technology’s ultra-low-power SAM L21 ARM Cortex-M0+ based microcontrollers (MCU).

The SAM L family of microcontrollers is built with innovative picoPower technology to deliver power consumption down to 25 µA/MHz in active mode, under 100 nA in sleep mode and fast wakeup times of 1.2 µs. These MCUs have achieved an EEMBC-certified ULPMark Score of 410, which is the highest score for an ARM Cortex-M23 or ARM Cortex-M0+ class device.

In addition to ultra-low-power capabilities, these devices feature an enhanced peripheral touch controller, chip-level robust security, ARM TrustZone technology, AES, Full Speed USB host and device, event system and sleepwalking, 12-bit analog, built-in op-amps and much more.

A rich set of peripherals, flexibility and ease-of-use make the SAM L21 series ideal for IoT, wireless, and any system that needs large memories and ultra-low power consumption. The SAM L21 is designed for simple and intuitive migration between SAM L devices with identical peripheral modules, compatible code and a linear address map, and is compatible with the SAM D family of general-purpose MCUs.

For your chance to win a Microchip SAM L21 Xplained Pro evaluation kit, visit http://page.microchip.com/Dataweek-SAM-L21.html and enter your details in the online entry form.
The STMicroelectronics LIS2DTW12 combines a MEMS 3-axis accelerometer and a temperature sensor on a single die for use in space-constrained and battery-sensitive detectors such as shipping trackers, wearables and IoT endpoints. The sensing accuracy of 0.8°C offers precision comparable with standalone standard temperature sensors.

In addition to enhanced temperature compensation, the flexibility provided by 65 different user modes enables developers to optimise power consumption and noise to meet application-specific requirements. The chip has a user-selectable full-scale range up to ±16 G and measures acceleration with output data rates from 1.6 Hz to 1600 Hz.

With a package height of just 0.7 mm, the LIS2DTW12 allows extra battery capacity for longer runtimes. Power-saving features include a 50 nA power-down mode, multiple operating modes down to less than 1 µA, a dedicated internal engine for processing accelerometer signals, and a large 32-level FIFO to reduce intervention from the main controller.

The device provides 16-bit accelerometer data and 12-bit temperature data through a high-speed I²C/SPI port, and allows single data conversion on demand. The motion engine performs free-fall and wakeup detection, single/double-tap recognition, activity/inactivity, stationary/motion detection, portrait/landscape detection, and 6D/4D orientation. ST's advanced self-test capability is also built-in to verify the sensor is functioning correctly.

For more information contact Robin Scholes, Altron Arrow, +27 11 923 9600, rscholes@arrow.altech.co.za.

Power controller for smart home appliances

Qorvo has introduced a new intelligent power control solution for reducing energy consumption, bulk, weight and noise in smart home appliances, AC-powered fans and compressors. This mixed-signal system-in-package (SiP) product can reduce bill-of-materials as well as enhance performance, reliability and energy efficiency in brushless DC (BLDC) motor and permanent magnet synchronous motor (PMSM) control applications.

The Qorvo PAC5556 Power Application Controller (PAC) delivers high power density in a compact 52-pin 10x10 QFN package. It features a 150 MHz Arm Cortex-M4F digital high-performance processor with 128 KB Flash memory and integrates a 600 V N-channel DC-DC buck controller and signal conditioning components. This reduces the bill-of-materials in high-voltage systems that do not require isolation.

The integrated power management supplies all necessary voltage rails for the system, including the 12 V or 15 V gate driver supply for MOSFETs or IGBTs. An additional, high-efficiency 5 V DC-DC buck converter provides power for other system peripherals.

For more information contact Andrew Hutton, RF Design, +27 21 555 8400, andrew@rfdesign.co.za.
UPS battery configuration made easy

Determining the UPS (uninterruptible power supply) battery configuration using a formula can be quite complicated and, since many users are not very familiar with it, a more simplified method can be used to speed up the process and thereby save time.

This is typically done in the pre-planning phase before designing the practical application solution.

The battery configuration can be quickly and simply calculated based on the UPS output load and the required backup time. The formula is as follows:

\[
\text{Required battery capacity (Ah) = UPS capacity (kVA) x 109 (Ah/cell) + kVA + number of battery blocks per group}
\]

Example 1
As an example, consider a 130 V d.c. system of 120 kVA operating a UPS with 32 cells in series per bank, and requiring a backup time of 60 minutes. The required battery capacity is:

\[
\begin{align*}
120 \text{ kVA} & \times 109 \text{ Ah (cell/kVA) = 13 080 Ah (total requirement)} \\
13 080 \text{ Ah} / 32 & = 409 \text{ Ah}
\end{align*}
\]

Therefore, if using a 12 V, 100 Ah battery bank x 4, there is a choice between using 32 cells per group, in which case the actual backup time will be less than 60 minutes, or 33 cells per group, resulting in a backup time of slightly more than 60 minutes.

If the required backup time is 30 minutes, then:

\[
\begin{align*}
120 \times 109 & = 13 080 \text{ Ah} \\
13 080 / 32 & = 409 \text{ Ah (for 60 minutes)} \\
409 / 2 & = 205 \text{ Ah}
\end{align*}
\]

However, since the discharge power and discharge time of the battery are not linear, simply dividing by 2 is incorrect; rather, a modified coefficient must be used (see Table 1). Therefore, in this case, 205 x 1.23 = 252 Ah, so one option could be 4 banks (32 cell/bank) of 12 V, 65 Ah battery.

If the required backup time is 20 minutes, then:

\[
\begin{align*}
120 \times 109 & = 13 080 \text{ Ah} \\
13 080 / 32 & = 409 \text{ Ah (for 60 minutes)} \\
409 / 3 & = 136 \text{ Ah}
\end{align*}
\]

\[
136 \times 1.41 (\text{modified coefficient}) = 192 \text{ Ah}
\]

Therefore, one option could be 3 banks (32 cells/bank) of 12 V, 65 Ah batteries.

Example 2
Consider a 126 Ah/cell/kVA system, of 120 kVA UPS with 32 cells per bank. If the required backup time is more than one hour you also need to consider the modified coefficient in the calculation (see Table 2).

If the required backup time is 3 hours, then:

\[
\begin{align*}
126 \times 120 & = 15 120 \text{ Ah} \\
15 120 / 32 & = 472 \text{ Ah}
\end{align*}
\]

\[
472 \times 3 = 1416 \text{ Ah (for 3 hours)}
\]

Then divide it by a modified coefficient as 1416 / 1.25 = 1133 Ah

The option of 4 banks of 12 V, 300 Ah batteries can therefore be selected.

According to the principle of energy conservation, the above method is the same for three-phase/single-phase or single-phase/single-phase UPS. Generally, high-power UPS systems are equipped with 32 batteries per battery pack and the number of parallel batteries should not exceed 4 so as not to affect the current sharing and charging effect of the battery pack.

However, the above is a simplified method that is only a rough calculation where the result which is not completely accurate. To obtain a more accurate result, one will also need to consider the parameters of the equipment, the requirements of the application, the power grid condition and the power conversion efficiency.

For more information contact Forbatt SA, +27 11 469 3598, sales@forbatt.co.
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4-channel PC-based oscilloscope

The newly developed Model 1330 from Peaktech is a 4-channel PC oscilloscope with 100 MHz bandwidth and 1 GSps sample rate, which is suitable for mobile use on a laptop, and permanent installation in control cabinets, industrial equipment and many other applications where a small, lightweight and powerful oscilloscope is required. The user can acquire the measurement data over the several data interfaces directly on the PC with the included software.

The supporting software and the instrument’s features make it diversely suitable for service, scientific and industrial applications. The oscilloscope has 20 automatic measurement modes, mathematical functions (+, -, *, /) and FFT, and comes with accessories including four probes, (1:1, 10:1), USB cable, four BNC cables, AC-DC adaptor, instruction manual, and software CD for Windows operating systems.

The Model 1330 has a USB port for real-time data transmission, and an insulated LAN network interface through which the data can be transmitted remotely in local area networks. This allows it, for example, to be installed in electrical systems while the data acquisition can be done comfortably from the workplace. The interface’s isolation ensures maximum safety for the user and comfortably from the workplace. The interface’s isolation ensures maximum safety for the user and comfortably from the workplace.

For more information contact Vepac Electronics, +27 11 454 8053, sales@vepac.co.za.

Rugged USB Flash drives and SD cards

Datakey Electronics’ new RUGGEDrive line of portable memory solutions offers the data storage and transfer capabilities of consumer-grade USB Flash drives and SD cards in a more reliable and secure package.

The unique form factor and rugged design of the RUGGEDrive line provide embedded system designers with a base level of security and reliable harsh-environment operation that consumer memory products fail to deliver.

The memory tokens are constructed using a solid over-moulding process. A rugged, composite plastic protects internal components and allows use in harsh environments. Unlike consumer memory products, RUGGEDrive tokens can withstand conditions typical in demanding military, industrial, commercial and medical settings, such as extreme temperatures, rough use, sterilisation, chemical exposure, static electricity, dust, dirt, moisture, shock and vibration. The use of industry-standard protocols (USB 2.0, SDHC/SDI) allows the memory tokens to be easily integrated into embedded controllers, single-board computers and industrial PCs.

RUGGEDrive memory tokens only interface with Datakey Electronics’ mating receptacles, which provides a base level of security and helps overcome the drawbacks of USB Flash drive and SD card connectors. The unique, physical connection between the receptacle and token ensures that data on tokens cannot be readily transferred to unauthorised PCs that lack RUGGEDrive receptacles.

Likewise, RUGGEDrive receptacles help protect embedded devices from viruses and other malicious files, as consumer memory devices have nowhere to plug in. The receptacles are rated for 50 000 cycles and can withstand use in harsh environments, whereas most consumer-grade USB and SD connectors are only rated for 1500 and 10 000 cycles, respectively, and are not intended for harsh-environment operation.

The RUGGEDrive line features two families of memory devices. The UXF memory token provides USB Flash drive functionality, and the DFX memory token provides SD card functionality. Both tokens come standard with 4 GB of non-volatile memory, with larger capacities (up to 32 GB) available.

RUGGEDrive receptacles feature multiple mounting options, including through-hole, surface-mount and panel-mount versions. Panel-mount receptacles are available in IP65, IP67 and EMI reduction versions to meet the needs of harsh environment applications.

For more information contact IPD Electronics, +27 12 345 3619, info@ipdelectronics.com

Tiny MCUs for IoT edge devices

Renesas Electronics announced four new RX651 32-bit microcontrollers (MCUs) supplied in tiny 64-pin BGA (4.5 x 4.5 mm) and LQFP (10 x 10 mm) packages. The MCUs address advanced security needs for endpoint devices employing compact sensor and communication modules in industrial, network control, building automation, and smart metering systems operating at the IoT edge.

The increase in endpoint devices operating at the edge has increased the need for secure over-the-air (OTA) firmware updates. The RX651 MCUs integrate connectivity, Trusted Secure IP (TSIP), and trusted Flash area protection that enable Flash firmware updates in the field through secure network communications.

The MCUs are based on the high-performance RXv2 core and 40 nm process that provide high performance with a 520 CoreMark score at 120 MHz, and strong power efficiency with a 35 CoreMark/mA score as measured by EEMBC benchmarks.

For more information contact Jody Botha, Hi-Q Electronics, +27 11 894 8083, jody@hi-q.co.za.
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Accounting for PIM with distributed antenna installations

Passive intermodulation (PIM) distortion is the result of discontinuities, metal-to-metal contact, and material properties that lead to nonlinear characteristics of typically linear passive transmission lines and components.

PIM can be induced in a variety of RF components, such as connectors, adaptors, cable, combiners, splitters, couplers, tappers, attenuators, terminators, antennas and cable-to-board interconnects.

PIM is generated when two or more signal components at different frequencies interact at a non-linear junction and create a distortion product from frequency mixing. PIM becomes an issue when the distortion product of a transmission is either reflected back toward a sensitive receiver and is in the receive band, or a distortion product is transmitted and received by nearby communication systems susceptible to the particular distortion product. Due to the passive mixing of PIM generators, the power levels produced by PIM generators is generally weak, and only higher-power transmission signals tend to generate PIM power levels that are significant.

In years past, PIM issues were avoided by choosing frequency bands and filters that mitigated the amount of PIM that could impact receive bands. However, modern cellular, Wi-Fi, emergency/public service bands, new 5G cellular bands, ISM bands, TV white space bands, and other wireless services are often used in conjunction, especially with distributed antenna systems (DAS).

Many DAS are designed and installed to carry multi-band signals, either from a variety of cellular carriers, emergency/public safety, Wi-Fi, and other building automation services. Hence, the antennas, amplifiers, filters and transmission lines for DAS are all designed to operate over a wide range of sub-6 GHz frequencies, which is subsequently where the most spectrum congestion is and the greatest harm from PIM can occur. With multi-carrier systems PIM products can potentially be created by the mixing of any combination of signals and have a higher chance of landing in the bandwidth of sensitive wideband receivers.

Narrowband systems are less susceptible to PIM, as the passband of the receiver tends to be very narrow, so a precise combination of signals is necessary to create a PIM product that lands in that narrow bandwidth. However, with modern highly modulated wideband communication systems, such as 4G LTE, Wi-Fi, and new 5G NR sub-6 GHz frequency bands, receive bandwidth is much wider, and the heavily modulated wideband signals also generate much wider-band PIM products than narrowband signals.

For example, if the fundamentals from the two mixing signals is 10 MHz, then the third-order product will have three times the bandwidth (30 MHz) and the fifth-order product will have five times the bandwidth (50 MHz). With heavily modulated wideband signals, especially those that use spread spectrum techniques, the receive signals are often very weak, and PIM products that overlap with the receiver bandwidth could easily desensitize the receiver and dramatically disrupt communications.

PIM considerations specific to DAS

With DAS, another large PIM concern is the metallic structures within buildings, transportation stations, stadiums, etc. that are nearby the remote radio heads (RRH) or distributed antennas. If there are any metallic structures within a few wavelengths of the antenna, then reflections with distortion products could be received by the antennas, amplified, and carried to a receiver.

There are a variety of low-PIM antenna technologies, as well as quasi-omni antennas and the use of multiple directional antennas precisely positioned to have antenna patterns that avoid PIM generators in the environment. Also, many DAS installation mechanisms allow for changing the position of a RRH or antenna by tens of centimetres, which can significantly reduce the strength of environmental PIM generators.

Moreover, PIM transmitted and generated within the environment by other RRH, DAS antennas, and other wireless communication systems could also impact wideband DAS in hard-to-predict ways. The reason multi-carrier and multi-frequency systems are more challenging to predict is that with each additional signal, the mixing products become much more complex.

There are additional temporal considerations for PIM in DAS systems, as the environment and signals around the DAS are likely non-static. Hence, changing environmental components could lead to PIM generated at different times and in impossible-to-diagnose situations. Therefore, it is often beneficial for DAS installers to ensure that the entire system exhibits as low an internal PIM level as possible, which makes detecting, identifying and troubleshooting external PIM factors easier and more reliable.

Another area of concern for DAS systems and PIM are the large amount of connectors, adaptors, combiners, splitters, couplers, hybrids, attenuators, and other passive components that are often installed in-line to the transmission path. The cables, interconnect, connectors, and metallic features of any of these components could generate PIM, and unless they are tested once installed, their installed PIM performance may be very different than what is indicated on the datasheet.

This is especially a concern for components with ferromagnetic and ferrimagnetic elements. Though ferromagnetic metals and components can be avoided with PIM-susceptible systems, it is often difficult to avoid ferrimagnetic components, such as isolators, circulators, and phase shifters, which tend to produce higher levels of PIM than other components.

Also, the proximity of a component to a signal source impacts the strength of the distortion products generated. Therefore, placement and planning of connectors, passive, and even active components, can have a significant effect on the amount of PIM reflected back to the receiver.

Another important factor to consider is superposition, in that every distortion product that is generated will form a compound reflected signal. With complex DAS, this could lead to several distortion products within the receiver’s bandwidth combining power, which makes such complex multi-carrier DAS systems even more susceptible to PIM with increased opportunity for higher-power distortion products from combinations of even low-power transmissions.

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FiRa Consortium seeks to revive UWB

A new consortium has been launched in an effort to resurrect UWB (Ultra-Wideband) technology, which gradually faded into obscurity following its initial release due mainly to its inability to compete with Wi-Fi.

The FiRa Consortium highlights UWB technology’s unique fine-ranging (FiRa) ability to deliver unprecedented accuracy when measuring the distance or determining the relative position of a target. Especially in challenging environments, UWB technology outperforms other technologies in terms of accuracy, power consumption, robustness in RF connection, and security.

Seeking to build on a strong foundation that supports interoperability among all categories of devices, the consortium was founded by four sponsor members: the ASSA ABLOY Group (which includes HID Global), NXP Semiconductors, Samsung Electronics and Bosch. Sony Imaging Products & Solutions, LitePoint and the Telecommunications Technology Association (TTA) are the first companies to join the newly-formed organisation.

The starting point for UWB technology is the IEEE standard 802.15.4/4z, which defines the essential characteristics for low-data-rate wireless connectivity and enhanced ranging. It is the aim of the FiRa Consortium to build on what the IEEE has already established, by developing an interoperability standard based on the IEEE’s profiled features, defining mechanisms that are out of scope of the IEEE standard, and pursuing activities that support rapid development of specific use cases.

Typical application areas that can benefit from UWB’s capabilities include seamless access control, location-based services and device-to-device (peer-to-peer) services. Due to its low power spectral density, UWB offers little to no interference with other wireless standards, so it is well suited for use with other wireless technologies, including near field communication (NFC), Bluetooth and Wi-Fi. There are also adjacent markets that leverage UWB in other ways, especially automotive.

For more information visit www.firaconsortium.org

Project kickstarts SA’s use of TV white spaces

The US Trade and Development Agency (USTDA) has awarded a grant to support a project to help improve Internet access to rural areas of South Africa.

The grant, which focuses on facilitating export opportunities for US companies in support of sustainable development projects globally, will fund several TV White Space (TVWS) deployments with the goal of establishing business and deployment models that can be replicated across the country.

As the first country in Africa to publish a TVWS regulatory framework, South Africa has long seen the potential for the technology to bridge the nation’s digital divide. Encompassing an unreached population of more than 20 million people in rural areas and difficult-to-reach terrain, South Africa is an ideal location for TVWS, which uses unused broadcast spectrum to deliver long-range wireless connectivity. The project is intended to demonstrate that TVWS is a feasible business solution for economically and affordably connecting rural South Africa.

“Since deploying the first TVWS system in Africa, Adaptrum has sought ways to use TVWS to bring much needed connectivity across Africa,” said Haiyun Tang, CEO of Adaptrum, which is leading the project. “Now that TVWS is allowed in South Africa, we are extremely pleased to have the support of USTDA for this project to ensure our technology can be deployed affordably and sustainably by our local South African partners.”

The Adaptrum-led project team is a consortium of US and South African partners including Microsoft, International Data Corporation and Project Isizwe. The consortium will collaborate with the grant recipient, the Wireless Access Providers Association (WAPA), to deploy three TVWS network builds and develop a business plan to help ISPs and their investors understand and take advantage of commercial opportunities with TVWS.

“The support from USTDA validates what we’ve seen in South Africa and many other locations – TVWS is a valuable and important technology for enabling affordable and reliable connectivity,” said Kevin Connolly, director of Airband International at Microsoft. “Microsoft works with hardware partners like Adaptrum and investment partners like USTDA to accelerate bringing connectivity to millions of people around the globe who lack Internet access, and we’re excited to bring this work to fruition in South Africa today.”

Once a successful business model is established, additional TVWS projects across South Africa and in other areas of southern and eastern Africa can be developed – bringing much needed connectivity investment to the continent by tackling issues such as the cost of infrastructure needed to reach the rural poor.
iCorp Technologies launches its new IoT slogan

This comes as a very deliberate progression from the company’s previous slogan, ‘inspire | innovate | implement’, which played a paramount role in creating an introduction and brand awareness of our PLT (product line technology) offerings over the last 11 years of electronic component distribution in South Africa.

Kevin Ashton coined the phrase ‘Internet of Things’ in 1999. Twenty years later, IoT along with AI (artificial intelligence) and blockchain are no longer ‘pie in the sky’ concepts. “The IoT integrates the interconnectedness of human culture – our things – with the interconnectedness of our digital information systems – the Internet. That’s the IoT,” Ashton told ZDNet.

iCorp’s new slogan imbies and embodies the product technologies which I like to refer to as the IoT of things. Our products showcase our IoT, NB-IoT and IIoT footprint. From the design-in phase or a product concept, our offerings to our customers can assist them to create intelligent M2M and IoT devices that connect and communicate smarter, quicker, securely and more reliably.

This digital disruption is fast becoming the future of our industry if not a normative to our everyday lifestyle. From a yellow quacking toy duck to a self-driving Uber car or a driverless truck, the Global IoT market value could exceed $14.4 trillion in a projection that could see anywhere between 10 and 20 million (or more) products connected. With 400 million smart water meters to be installed worldwide by 2026, scalable meter data management will become crucial. iCorp aims to be smartly disruptive through its innovative products in this poignant timeframe.

In a Dataweek article celebrating iCorp’s tenth birthday earlier this year, I alluded to our company’s strategic global partnerships with key manufacturers who are leading the M2M technology space in both the IoT and AI sectors. I would like to extend my congratulations to Patrick Qian, the CEO of Quectel Wireless Solutions and his team on the company’s IPO (initial public offering) last month on the main board of the Shanghai Stock Exchange. With more than 100 million modules shipped across the globe to 5000+ customers, Quectel is clearly a market leader in the M2M space.

iCorp is proud to have been Quectel’s distribution partner since 2013, and in February this year, Quectel led the 5G space with its then newly-launched 5G commercial modules RG500Q/RG510Q and RM500Q/RM510Q for enterprise and mobile broadband applications such as fixed wireless access, mobile hotspot devices, and public safety and surveillance applications. The modules feature the Qualcomm Snapdragon X55 5G modem and antenna modules with integrated RF transceiver, RF front-end (RFFE) and antenna elements from Qualcomm Technologies.

In our IoT focus, we feature inter alia, Quectel’s new AI module, the SC66 which is now in the engineering sample stage. Also new is the family of LPWA modules – BG95 and BG77 – which are based on the Qualcomm 9205 LTE modem. One of iCorp’s hot sellers is the EC25, an LTE Cat 4 module optimised for M2M and IoT applications with worldwide LTE, UMTS/HSPA+ and GSM/GPRS/EDGE coverage. Its integrated GNSS greatly simplifies product design, and provides quicker, more accurate and more dependable positioning.

Quectel also features a variety of real-time, accurate, multi-GNSS positioning modules. The range of modules includes the extremely compact size L70, the multi-GNSS L76 and L26 with dead-reckoning function, and the L80, L86 and L96 with onboard GPS antennas.

Also included in this IoT feature, we have focused on Antenova, iCorp’s antenna manufacturer of choice. Founded in 2001, Antenova is a leading provider of high-performing standard antennas and RF antenna modules for wireless M2M, IoT and consumer electronic devices.

For more information contact iCorp Technologies, +27 11 781 2029, enquiries@icorptechologies.co.za.

• Extremely compact size: 25.0 mm × 16.0 mm × 6.8 mm
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• Support dual GNSS bands (L1, L5)
• Built-in LNA for better sensitivity
• Dual Antenna Integrated
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Managing the IoT on an energy budget

You might not think about it, but, on average, you utilise hundreds of microcontrollers (MCU) in a day. Everything from your toothbrush to your car has one or more MCUs inside them, and the number of MCUs you rely on is growing with the rapid adoption of the Internet of Things (IoT) movement.

Historically, users wanted MCUs because they could process data and solve problems faster than a human could. MCUs also help make products more convenient and consistent in behaviour. The microcontroller speed or frequency indicates how fast data is processed and problems are solved. Speed is generally not a big problem anymore. The challenge now is that the MCU needs to be able to solve more complex problems while it is being put on a power diet.

Let’s face it. We all get a little worried and start looking for power outlets when our computer or smartphone battery gets close to zero. Imagine if all your battery-powered products required daily charging. To prevent this, we need to put our devices on a budget. They need to become energy efficient.

What is inside embedded applications?

At a high level, all embedded applications are strikingly similar. Everything from industrial products, like water meters and security sensors, to personal items, including smart wearables, are built from a number of components. These components are connected to each other to solve specific tasks.

A typical application includes many building blocks. Here is a list of categories and some common components and functions:

- Power management: battery, regulators, energy harvesting, energy storage.
- MCU support: extra MCUs/co-processors, memories, external RTCs.
- Sensors/input: PIR, light, HRM, IMU, GPS, rotation count, capacitive touch.
- Actuators/output: display, LED, audio, motor control.
- Wired connectivity: USB, UART, I²C, Ethernet, CAN, PLC.
- Wireless connectivity: radio/RF, Bluetooth Smart, ZigBee, Thread, proprietary, NFC.

All of these components consume energy from your power source. So, when building an energy-efficient system, logic dictates that you should choose components within your budget that are inherently energy efficient. This is sometimes difficult because many of the items listed above are highly integrated and combine functionalities. For example, in Silicon Labs’ Bluetooth Smart MCU, the Blue Gecko, both the Bluetooth radio device and the MCU are combined, so the user only needs one device.

Energy sources

A single application might use multiple power sources, but common across these energy sources, beyond the wired option, is that minimising current consumption is key. For example, if you’re building a wired home automation system, you may include a backup battery in case there is a power outage. This helps ensure that not all functionality is lost in an emergency.

The following are topics to think about when choosing an energy source for your application:

- Mobility – Can the device move? Does it need to be near a socket?
- Lifetime – For how long can the device live before it needs maintenance?
- Cost – How expensive is this energy source?
- Form factor – What size restrictions does my product have?

Designing with batteries

Let’s say you’re a designer and the specification states that the product or application needs to last for at least three years. You’re decided to use batteries as the energy source. Now you need to make a trade-off between lifetime, form factor and cost.

Let’s consider these two coin cell options:

Option A: CR1616, which comes in a 16 mm (diameter) x 1.6 mm (height) package with 55 mAh capacity.

Option B: Common CR2032, which has 20 mm (diameter) x 3.2 mm (height) dimensions with 210 mAh capacity.

With the CR2032, the average current consumption of your application needs to stay below 8 µA in order to get the desired lifetime of three years, based on a very simple model of the battery. If you go with the CR1616, the application must consume less than 2 µA to achieve the same lifetime. By making your application consume less than 2 µA, you go for the smaller battery, and thus get a smaller form factor for the product.

Surprisingly, the smaller battery in this case actually has a higher cost than the larger one, so the current consumption reduction does not give a cost improvement when switching from the larger battery to the smaller. However, imagine switching from two of the CR2032 batteries to a single CR2032. That gives both a form factor and a cost improvement. Whether a single smaller battery has lower cost than a bigger one can depend on multiple factors, including product demand and availability.

If your application is a wearable or other rechargeable accessory, you may want to bypass coin cells altogether and explore the lithium polymer batteries.

Designing with energy harvesting

In general, energy harvesting looks like a very attractive solution. You just use the surroundings to generate the energy you need. But, as with batteries, energy harvesting has trade-offs to consider. Is the power source reliable? Is your power converter efficient enough?

Let’s consider the sun, which is a pretty reliable and sustainable power source. Solar harvesting panels must be in a bright location, and they need to have a given surface area. They might be able to generate 10 mW/cm² under direct sunlight, but can drop to 10 µW/cm² when indoors. That is 1000 times less energy to play with. To support night-time operation, a rechargeable battery is needed as well, which increases cost and penalises form factor.
Designing with wireless power

Wireless power delivery, also known as remote power delivery, is similar to energy harvesting in that your application picks up energy from its surroundings. The difference is that in this case, energy is not assumed to be present, in the form of light, vibration, or other natural energy source. A power transmitter generates the energy the application is supposed to pick up.

The challenges with remote power delivery are somewhat similar to those of energy harvesting. For inductive power delivery, the transmitter is generating an alternating magnetic field, and the receiver uses a coil to capture the energy. In this scenario, the maximum distance between the transmitter and receiver, and also the amount of power that can be delivered, is based on the size of the coil. This puts constraints on form factor and flexibility.

Qi and A4WP are two emerging standards for inductive wireless charging, which is currently being used in a number of smartphones and wearables. These require the receiver and transmitter to be in very close proximity, and allow very little mobility. They are thus really only suitable for applications such as wireless charging.

Another method of remote power delivery is based on radio frequencies. By outputting a strong radio signal and using beamforming techniques, a transmitter can send a signal carrying sufficient energy to a receiving antenna. Challenges with this technology currently include transmission efficiency.

Deciding which energy source to choose for an application depends on the properties of the application itself. The rest of this article will dig into applications that operate from constrained energy sources.

Energy efficiency – the big picture

Sensors are the eyes and ears of an application. When working with a sensor in an application, the straightforward approach is to leave the sensor on all the time, as shown in case A of Figure 1. With this approach, the MCU can read the voltage across the variable resistor at any time, and calculate the current temperature based on the voltage.

This option is the easiest way to control the sensor, but it’s also the method that consumes the most energy. Now, 33 µA might not seem like much, but when a solar cell that small only produces 10 µW of current, we quickly see the problem. A better setup is shown in case B of Figure 1, where the MCU is able to control the power of the sensor directly, turning it on only when needed.

For an application that only needs to measure temperature once per second, the current consumption of the thermistor is now reduced to 0.165 nA. Assuming that you keep it on for 5 µs in order to sample it once every second, this approach gives you a 200 000x improvement in current consumption.

When controlling the supply of external components through a pin on the MCU, you have to clearly define the default state of these circuits. On Silicon Labs’ EFM32 products, all pins are floating when the device comes out of reset, which, in this scenario, is not an issue.

For a device with default-low I/O, you want to connect the sensor as shown in case B of Figure 1. But if the I/O comes out as default-high, you should connect the other end of the resistor divider to VDD (supply) instead of ground. This will prevent current consumption through the sensor during MCU reset.

An application can consist of a number of components and you have to make a decision on how to control each component in the most efficient way. Note that designing for energy efficiency actually has a cost. In the

thermistor example above, an extra MCU pin is required to control the power to the thermistor.

Additional attention to efficiency also has to be given during software development.

Designing for energy efficiency can in some ways be harder than designing a system that does not care about efficiency. But in energy-constrained systems, it is well worth the investment.

What about the MCU?

We discussed that the application components must be duty-cycled in order to maximise efficiency. The same is true for the MCU itself. Because they are more sophisticated components, MCUs almost always have more than just an on/off button. MCUs have multiple energy modes, where each mode allows a set of capabilities with an associated current consumption overhead.

Table 1 shows an overview of the energy modes of the EFM32 MCUs. The Run mode (EM0) has all functionality available. As the MCU goes to deeper energy modes, less functionality is available, but drastically lower current consumption can result. There are two key takeaways from this table:

1. The CPU is only available in the highest energy mode. In order to reap maximum benefits, the CPU must be turned off whenever it is not needed. The system must aim to sleep as much as possible.
2. The system should sleep as deeply as possible whenever it’s sleeping. With deeper sleep, less functionality is available. Thus, the right modes have to be chosen to allow the system to sleep as much and as deeply as possible.

By requiring the CPU to be off as much as possible in order to save energy, the CPU tasks must be offloaded to the hardware in the MCU. Instead of being in a paradigm where software running on the CPU does everything, software development should focus on setting up hardware to do the heavy lifting and only intervene when hardware needs assistance.

In other words, hardware should be the main driver of the application.

This takes the system to an event-driven architecture, allowing massive energy savings. A system using the traditional approach running at 10 MHz would consume more than 1.1 mA, while a system using the event-driven approach would consume as little as ~0.9 – 1.3 µA, depending on the sensor and sample rate. This is almost a three-orders-of-magnitude difference. More importantly, it’s the difference between a day and multiple years of battery life.

Multi-tasking

With the traditional approach, the CPU does everything, and can only manage a limited number of functions. With the event-driven approach, the CPU is freed up because hardware does the bulk of the work. With this method, an MCU can drive sophisticated applications.

On an MCU with minimal Flash and RAM resources, this is how you should write code. With this kind of multi-tasking you can get the absolute most out of the hardware in the MCU, both in terms of performance and energy savings. We call this ‘coding down to the metal.’

Spending some of the MCU resources on an embedded operating system provides a level of abstraction that makes building sophisticated, event-driven applications easier, but potentially less efficient. For applications running on MCUs with 512 KB Flash or more, the memory overhead can be negligible, making this an easy choice.

On MCUs with 32 KB Flash or less, there are still operating systems that can do the job, but the percentage of the MCU resources used by the OS

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increases drastically. A minimal configuration of FreeRTOS requires between 5 KB and 10 KB Flash and a minimal amount of RAM.

For complex applications, an operating system might actually make the system more efficient than coding to the metal. This approach gives software developers a framework for how to write code to use energy modes in the most efficient way.

Some operating systems or ecosystems to check out include ARM mbed OS, FreeRTOS and RTX. They all provide tick-less sleep modes, meaning that unlike normal PC operating systems that always waste energy by waking up every 1 ms or 10 ms, these operating systems only wake up when they are needed.

Optimising the system

It is relatively simple to cater for a system dealing with a single function and a single source of wakeups, but imagine a system with 10 different components that need to be managed. Some can be controlled fully autonomously, while for others the CPU might have to wake up periodically in order to take control.

If care is not taken with such a system, it can end up in a situation like the one shown in case A of Figure 2, with many more wakeups than necessary, resulting in a less efficient system.

The figure shows two deterministic processes, which execute periodically, and one sensor event, firing non-deterministically. In case A, the processes arbitrarily wake up to perform their tasks, which results in a total of 11 wakeups, wasting a significant amount of energy due to the time it takes to transition between sleep modes.

To improve on case A, you can do sleep planning. For all deterministic processes, i.e., processes we know of beforehand that are going to require a wakeup, care should be taken to align the wakeups as much as the system allows, minimising the number of wakeups.

In case B, the wakeups by Process 2 have been aligned with the wakeups from Process 1, resulting in a total of six wakeups during the same period, a significant reduction from case A.

Sleep planning

As we have discussed, minimising awake time is important. In many cases, software running on the CPU is waiting for something to happen. If the CPU is set to wait for a fixed time, the best approach is to use a hardware timer. Hardware timers come in a range of types with varying functionality, current consumption and accuracy.

On an EFM32 system, if the CPU needs to sleep for a short number of clock cycles while maintaining full MCU operation, the software should use the TIMER peripheral and place the system in EM1 while waiting. This method will significantly reduce current consumption, and wakeup is instantaneous.

If only EM2-EM4 level functionality is necessary while waiting and the wait-time is more than 31 µs, the period of a 32 768 Hz oscillator, the low-frequency timers LETIMER, RTC or RTCC can be used and the system can go to EM2 for maximum efficiency. If high accuracy is required, a TIMER can be synchronised to the low-frequency timer upon wakeup through PRS to time out the last clock cycles with the accurate high-frequency TIMER.

If wait time is relatively long, i.e., multiple milliseconds, and does not have to be accurate, and the system only needs EM4 functionality while sleeping, sleep can be done using the CRYOTIMER, running on the 1 kHz ULFRCO oscillator for extremely low sleep current in the 100 nA range.

Note that wakeup from EM4 costs more energy than wakeup from EM2, because the wakeup is through a reset, so even though EM4 could be used for sleeping for 5 ms, it might not be the most energy efficient. With sleep times of minutes or more, EM4 starts becoming extremely efficient.

CPU efficiency

No matter how much you try to optimise for sleep, the CPU needs to execute code now and then. This can include everything from regular application logic to network stacks and signal processing algorithms. The CPU is an important part of the MCU. Here are the top five items to ensure the CPU runs code efficiently:

1. Let the compiler optimise your code. This tip might seem obvious, but make sure the code is compiled with full optimisations enabled. If the compiler is able to do link-time optimisation, use this as well. Code compiled for debugging is inefficient on many compilers, one reason being that values are fetched from memory, calculated and then written back on every operation. Without optimisation, it is also not fully utilising the capabilities of the CPU, which also slows down execution.

2. Target the right architecture. Choose the right CPU for your application and ensure that the compiler creates code optimised for that correct device. For example, Cortex M4 is excellent for bigger applications that contain number crunching. Cortex M3 does not have all the DSP capabilities and no floating point, compared to the Cortex M4, but is still relatively high-performance. Cortex M0+ is the most efficient of the bunch as long as the amount of signal processing is at a minimum. It is excellent for stacks and control logic.

3. Operate at the right frequency. Even though lower frequencies give lower current consumption, it is generally better to finish the job quickly to be able to go to sleep; in other words, a higher frequency might give better energy efficiency. If the different parts of the system have different needs (i.e., USART needs 4 MHz, but the CPU needs 8 MHz), use pre-scalers for clock domains to make the frequency selection optimal.

4. Use available hardware accelerators. Some operations perform more efficiently in hardware than on a CPU. One example is cryptography. The CRYPTO peripheral available on the EFM32 Gemstone devices can complete operations more than 10 times faster and much more efficiently than running them on the CPU. Another example is the alpha blending hardware on some of the EFM32 products. This hardware makes graphics compositing for external displays more efficient.

5. And, of course, sleep whenever possible.

For more information contact Sailen Nair, Altron Arrow, +27 11 923 9600, snair@arrow.altech.co.za.
Radio spectrum is a precious resource and it quickly gets filled up. It did not take long for users of Wi-Fi in urban areas to understand how interference from nearby routers would affect the communications performance they could achieve from their own network equipment.

One of the first responses to this problem was to simply add more frequency bands. In addition to the original 2.4 GHz band, which still needs to be shared with many other protocols (including Bluetooth), Wi-Fi added support for additional channels around 5 GHz. However, the number of frequency bands into which Wi-Fi can expand is severely limited – because there are too many other applications that need access to their own portions of the RF spectrum.

Over time, developers of more advanced Wi-Fi equipment have countered the frequency restriction issue by employing a variety of techniques to push more data into the core spectrum. These range from advanced modulation schemes that transmit multiple data bits in each radio symbol to antenna-diversity enhancements that make it possible to steer transmissions towards individual receivers.

Other proposals have moved Wi-Fi into the 10 GHz-plus range. This can provide wider-bandwidth channels and commensurately high data rates. But, why not go further up the electromagnetic spectrum and make use of infrared or visible light instead?

Visible light communication has already been deployed for point-to-point backhaul applications in order to achieve data rates in excess of 100 Mbps where it is impractical to deploy cables, such as across deep canyons. Light-based transmissions are also being investigated for their ability to improve the connectivity of systems both above the atmosphere and below the waves.

RF scatters quickly in water, making it hard to establish reliable communications above signals that employ extremely low-frequency carriers and which have commensurately low data rates. Although water also strongly absorbs the red end of the visible light frequencies, blue-green lasers can carry transmissions at data rates of up to a hundred Mbps over several tens of metres, according to recent research studies.

Aiming at much longer distance applications, NASA has begun trials of ground-to-space communications using a modulated infrared laser. The 622 Mbps channel avoids the attenuation caused by clouds by switching between different ground stations that cooperate to communicate with an orbiting satellite.

The Li-Fi version of visible light communications is targeted at more down-to-earth applications. It was developed to take advantage of the LEDs that go into standard light fittings, albeit with some adjustments. Many commercial LED light fittings use a high-brightness element that produces light at the blue end of the spectrum. A coating of yellow phosphor shifts the overall colour of the light to white. The phosphor’s action slows down the effect of any amplitude modulation imposed on the source light, limiting its bandwidth to around 2 MHz. However, if a receiver filters out the yellow component, it is possible to achieve data rates as high as 1 Gbps, in principle.

Having receivers that respond to the different components of a light fitting with tuneable colour, which normally use a mixture of red, green and blue LEDs, it is possible to push the data rate to 5 Gbps or more. Experiments by a University of Edinburgh team led by Professor Harald Haas (who coined the term Li-Fi), have shown that adding laser diodes to the luminaries and having them transmit in parallel could achieve a transmission rate of more than 100 Gbps.

Li-Fi shares some usage attributes with versions of Wi-Fi that operate in the 10 GHz-plus part of the radio spectrum. As the frequency of the carrier signal increases, RF communications become more directional. Although protocols that make use of 10 GHz-plus channels, such as 5G cellular, will take advantage of reflections to improve reception performance,

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Communications channels will predominantly be based on line-of-sight transmission. As Li-Fi has even greater directivity, it allows the construction of 'attocells' where a single user operating under a downlight, for example, has the bandwidth to themselves. However, Li-Fi is not purely a line-of-sight technology. It has some ability to employ reflections, which thereby avoids the need to maintain strictly line-of-sight transmission paths. This is enabled by the use of coding systems, such as orthogonal frequency-division multiplexing (OFDM), that are more complex than the simple binary codes employed in early Li-Fi experiments.

The directivity of Li-Fi is provides a potential advantage in terms of security. As well as being largely restricted to a cone of light underneath the transmitter, signals do not penetrate solid walls at all. Some proposed 60 GHz Wi-Fi transmission schemes, such as IEEE 802.11ax, utilise techniques that make it possible to send signals through walls as this is seen by the standard's working group as important for overall usability in homes.

With Li-Fi, any hacker who wants to intercept the signal needs to be close to both the transmitter and the legitimate receiver. That factor alone clearly increases the chance of detection.

A use case proposed by the IEEE 802.11bb working group is that of a Li-Fi-enabled desk lamp which provides a secure wireless connection between the user's computer and the core network. The uplink channel from device to light fitting makes use of a smaller emitter operating in the infrared region. This avoids interference with the downstream signal and also has the benefit of not distracting the device's user.

In the early stages of the technology's evolution, there was some concern over whether users would notice flicker from Li-Fi-enabled transmitters. The modulation speed is so high though that the effect is unnoticeable other than a possible shift in the colour balance of the overall light output. However, this is a factor for which luminaire designers can compensate.

One potential drawback with Li-Fi when fitted to ceiling lights is that of co-channel interference. Here the light cones intersect, so a receiver will not get a clear signal from either transmitter. OFDM-based coding schemes help overcome this issue in addition to making light reflected off walls and other objects usable for communication.

The IEEE 802.11bb working group has proposed a protocol that at minimum provides a data rate of 10 Mbps rising to a peak of 5 Gbps, which is 10 times faster than the widely implemented IEEE 802.11n form of Wi-Fi, based on a 5 GHz carrier. The more recent and currently much more expensive IEEE 802.11ac version of Wi-Fi narrows this gap. It can deliver 1.73 Gbps.

Wi-Fi promises to match Li-Fi's peak data rates. This competition will come from the IEEE 802.11ax and 802.11ay versions of Wi-Fi that employ carrier frequencies around 60 GHz. These standards improve on the short range suffered by the first attempt to build a 60 GHz Wi-Fi - IEEE 802.11ad.

Some tests have pushed the maximum range of IEEE 802.11ay to 300 m, making it suitable for office networks. However, its usage model is different to Li-Fi. One key difference is that a single router is expected to serve multiple users whereas Li-Fi proponents expect to make the most of the attocell concept, with backhaul networks providing the ability to serve Gbps sessions to multiple users within the same room. Another difference between IEEE 802.11ay and most other protocols is that it can also offer power/control over USB.

Atlanta Micro has launched a new line of connectorised modules for some of its most popular parts. These modules are made of aluminium and offer RF shielding along with field-replaceable SMA connectors and mounting holes.

The first available modules include any of the company's 3 mm amplifiers such as the AM1016, AM1018, AM1025B, AM1063-1 and AM1064-1. The module version of these parts are designated with a ‘-M’ at the end (for example AM1064-M). The amplifier module is 3.05 x 2.54 x 1.524 cm with SMA input and output and a feedthrough capacitor to bias tee that powers the device. These modules are ideal for lab use and/or prototype systems.

The first available filter module is the AM3025A which is designated as the AM3025A-M. This filter module provides a sub-octave pre-selector filter bank from 400 MHz to 6 GHz with a filter bypass path. With dimensions of 4.7 x 4.7 x 1.65 cm, field-replaceable SMA connectors and power/control over USB, this module is ideally suited for in-lab use, receiver protection, and a variety of EMI reduction applications.

Atlanta Micro also announced that a future line of modules will be available by the end of September 2019. In addition to the above, it will offer its popular bypassable amplifiers such as the AM1065, AM1067 and AM1081 in the same form factor of 3.05 x 2.54 x 1.524 cm.

The company will also be offering a 'choose your own' bandpass filter solution in which customers may choose any digitally tuneable low-pass filter and any digitally tuneable high-pass filter from its digitally tuneable filter catalogue. This module will be available in the same form factor of 4.7 x 4.7 x 1.524 cm and will also offer power/control over USB.

Perform additional services that arise from the algorithms used to compensate for obstructions. Potentially, routers can map rooms, detect the presence of people and can even determine gestures. In a Li-Fi environment, these functions would more likely be implemented with the help of separate cameras.

Although Li-Fi will need to slug it out with the newer forms of Wi-Fi in conventional home and office deployments, light-based communication has some clear-cut advantages in certain environments. In aircraft, for example, the weight of cables used to deliver multimedia services to passengers is a major obstacle to building more fuel-efficient vehicles. Li-Fi makes it possible to deliver high data rates to individuals simply by replacing the conventional lights on each seat with suitable Li-Fi-enabled LED.

Li-Fi provides a solution for high-bandwidth communications where interference from RF is problematic, such as in the operating theatres of hospitals. It is potentially a much safer technology for industrial systems, particularly those where there is a high risk of explosion. For example, plants that handle fine powders and volatile chemicals cannot easily employ high-frequency RF communications and stringent safeguards are needed for electrical data cables.

Thanks to its novel approach, Li-Fi will probably find use cases in environments where it has previously been difficult to implement high-speed communication. For most situations though, where considerations of data capacity and convenience are uppermost, the choice between either Li-Fi or Wi-Fi is likely to come down to the specific requirements of the application.

For more information contact TRX Electronics, authorised Mouser Independent Representative in South Africa, +27 12 997 0509, info@trxe.com.
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The NINA-W10 series from u-blox comprises standalone multi-radio 2,4 GHz MCU (microcontroller) modules that support Wi-Fi 802.11b/g/n and Bluetooth v4.2 (Bluetooth BR/EDR and Bluetooth low energy) communications. They integrate a wireless MCU, Flash memory, crystal oscillators, and components for matching, filtering and decoupling.

Two variants are available: NINA-W101 (with an antenna pin) and NINA-W102 (with an integrated antenna). These modules are ideal for telematics, low-power sensors, connected factories, connected buildings (appliances and surveillance), point-of-sales, and health devices applications.

The NINA-W10 series is certified as a modular transmitter in the following countries: US (FCC), Canada (IC/ISED RSS), Japan (MIC), Taiwan (NCC), South Korea (KCC), Australia/ New Zealand (ACMA), Brazil (Anatel) and South Africa (ICASA). They have also been assessed to comply with RED (Radio Equipment Directive) in the EU.

The modules can be qualified according to ISO 16750 for professional-grade operation, supporting an extended temperature range of -40°C to +85°C.

For more information contact Andrew Hutton, RF Design, +27 21 555 8400, andrew@rfdesign.co.za.

The Locosys RTK-4671-SHDR/MHDR is a high-precision GNSS RTK (global navigation satellite system real-time kinematics) solution targeting the smart driving and lane-level navigation markets.

The newly designed Loco II engine architecture is optimised to offer a seamless experience in dense urban canyons and minimise the time required to fix the position.

The solution comprises a cost-effective GNSS RTK board for centimetre-level positioning and accurate raw measurements output, which can be integrated with autopilots and inertial navigation units. It supports GPS, GLONASS, Beidou, Galileo, QZSS and SBAS constellations to improve the continuity and reliability of the RTK solution even in harsh environments.

Compatibility with other GNSS boards on the market is provided by flexible interfaces, complemented by popular log/command formats with correction data from the CORS network. It also supports both rover and base solutions for those which do not have a public CORS network.

The single-band RTK-4671-SHDR and dual-band RTK-4671-MHDR are powered by an Arm processor, and integrate Flash memory, TCXO, RTC crystal, LNA and SAW filter, and embedded MEMS sensors (6-axis accelerometers plus gyros). The high-precision positioning/dead reckoning receiver offers centimetre-accurate positioning and heading with low power consumption.

Pasternack has launched a new series of high-frequency couplers that are ideal for 5G telecommunication, automotive radars, satellite communication, point-to-point radios and aerospace applications.

The range of RF directional couplers consists of 24 models that have a high maximum operating frequency range from 26.5 GHz to 67 GHz. In addition to high isolation, low insertion loss and very good return loss, they have power handling capabilities up to 30 W (CW) and feature a coaxial design available with SMA, 2.92 mm, 2.4 mm and 1.85 mm connectors.

These couplers are offered with 6 dB, 10 dB, 15 dB, 20 dB and 30 dB coupling levels. Plus, they are available for the engineer’s immediate need for a small quantity of components while fulfilling the demand for high-quality, high-frequency products.

For more information contact Andrew Hutton, RF Design, +27 21 555 8400, andrew@rfdesign.co.za.
The **WE-LAN AQ** is a LAN transformer manufactured by a fully automated production process. Its innovative coil winding technique reduces the electrical variation and increases their reliability, while improving performance over a wide frequency range. LAN transformers and RJ45 connectors suitable for different speeds and PoE current ratings can also be found in the further LAN product families.

For further information, please visit:  
[www.we-online.com/lantastic](http://www.we-online.com/lantastic)
Big is beautiful: The benefits of large capacitors

By David Jones, senior product manager for passive components, Farnell.

Although miniaturisation has been a theme in electronics for more than 50 years, reflecting advances in semiconductor and passive-component manufacturing technologies, there are limits on how small some components can get.

The capacitor is a prime example of a component where small is not always beautiful, as meeting electrical characteristics and safety demands means that a component small enough to solder directly onto a PCB may just not be up to the job.

Filtering

Capacitors are widely used in filtering and decoupling. For small-signal applications the capacity of the device is determined by the filter topology used and the frequency range over which the filter operates. When dealing with power-rail circuitry, the capacitors need to be able to store very high levels of electrical energy, whilst satisfying safety requirements. This is a prime example of where big is beautiful as the power handling capability of the capacitor and isolation built-in are more important than the size of the component.

Size, especially the minimum distance between power-handling traces on the circuit board or between cables, is a critical parameter in many safety standards, leading to many manufacturers directing improvements in materials and component design to deliver higher levels of capability rather than reducing size. Many of the big and beautiful capacitors are designed for filtering in power systems.

Class-X and Class-Y capacitors

Class-X and Class-Y capacitors are some of the most commonly used large filter capacitors in AC applications and are often known as EMI/RFI suppression capacitors, or AC line filter safety capacitors. Due to safety risks, caused by connection directly to the AC power input across the live and neutral lines (Class-X) or neutral and ground (Class-Y), these connectors are all safety certified and if they fail, it must be in a manner that ensures safety.

Class-Y capacitors are particularly subject to the over-voltages and voltage transients often seen on domestic and industrial AC supplies. Lightning strikes nearby, for instance, can lead to extremely high-voltage transients and there is a high probability of damage to the device. A failure in a Class-Y device, however, could lead to a potentially fatal shock because of the loss of the ground connection and to avoid this, Class-Y capacitors are therefore designed to fail open, which causes a loss of filtering capability but avoids a safety hazard.

When a Class-X capacitor fails it is most likely to cause a short circuit, which in turn will normally engage an over-current protection device such as a fuse or circuit breaker. The capacitor’s failure is therefore unlikely to cause an electric shock to the user.

The degree to which a capacitor is prone to failure depends on its internal construction. In ceramic X and Y capacitors, damage can occur over time that weakens the device until it fails. Metallised-film capacitors, however, such as Vishay’s MKP3381 family or the B32916 series from TDK-Epcos, have self-healing capabilities that avoid short-circuit and related damage. At the point of failure, an insulating region forms so that the capacitor can regain almost complete operational capability, avoiding a short circuit. Metallised film in Y-type devices is also more likely to fail open than ceramic-based devices, improving safety.

There are a number of X and Y capacitor subtypes defined in the international standard EN 60384-14. X-type capacitors are divided into X1, X2 and X3 categories: X1 capacitors are used for applications that need high pulse resilience and X2 and X3 types are used for general-purpose applications.

Y-type capacitors are similarly divided but differ according to the level of insulation: Y1 class capacitors are rated up to 500 V a.c. and a peak test voltage of 8 kV, scaling down to Y4, which are rated to 150 V a.c. with a peak test voltage of 2.5 kV. To improve density, manufacturers such as Kemet build more than one capacitor into the same package, for instance the PHE840M which has a maximum capacitance of 10 µF.

Power factor correction

Larger capacitors are also frequently used to perform power factor correction, which is enforced by law in many territories and can reduce the cost of electricity delivery.

The power factor of a system is the ratio between the true power used by the system (averaged over an AC cycle) and its peak consumption. If linear power converters are used on the front end of a system, they normally exhibit a power factor close to one, creating some issues. These converters are inefficient when compared with more advanced switched-mode front-end power supplies used in many systems; they take power in brief bursts, rather than over the full cycle of an AC wave, resulting in high peaks relative to the true power and a low power factor.

High-voltage capacitors in sizes of 50 µF or more per AC phase can be employed in power factor correction modules, usually installed in parallel to the user equipment, to improve the capacitance density and ease design-in. Suppliers such as TDK-Epcos and Kemet provide capacitors that have terminals for all three phases, each connected to a separate internal capacitance module.

Suppression

Large capacitors are invaluable for filtering and spike suppression purposes within the system, particularly when dealing with highly inductive loads such as in motor control. Polypropylene film capacitors, similar to those often employed for power factor correction, are effective choices for spike-suppression applications due to their self-healing properties, low losses and high isolation capability. Sizes for these devices can range from several hundred nanofarads to hundreds of microfarads, with products supplied by a wide range of manufacturers, including Kemet, TDK-Epcos, Vishay and Wima.

Motors can draw high currents both when starting up and when brought to a sudden stop. This is a particular problem in battery-powered systems that may struggle to supply the instantaneous current required. The inclusion of large capacitors to supply large current pulses gives the system the ability to ride through such events and avoid brownouts in other parts of the system. Typically, electrolytic capacitors such as Kemet’s MIS/MD family of aluminium electrolytic capacitors, provide the low series resistance and capacity needed to support the system for the milliseconds during the peak current demand.

High-current relays within a system present another source of energy spikes that need to be suppressed: arcing across contacts when the relay is opening or closing. If not controlled, repeated arcs erode the relay contacts until it fails. A capacitor wired in parallel with the relay’s load will suppress the arcs because it can charge and discharge more quickly than the time taken for the relay to complete a switching operation.

As with other high-power filtering and suppression applications, effective capacitors use a metallised film or foil construction. As charging time is a vital consideration, component selection needs to take into account the relationship between capacitance required and the effective series resistance. Furthermore, as many film capacitors provide an ESR (effective series resistance) that is lower than that required for a typical suppression circuit, a low-value resistor is often wired in series.

Conclusion

As the ability to survive large voltage and current spikes – as well as handle high power levels on a long-term basis – is key to many applications, capacitors that are both large in capacitance and in size are essential.

Manufacturers continue to work on improving in-system density through co-packaging as well as on performance, but in these applications small is not beautiful: the design-in decision comes down to capability.

For more information contact Farnell element14, 0800 111 057, info-za@farnell.com, http://export.farnell.com/welcome-south-africa
Qi-compliant wireless charging coils

Vishay has expanded its offering of Qi-compliant wireless charging transmitter and receiver coils with the introduction of 14 new products in industry-standard shield sizes.

Consisting of eight single-coil transmitters, three three-coil transmitters and three single-coil receivers, the products offer designers a source for the most popular sizes used in Qi wireless charging pads for handheld battery-powered devices. Available transmitter coil types include A11, A6, MP-A9, MP-A6, MP-A4 and MP-A2.

The transmitters offer power ratings from 5 W to 15 W, while receivers feature power ratings of 3.5 W and 5 W. The RoHS-compliant coils operate over temperatures from -40°C to +125°C and offer inductance tolerance of +10%. All configurations are customisable to customer specifications upon request.

For more information contact Quatraine Domoney, Avnet South Africa, +27 11 319 8600, quatraine.domoney@avnet.eu.

Rugged PFC capacitors

TDK’s DeltaCap X Black Premium is a new series of Epcos MKD capacitors for power factor correction (PFC). With rated voltages of between 440 V a.c. and 850 V a.c., the capacitors with an internal delta connection are designed for power factor correction and filtering of harmonics at the low-voltage level.

With capacitance values of 3 x 51 µF to 3 x 165 µF, power correction performances ranging from 20 kVAR to 44 kVAR (50/60 Hz) per capacitor are achieved. The special black coating improves the dissipation of heat, thereby achieving a very long service life of up to 300 000 hours in accordance with temperature class -40/D.

The DeltaCap X Black Premium types are – like all Epcos capacitors for power factor correction – self-healing and are equipped with an overpressure disconnector which isolates all three phases from the grid in the event of damage. The impregnation, based on biodegradable soft resin, has an additional positive effect on the heat dissipation.

Thanks to the extremely rugged construction, the capacitors of the B32305A* series can withstand a maximum inrush current of 500 x IR, temperatures of up to +65°C and perform up to 62 000 operating cycles per year. The capacitors are suitable for use with or without reactors in both conventional and dynamic PFC systems, and also for use in tuned resonant circuits in industrial power grids and harmonic filters.

For more information contact Electrocomp, +27 11 458 9000, andrew@electrocomp.co.za.

LAN transformers for industrial Ethernet interfaces

Würth Elektronik eiSos is expanding its LAN transformer range with the WE-LAN AQ, designed for the elevated requirements in the industrial sector. It can be used in applications requiring up to 1000Base-T performance.

The transformer features optimised crosstalk, insertion loss, return loss, differential and common-mode rejection. Its innovative coil winding technology reduces electrical fluctuations and raises reliability while boosting performance over a wide frequency range. Production in a fully automated process guarantees consistently high quality.

The WE-LAN AQ series are cost-effective, robust and reliable components. With a maximum height of just 4.5 mm, they are also very compact and are ideal for SMT assembly.

For more information contact Jason Page, Würth Elektronik eiSos, +27 71 259 9381, jason.page@we-online.com.
LED flicker, and how to prevent it

By Andrew Hutton, product manager: Power, Avnet Abacus.

With the growing popularity of LED lighting, especially now that very cheap LED luminaires are coming to the market, flicker is becoming more of a problem.

Flicker, a repetitive switching on and off of the light source, isn’t a problem for incandescent bulbs because if the power supply to the bulb drops momentarily, the element doesn’t lose sufficient heat for the light output to diminish. With LEDs, however, once the supply current drops below a certain level, no matter how briefly, the light will turn off (an LED takes around 300 µs to turn off). In fact, pulse width modulation (PWM) control schemes used in dimming use this effect at high frequency to dim the light output. It is lower frequencies, even those above 80 Hz that aren’t visible to the naked eye, that cause problems.

Flicker present in LED lighting, even if not visibly perceptible, can have serious consequences for people’s health, especially if they are exposed for long periods of time. At one end of the scale, it can be annoying and distracting, and even slow text reading speed by 30%. It can also cause eyestrain, blurred vision and dizziness. The most serious problems flicker can cause include migraines and even triggering epileptic seizures (if in the range of 3 to 70 Hz).

LED lighting flicker can also cause technical problems, for example, if used in sports stadium lighting, invisible flicker can be very visible when camera footage is slowed down for replays. More significant levels of flicker can also cause havoc with video footage played back at normal speed, appearing as dark lines across the picture.

The causes of flicker include cheap and simple LED drivers that use rectified mains to power the light source. While electrolytic capacitors are used to reduce ripple in the output current, they are expensive and bulky components, which are often the cause of failure of luminaires because of their relatively short lifetimes. For these reasons, manufacturers often skimp on capacitor specifications when budget is tight.

The frequency of rectified mains would be 100 Hz in Europe or South Africa, or 120 Hz in the US, which is right in the problem area. Poor-quality LED dimmer circuits whose PWM frequencies are below 200 Hz are another common culprit, along with electromagnetic interference from external noise sources.

Flicker may be measured in a number of ways. The most common are flicker percentage and flicker index. Percentage flicker is a measure of the depth of modulation of flicker, simply comparing the maximum signal level to the minimum. Lower percentage flicker means less substantial light flicker is present.

The more informative metric, flicker index, accounts for the different possible duty cycles of the drive signal, comparing the duration of high and low light levels with the average intensity. Lights can have similar flicker percentage while having very different flicker index (i.e., very differently shaped drive signals).

Referring to Figure 1, the formulae defining these two metrics are:

\[
\text{Percent flicker} = 100\% \times \frac{(\text{max} - \text{min})}{(\text{max} + \text{min})}
\]

\[
\text{Flicker index} = \frac{\text{area above mean}}{\text{total area}} = \frac{\text{Area 1}}{\text{Area 1} + \text{Area 2}}
\]

There is a relatively new industry standard that regulates the amount of acceptable flicker in LED lighting, IEEE SA-1789-2015. This standard provides guidance to help manufacturers design or select suitable LED drivers in order to minimise health and productivity effects due to flicker (in contrast to previous versions of the standard which focused on visible flicker).

![Figure 1. A theoretical LED driver output signal used to demonstrate the percent flicker and flicker index.](source: IESNA Lighting Handbook, 9th Edition (Rea 2000))
Digital fibre-optic sensor

The DFS digital fibre-optic sensor series from Tri-Tronics is designed to provide reliable detection using plastic fibre-optic light guides.

The slim-line housing with protective lid will fit in a variety of small spaces. The DFS is adjusted by a single push of a button, and eliminates guesswork on the part of the operator, with default settings that will work for most applications. The sensor is as simple or as complicated as the operator desires – if the application is a bit more complex, it can be adjusted in many configurations.

The device is optimised specifically for plastic optical fibres, and features a digital OLED display to precisely monitor applications. Functionality includes simple auto-set or application-specific teaching adjustment, manual fine-tuning, and an intuitive on-screen menu. It is available with a visible red or infrared sensing beam.

Anti-crosstalk technology allows up to eight sensors to be linked together without unwanted overlapping signals between communication channels. A snap-lock mechanism holds the fibres securely with no special tools – simply move the locking mechanism forward to open, insert the fibres, and then slide it back down to create a secure connection.

For more information contact Vepac Electronics, +27 11 454 8053, sales@vepac.co.za.

All-in-one light pipe system

Bivar’s Zero Light Bleed adaptor technology, with built-in surface-mount LED, channels light directly to the lens, eliminating disruptive light bleed.

The all-in-one adaptor system is built with optimum light pipe and LED compatibility to deliver convenience and resource savings for procurement and assembly.

The rigid light pipe system is available in right-angle LPR and vertical LPV configurations with a wide variety of sizes and colours. It is designed to maximise compatible LED and light pipe pairing, providing maximum light transmission while eliminating light crosstalk between light pipes.

The adaptor assembly is soldered directly to the PCB, thus strengthening its attachment to facilitate high-vibration applications. The new system simplifies sourcing by including the surface-mount Zero Light Bleed adaptor, LED and light pipe in one, delivering convenience and resource savings for both procurement and assembly.

For more information contact Vepac Electronics, +27 11 454 8053, sales@vepac.co.za.
Connectors for high signal integrity

Limited space and superior performance demands characterise modern-day electronic systems.

Connectors need to be compact, secure and should offer high signal integrity signal-carrying capacity. The ERNI SMC range (Small Multiple Connectors) enables electronics manufacturers to meet these demands by offering a variety of designs, heights and contact densities.

The product range consists of dual-row connectors positioned in a 1.27 mm grid, with pin counts of 12 to 80. Straight or angled male and female terminal strips enable a variety of mating configurations, allowing diverse and compact board-to-board spacing. The SMC connector also supports wire-to-board solutions and reaches data rates up to 3 Gbps.

Since SMC connectors work reliably under adverse conditions and are highly robust, they are especially suitable for instrumentation and industrial applications, such as factory and process automation, industrial robots, switches or PLC controls, and modular control systems for communication between controller and I/O modules.

For more information contact Actum Electronics, +27 11 608 3001, sales@actum.co.za.

Solderless waterproof detector switch

Alps Alpine has developed an SPVQ8 Series detector switch for use in detecting the opening and closing of side doors, hoods and other vehicle doors.

Electrification of vehicles is progressing and cars are becoming lighter. The electronic components inside them therefore need to be smaller and lighter, too. The detector switch recently developed by Alps Alpine is intended for open/shut detection of side doors, hoods and other vehicle doors, as well as connection detection, e.g. for seatbelt buckles.

Each car has around 10 such products. This SPVQ8 Series detector switch has an optimised terminal shape – a short fork terminal – achieved using high-precision die manufacturing and stamping technology. This has reduced the overall thickness of the product by 25%, thereby contributing to thinner, lighter customer equipment. It is a solderless design – a popular feature of existing models allowing one-touch board mounting. The use of a double-sided sliding contact ensures stable contact even in shock and vibration environments.

For more information contact Quatraine Domoney, Avnet South Africa, +27 11 319 8600, quatraine.domoney@avnet.eu.

Miniature IP67 connectors

TE Connectivity's SlimSeal connector Miniature series is a dust- and water-proof, IP67-rated connector system suitable for harsh environment applications, such as outdoor lighting and other high-humidity applications.

This wire-to-board and wire-to-wire connector system is a space-saving solution available in two- and three-position configurations. A robust press-to-release spring latch ensures that the connector mating is secure. Availability in different colours enables easy identification and flexibility in design.

The current rating of the connectors is 5 A for 18–20 AWG wire gauges (3 A for 22 AWG) and they are good for up to cycles and temperatures between -40°C and +105°C.

For more information contact Juan Ras, Altron Arrow, +27 11 923 9600, jras@arrow.altech.co.za.
Compact cable-to-cable connectors

The ERNI MiniBridge connector range has been designed for space-saving, versatile and high-rated connections.

EMI filtered circular connectors

API Technologies offers custom circular connectors in EMI filtered or unfiltered styles, including MIL-DTL-55116, -83723, -24308, -26482 and -5015. Their zinc-nickel finish is a RoHS-compliant, cost-effective and sustainable plating alternative to cadmium, and provides long-lasting corrosion resistance to exposed connector surfaces. It offers the same level of harsh environment protection, temperature ranges and electrical performance as cadmium finishes, but without the toxicity and negative environmental impact, the company says.

The filtered, compact shell connectors provide an effective filtering device that reduces the amount of real estate required within a product enclosure. Using its expertise in EMI filter design and manufacturing, API offers planar-style filtered arrays, available in C and Pi circuits. Other filter circuits including transient protection are available.

In addition, the company can accommodate customers’ quick-turn schedule for prototyping by adding either planar or tubular capacitor filtering to the rear of a standard connector.

For more information contact Electronic Industry Supplies, +27 11 726 6758, hreispy@iafrica.com.

PCB-mounted power relays

The RZF series power relay from TE Connectivity offers through-hole technology (THT) printed circuit board (PCB) terminals plus top-mounted 4.8 x 0.5 mm quick-connect tab terminals for load connections.

Its low-profile design results in a mounted height about 19% less than that of some previous-generation PCB relays with similar features and top mounted tabs. Contacts in a 1 form A (normally open) arrangement are rated 16 A at 250 V a.c., resistive. The 530 mW coil is offered in 5 through 48 V d.c. versions.

The relay complies with IEC 60335-1, 5th edition (GWT) and is UL recognised, VDE approved and CQC certified. It is suitable for applications such as microwave ovens, water heaters, cooking appliances, air conditioning as well as other industrial/commercial equipment.

For more information contact Juan Ras, Altron Arrow, +27 11 923 9600, jras@arrow.altech.co.za.
Yamaha's S10 and S20 i-Pulse 3D hybrid surface mounters, featuring enhanced support for MIDs (moulded interconnect devices), were developed under the concept of a single-unit manufacturing centre designed for surface mounting, dispensing and inspecting.

In addition to having fast product loading speed and high accuracy, as well as versatile mounting options from ultra-small chips to large components, these models are hybrids with their mounting heads and dispensing heads intermingled, allowing alternate dispensing and mounting.

The machine's tilt mechanism and long stroke on the Z-axis make surface-mounting possible on concave, convex, sloped and curved surfaces. Head variation can also be set to a 6-axis 6-theta, or 12-axis 2-theta configuration. Stable dispensing and inspection is carried out thanks to the adoption of a colour fiducial mark recognition camera and advanced lighting units.

The S10 and S20 can handle boards up to 1240 x 510 mm in size (or optionally 1825 x 635 mm) and components ranging from 0201 (0.25 x 0.125 mm) chips up to 120 x 90 mm, with mounting heights up to 35 mm.

For more information contact Zetech, +27 11 609 1244, orlalain@icon.co.za.

### Dual-syringe dispenser

Techcon announced the release of its new 50 ml dual-syringe dispenser designed for hassle-free dispensing of 50 ml dual syringes.

The system can accommodate conveniently packaged 50 ml side-by-side syringes, in ratios of 1:1, 2:1, 4:1 and 10:1.

A secure attachment adaptor ensures quick changeover when the dual syringe is empty. Operation is achieved through pulsed air pressure from a TS250 or TS350 Series dispenser. The dispensers' on-board vacuum function can be activated when the dual pistons require retraction for syringe changeover.

The multi-configurable robot integration bracket allows convenient semi-automated use, with the option of using the system with any of Techcon's disposable path valves – TS1212, TS5624DMP or TS5000DMP-SRDCX.

Additionally, a hanging ring is provided to store the tool when not in use.

Techcon also offers a complete line of consumables which includes dispensing tips, syringes, cartridges and nozzles.

For more information contact Test & Rework Solutions, +27 11 704 6677, sales@testandrework.co.za
Miniature quartz crystal

IQD Frequency Products has launched one of the world’s smallest quartz crystals, the IQXC-240, which measures just 1.2 x 1.0 mm with a height of only 0.33 mm. It is available in frequencies between 36 MHz and 80 MHz and is ideal for applications where space is at a premium, such as IoT, VGA, USB and Wi-Fi.

Frequency stabilities can be specified as low as ±10 ppm over the commercial temperature range of -20°C to 70°C and ±15 ppm over the industrial temperature range of -40°C to 85°C. The frequency tolerance can be specified down to ±7 ppm. In line with the requirements of the latest generation of microprocessors, the load capacitance can be as low as 5 pF.

Housed in a 4-pad ceramic hermetically-sealed package with an electron beam-sealed metal lid, the device minimises EMI radiation. It is designed to be able to withstand shock levels of up to 1000 G in accordance with IEC 60068-2-27, and is available on tape and reel.

For more information contact Jason Page, Würth Elektronik eiSos, +27 71 259 9381, jason.page@we-online.com

Bidirectional laboratory power supply

EA Elektro-Automatik’s new 30 kW EA-PSB 10000 is a bidirectional power supply with a working efficiency of up to 96%, both as a source and as a drain with energy feedback. The device can be switched from source to drain with no delay.

For example, charging and discharging an energy storage in various power ranges may be carried out with just one device. Energy in the motor testing recuperation phase can be collected directly by the EA-PSB 10000 and fed back to the mains.

The efficiency of the devices leads to a reduction in heat generation, but EA also offers water cooling as an option, with up to 95% of the power loss dissipated through the fluid. The fully digital controls allow remote setting of, for example, customer-specific PID parameters which differ from the factory settings.

In order to fully utilise the performance of the EA-PSB 10000, intuitive control software is provided. With EA Power Control the user can operate up to 20 devices remotely, control additional functions such as sequencing, and use a practical data collection. A further new feature is the battery simulation software. Thus the customer can use the EA-PSB 10000 to test their hardware under practically real conditions.

For more information contact Vepac Electronics, +27 11 454 8053, sales@vepac.co.za.

Pressure and temperature sensor

The MSS837-02BA pressure sensor module from TE Connectivity is an ultra-small, gel-filled pressure sensor optimised for both altimeter and barometer applications. Designed for consumer devices such as wearables, multisport watches and fitness trackers, the robust sensor package enables it to withstand harsh environments often encountered in these applications.

This MEMS-based sensor includes a high-linearity pressure sensor with an ultra-low-power 24-bit digital output (°C) and an altitude resolution at sea level of 13 cm. This enables high-resolution measurements, such as counting flights of stairs.

The micro altimeter’s robust sensor package consists of ceramic and metal materials. A high-resolution temperature output allows the implementation of a thermometer ion without any additional sensor. Expanding on TE’s MSS837 series of ultra-compact digital altimeters, the new-generation 2-bar models offer options for improved endurance in chlorine environments and shielding for reduced signal noise and interference.

For more information contact Juan Ras, Altron Arrow, +27 11 923 9600, jras@arrow.altech.co.za.

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**Microtronix Manufacturing**

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With world class factories on your door step, why would you look elsewhere?
Aimtec has introduced three new series of switching regulators – the AMSRB1-78JZ, AMSRL1-78JZ and AMSRL-78JZ – all meeting the EN62368 standard and suitable for IoT (Internet of Things) applications.

The AMSRB1-78JZ has an ultra-wide input voltage range of 6 to 36 V and output voltages from -15 to 15 V. This series also has a very high efficiency of up to 96% for minimal heat creation. In a fully encapsulated, compact 11,6 x 8 x 10,4 mm plastic case, this series offers features such as continuous short circuit protection and low ripple and noise.

For more information contact Quatraine Domoney, Avnet South Africa, +27 11 319 8600, quatraine.domoney@avnet.eu.

SynQor has added a new isolated PFC (power factor correction) module to its AeroQor range of products for the airborne electronics market. Featuring highly efficient active power factor correction, the AC-DC converter is designed to be used as a COTS (commercial off-the-shelf) component in airborne applications. It operates from a universal AC input and generates an isolated DC output. Regulated output and droop output modules are available in the AeroQor PFC range. Used in conjunction with a hold-up capacitor, and SynQor’s AC line filter, the AeroQor will draw a nearly perfect APFIC-U-280-HT-C-G sinusoidal current (with a power factor in excess of 0,99) from a single isolated PFC converter phase AC input.

The module is designed with a universal AC input of 85-264 Vrms and a 100 or 325 W output, with a variety of output voltages including 12, 24, 28, 48 and 55 V d.c. The module has an input frequency range of 47-63 Hz or 360-800 Hz.

For more information contact Conical Technologies, +27 66 231 1900, daniel.haywood@conical.co.za.

NXP Semiconductors announced availability if its EdgeLock SE050 Plug and Trust Secure Element (SE) family to secure Industrial 4.0 and Internet of Things (IoT) applications from edge to cloud. The Common Criteria (CC) EAL 6+ certified device makes it easy to implement high-performance security for sensing and control. Additionally, it streamlines deployment of IoT services and on-boarding of edge devices to public and private clouds, edge computing platforms and infrastructure.

I2C master functionality allows for direct control of critical functions as well as integrity and confidentiality of sensor data. The SE050 has a contactless interface for late-stage parameter configuration of unpowered devices, and integrates functionality typical to Trusted Platform Modules (TPM).

The device simplifies integration with different microcontrollers, microprocessors, operating systems (Linux, RTOS, Windows, Android) and major cloud platforms.

For more information contact EBV Electrolink, +27 21 402 1940, capetown@ebv.com.
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