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Dataweek South Africa’s leading electronics and communications publication
STMicroelectronics is applying its Arm Cortex expertise to expand the capabilities of its STM32 microcontroller (MCU) portfolio to applications requiring even more performance, resources and large open-source software. The introduction of the STM32MP1 multicore microprocessor series with compute and graphics support facilitates development of high-performance solutions for industrial, consumer, smart home, health and wellness applications. Find out more on page 25.

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

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Featuring a range of technical and opinion articles on wireless mesh networking, ICASA certification, passive RFID, solid-state RF power sources, and COTS-based SDR.

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A selection of some of the newest integrated circuits to hit the market.

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Ever wondered how Mil Spec requirements impact the design of printed circuit boards?
US-China trade war hits chip makers

The escalating trade war between the US and China has the global economy on high alert, and unless things normalise soon it is going to have massive ramifications on many industries.

Following US president Donald Trump’s decision to raise tariffs on $200 billion worth of Chinese goods, China responded in kind by announcing it would raise tariffs on $60 billion of American products. Rather than spurring intensified negotiations and some sort of backdown, the Trump administration unsurprisingly responded to this by ratcheting up the tensions, saying it is considering raising tariffs on all of China’s remaining imports, amounting to about $300 billion worth of products.

The economic realities are that US citizens will bear the brunt of the increased cost of imported Chinese goods, and many would argue that Trump is more interested in picking a fight than the welfare of his people. But the fact remains that China has an abysmal record when it comes to protecting (and appropriating) intellectual property of foreign companies, and it was inevitable that the problem would come to a head sooner or later.

One of the biggest companies in the eye of the storm is Huawei. The Chinese telecommunications giant has come under intense scrutiny for its cybersecurity practices, by the US and other countries. The US became the first country to put the company on an official blacklist, when Trump signed an executive order giving the federal government the power to block US companies from buying foreign-made telecommunications equipment deemed a national security risk.

The argument from the American side is the concern that the Chinese government could force companies like Huawei to deliberately build backdoors into its products to spy on American networks. Huawei’s CEO has repeatedly denied this is happening or would ever be countenanced, but depending on your mind set you might think “well, he would say that, wouldn’t he?”

As a Huawei smartphone user, I’m relieved that all the cybersecurity concerns revolve around its telecommunications infrastructure equipment rather than its consumer products. What is worrying in the context of the larger trade war, though, is the fact that Google has announced it will comply with the executive order by blocking support to Huawei for US software, so while a Huawei phone will continue to function it may not receive updates to the Android platform, or to services such as Gmail, Chrome and Google Maps.

Semiconductor chip manufacturers were immediately impacted by these developments, with both Infinion Technologies and STMicroelectronics’ stock prices suffering. Other chip makers, including Intel, Qualcomm, Xilinx and Broadcom were also reported to have instructed employees not to supply Huawei until further notice, and if true, those companies’ revenues will inevitably also take a hit as a result.

On an unrelated note, communications minister Stella Ndabeni-Abrahams went on SABC’s Morning Live TV programme recently to say that one of the reasons for the delay in implementing digital terrestrial television (DTT) migration is the fact that so few people have registered to receive the free set-top boxes stockpiled by the government. “We have lots of boxes in our warehouse, we’ve been calling upon South Africans, the deserving ones, those that have household income of less than R3 200, to go and register in their post offices, so that we can have the database and they can access the boxes. There’s been a low uptake of the boxes.”

The problem with that argument is that the delay in switching on DTT signals has been one of the central issues around the hold-up all along. So if more people had registered for free boxes, rather than alleviating the problem, surely there would just be more disappointed people waiting for something to watch?
South Africa

- South Africa will soon join the World Economic Forum’s (WEF) Centre for the Fourth Industrial Revolution Network (C4IR Network) alongside China, India and Japan by launching an affiliate centre. The WEF established the C4IR in San Francisco, USA in March 2017 as a hub for global, multi-stakeholder cooperation to develop policy frameworks and advance collaborations that accelerate the benefits of science and technology. The South African government, through the Department of Science and Technology (DST), intends to establish an affiliate centre as a public-private partnership based at the Council for Scientific and Industrial Research (CSIR).

- Stella Ndabeni-Abrahams, the minister of communications, marked the 50th anniversary of the International Telecommunications Union (ITU) on 17 May when she delivered a keynote address at the launch of Telkom’s fibre connectivity in Soweto. World Telecommunications and Information Society Day (WTISD) marks the signature of the first International Telegraph Convention in 1865, which led to the creation of the ITU.

Communications minister Stella Ndabeni-Abrahams attending the launch of Telkom's fibre connectivity in Soweto.

Overseas

Business

- In the second quarter of the 2019 fiscal year, Infineon Technologies’ revenue grew by 1% from 1.97 billion Euros to 1.98 billion Euros quarter-on-quarter. Revenue was up in the automotive and digital security solutions segments, marginally down in the industrial power control segment, and somewhat more significantly down in the power management and multimarket segment. Net income for the quarter amounted to 231 million Euros, compared to 254 million Euros in the previous quarter. Quarter-on-quarter, earnings per share from continuing operations remained unchanged at 0.22 Euros (basic and diluted).

- Maxim Integrated Products reported net revenue of $542 million for its third quarter of fiscal 2019 ended 30 March 2019, a 6% decrease from the $577 million revenue recorded in the prior quarter, and a 16% decrease from the same quarter of last year. Diluted earnings per share (EPS) in the March quarter were $0.47. Looking ahead to the June quarter, the company expects to achieve revenue of $540 million to $580 million, and EPS between $0.53 and $0.59.

- National Instruments announced Q1 2019 revenue of $311 million, flat year over year. GAAP net income for the quarter was $23 million, with fully diluted EPS of $0.17. Excluding the impact of foreign currency exchange, revenue was up 3% in the Americas, up 6% in APAC, and down 3% in EMEA.

- NXP Semiconductor delivered revenue of $2.1 billion during the first quarter of 2019, just above its guidance but still a year-on-year decrease of 8%. Due to a richer mix of sales and expense control measures, the company managed to deliver improved profitability toward the higher end of its guidance range, and returned $788 million to its shareholders during the quarter, consistent with its long-term capital return policy.

- Revenue in ON Semiconductor’s first quarter of 2019 was $1.39 billion, up approximately 1% compared to revenue in the first quarter of 2018, but down approximately 8% as compared to revenue in the fourth quarter of 2018. Net income for the latest quarter was $114.1 million or $0.27 per diluted share, compared to $139.6 million or $0.31 per diluted share in the same quarter of 2018, and $165.6 million or $0.39 per diluted share in the immediately prior quarter.

- For Silicon Labs’ first quarter of 2019, revenue was at the midpoint of guidance at $188.1 million, down from $215.3 million in the previous quarter, and diluted EPS were $0.12. IoT revenue was down 11% sequentially and up 3% year-on-year; infrastructure revenue was about flat sequentially and down 7% year-on-year; broadcast revenue was down 25% sequentially and 27% year-on-year; and access revenue was down 36% sequentially and 43% year-on-year. The company expects second quarter revenue to be in the range of $202 million to $212 million.

- STMicroelectronics achieved first quarter net revenues of $2.08 billion, and net income of $178 million or $0.20 diluted earnings per share. For the full year 2019, it expects net revenues to be in the range of about $9.45 to $9.85 billion, and therefore plans for strong sequential growth in the second half of the year compared with the first half, across the industrial, automotive and personal electronics end markets.

- Texas Instruments reported first-quarter revenue of $3.59 billion, net income of $1.22 billion and earnings per share of $1.26. This represented a 5% year-on-year decline in revenue, with the company’s core analog and embedded processing businesses experiencing 2% and 14% declines, respectively.

Companies

- Microchip Technology has delivered its 25 billionth microcontroller (MCU), in the same year the company marks its 25th anniversary. The company awarded the milestone purchase of its PIC24 MCU to Gentex, a long-time supplier of electro-optical products for the global automotive industry. Gentex integrates the PIC MCU into its HomeLink car-to-home automation system, which consists of in-vehicle buttons that can be programmed to operate garage doors, security gates and other home automation devices.

Industry

- The Semiconductor Industry Association (SIA) announced worldwide sales of semiconductors totalled $96.8 billion during the first quarter of 2019, a decrease of 15.5% over the previous quarter and 13% less than the first quarter of 2018. For the month of March, sales decreased on a year-to-year basis across all major regional markets and semiconductor product categories, consistent with the cyclical trend the global market has experienced recently.

Worldwide Semiconductor Revenues

Source: WSTS
Actum acquires Band-It business in South Africa

The Actum Group has acquired Banding and Identification Solutions Africa (BISA), the leading distributor of Band-It clamping and fastening products in South Africa. The transaction, which was finalised in November last year, serves to expand and strengthen Actum’s industrial brand portfolio, according to Greg Barron, Actum Group director.

“The partnership was a significant stride forward in the group’s expansion strategy. This was a very strategic acquisition, as we were already distributing the Band-It product in the coastal areas. It has given us the opportunity to offer this product to many other customers in the Actum stable and to build on our existing product line,” explains Barron.

BISA has been a leading distributor of stainless-steel strapping and identification solutions since 1993, and enjoys a strong reputation in the local industrial market. As a niche product driven by quality, Barron believes Band-It is a logical and highly beneficial addition to the Actum Group. Band-It senior business executive, Rosa Remendos, is equally optimistic about this new chapter in the BISA business: “It’s all about growth and opportunity. Actum has an excellent reputation in the industry and it’s exciting for us to be associated with a company like this. We make a good team.”

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

Otto Wireless scoops two new agencies

Otto Wireless Solutions has recently been appointed as the official distributor for two overseas manufacturers of RF and microwave components: Taiwanese microwave ceramic components designer and manufacturer, Cirocomm, and Italy-based Mipot, which manufactures and sells RF modules in the ISM band.

Cirocomm’s portfolio of products includes DR filters, PCB/FPC antennas, patch antennas, active antennas, external antennas and more. The first products to arrive on South African shores are its ceramic SMD antennas, which can be found on the Otto Wireless Solutions website.

Cirocomm maintains small form-factor products by selecting high K-value material. Its miniature antennas are commonly found in Wi-Fi and 5G products such as cameras and industrial equipment. Cirocomm has its own antenna labs (with HFSS software, RF measurement gauges, and equipment such as over-the-air chambers) which enables it to provide result-focused solutions to meet customer needs.

Mipot offers solutions for Internet of Things (IoT), machine-to-machine (M2M) and other low-power wide-area network applications. “As customer demand for LoRa products has steadily increased, Otto Wireless Solutions has actively sought a technology partner capable of delivering module solutions for this market, and is pleased to announce that Mipot’s LoRaWAN module has received ICASA type approval. The product has been locally tested and is compatible with other LoRaWAN products available from Otto,” commented Chris Viveiros, operations and technical director of Otto Wireless Solutions.

According to Viveiros, many LoRaWAN devices were considered, but many were found to be operating well outside of the limits set by ICASA, and would therefore not be suitable for the South African market. “Mipot, on the other hand, being a European product, was found not only to be compatible with local type-approval requirements, but also provided high-quality documentation, and the team at Mipot displayed an enthusiastic approach to working with Otto Wireless Solutions to grow the market,” he said.

For more information contact Otto Wireless Solutions, +27 11 791 1033, chris@otto.co.za
Widest selection of electronic components
CSIR outlines new strategy

The CSIR (Council for Scientific and Industrial Research) has revealed details about its new strategic direction, built around the vision of accelerating socioeconomic prosperity in South Africa through leading innovation. The strategy sets out how the organisation will leverage its strong science, engineering and technology capabilities to build on industrial development opportunities, to ultimately create a more balanced focus on scientific and industrial development.

It focuses on nine synergistic clusters and enabling initiatives that span several industries and rely on collaboration with a host of public and private sector stakeholders, funding partners, industry associations, higher education institutions and innovation partners.

The clusters are technology industry convergences that were selected based on considerations of national priorities, potential for socioeconomic impact and the fourth industrial revolution. Industry challenges, value chains, emerging technology and socioeconomic trends and capability requirements were also considered.

The Future production: Mining cluster supports the growth and revitalisation of the mining industry through innovation for process, equipment and health and safety improvement. Activities in the Future production: Manufacturing cluster are directed at strengthening manufacturing and assembly, facilitating supply chain integration and improving production and processing lines by leveraging technological advances and supporting Industry 4.0 readiness. The Future production: Chemicals cluster improves the competitiveness of chemical industries through innovation in biochemical conversion, pharmaceuticals and advanced materials.

The NextGen Health cluster focuses on driving a local healthcare industry and improving health outcomes through synthetic biology and advances in digital, diagnostic and treatment technologies. Activities in the Advanced Agri and Food cluster are directed at strengthening the agricultural industry and associated agro-processing value chains through advanced technology and predictive science-based tools.

Work in the Defence and Security cluster is aimed at strengthening capabilities in defence, civil security and cybersecurity through advanced technologies.

The NextGen Enterprises & Institutions cluster is about transitioning South Africa’s institutions into a digitalised era. In the Smart Logistics cluster the focus is on enhancing the efficiency and safety of transport and logistics infrastructure and operations in support of a competitive economy. The Smart Places cluster works towards achieving smarter resource use (energy, water, climate change environment), infrastructure and service developments through transformative technologies.

As part of this new strategy, the CSIR has identified a new set of values to underpin its new organisational culture. These are not only intended to enhance work ethic, but also to hold the organisation accountable externally. The new CSIR value statement is: “Our beliefs, principles and the impact we wish to make to improve the quality of life of South Africans are EPIC. Team CSIR pursues Excellence, celebrates People, personifies Integrity, and welcomes Collaboration.”

Collaboration is key to the strategy’s successful implementation and the CSIR says it is looking forward to engaging and collaborating with both private and public sectors to understand the requirements of those whom it wishes to assist in becoming more competitive and capable.

For more information visit www.csir.co.za
The ubiquity of IoT in design

Information from Etion Create.

The Internet of Things (IoT) is a wave that impacts all ‘verticals’ and ‘horizontal’ design, and organisations who deliver design and manufacturing services in this hazy matrix are not spared the change. It is being ignited by the tsunami of capability presented by digital evolution and the reality of Things.

This creates a complex web of interconnected potential that allows for endlessly inventive solutions, but it places pressure on an original design manufacturer (ODM) to do more than just perform – it must transform. There is a real need for innovation that delivers on customer expectations realistically and within budget while providing the organisation with a competitive advantage.

According to Petrus Pelser, managing director of Etion Create, an ODM that recognises these challenges and applies specialised thinking will find significant opportunity in the IoT space. "It is critical to address the different requirements of IoT – the multitude of sensors and the complexities of embedding them into a solution – while simultaneously delivering precisely what the client needs," he says.

The challenge isn’t that IoT can’t deliver on expectations, but rather that far too few providers can develop every aspect of a solution and even fewer recognise the design limitations that may apply. To benefit from IoT, every part of the process has to be aligned and there has to be a clear strategy from the outset.

"A holistic ODM works closely with customers to ensure that they design, develop and manufacture the product required from the outset. IoT needs a lot of listening followed by plenty of design thinking," says Pelser. "It is a completely different process from the traditional, waterfall development process utilised in other sectors. The IoT space requires specialised thinking and this can only be effectively achieved in a cohesive ecosystem.

"If you consider a high-volume market and addresses a broad spectrum of sensor solutions and this means that price and connectivity are a critical pivot point. IoT may be a buzzword but it is still at the start of what it can do and where it can go, and there are barriers that impact on pricing and connectivity.

"The unit cost may be low, but the cost of development and implementation within the infrastructure limitations of IoT networks can push the price up," says Pelser. "Any IoT investment must consider the market fit, the budgets for high volumes and the network connectivity constraints. Today, a lot of people just look at the solution but they don’t realise the cost implications of setting up a low-bandwidth IoT network."

To succeed, IoT applications have to be structured around the considerations of bandwidth, network, battery power and cost. They have to be fit for purpose and capable of high-volume, industrialised rollout and, most importantly, they have to work. It is into this that the right ODM fits as neatly as a piece into a puzzle, or perhaps a sensor into a network. Etion Create has a track record in design thinking, recognising the limitations and the potential of technology and creating solutions that are both realistic and intelligent.

"We don’t do massive investment into products and then see if they can be sold or if they are relevant," says Pelser. "Instead we work with our customers, identify the market, and then we work together to build a proof of concept and a pilot. This ensures that our mutual investment into the IoT space aligns with the potential outcome."

Development is costly, even with sensors becoming increasingly small and cheap, but designing a solution for a low-cost, low-power network pushes up the price tag. Etion Create makes the investment decision smaller by working within the lean startup methodology – testing the market, ensuring the solution is relevant and viable, and assessing potential without a massive upfront investment.

"We are focused on trends in the market," concludes Pelser. "Working with customers to develop ubiquitous IoT solutions really plays into our capabilities. We are living in a highly connected world and everyone wants more efficiency and accessibility. A lot of the smart cities and solutions starting to emerge require IoT solutions that map back to demand, cost and capability and we work with our customers to put them at the forefront of this evolution."

South Africa isn’t behind the times or the rest of the world when it comes to IoT innovation. The country is powered by the need to overcome unique challenges and complexities and this ignites remarkable innovation and opens up significant potential. Partnering with Etion Create, local organisations can learn more about IoT and embark on a journey that can transform business, customer engagement and the future.

For more information contact Etion Create, +27 12 678 9740.
Miniaturised CO₂ sensor

Thanks to new energy standards and better insulation, buildings have become increasingly energy efficient, but at the cost of accelerated deterioration in air quality. Since high CO₂ levels compromise human health and productivity, CO₂ is a key indicator for indoor air quality. Air exchangers and smart ventilating systems in the commercial and the residential sector use CO₂ sensors to regulate ventilation in the most energy-efficient and human-friendly way.

Furthermore, CO₂ sensors play an essential role for indoor air quality monitoring and can therefore be integrated in IAQ monitors, air purifiers and smart thermostats. Addressing these needs, Sensirion has developed the SCD40, a miniaturised CO₂ and RH/T sensor that fits in a space of just one cubic centimetre. Based on the photoacoustic sensing principle, it is well suited for high-volume and cost-sensitive applications.

With dimensions of just 12 x 12 x 7 mm, the SCD40’s footprint has been shrunk by a factor of five compared to its predecessor, the SCD30. Using the photoacoustic sensing principle, the dimensions of the optical cavity are drastically reduced without compromising on sensor performance.

The integrated humidity and temperature sensor delivers two additional sensor outputs. The SCD40’s feature set makes it particularly relevant for CO₂ sensing markets such as IoT, automotive, HVAC, appliances and consumer goods.

Optical spectrum analyser

Anritsu announced the sales launch of the new MS9740B spectrum analyser which has been developed for evaluating the output characteristics of optical active devices used by optical communications systems.

The MS9740B keeps the same measurement sensitivity performance, functions and size as its predecessor MS9740A while shortening measurement processing times by 50%, further improving production-line efficiency by optimising the optical receiver bandwidth settings most commonly used by customers.

The spread of next-generation 5G mobile and cloud communications services is expected to increase data traffic volumes massively. Networks supporting this infrastructure are experiencing explosive jumps in network traffic, which demands both increased module production and shorter inspection times to allow in-time delivery required for the rapid expansion and adoption of faster rate optical modules at 10 Gbps, 100 Gbps and 400 Gbps.

The benchtop MS9740B features wide dynamic range, high resolution, and fast sweep speeds over a wavelength range of 600 to 1750 nm. The device supports multimode fibre input and is ideal for manufacturing and evaluating 850 nm band VCSEL modules.

The MS9740B retains the optical active device (LD-Module, DFB-LD, FP-LD, LED, WDM and optical amplifier) measurement menu screens as its predecessor for evaluating devices. It supports all-at-once measurements of key evaluation items, such as optical centre wavelength, level, OSNR, spectrum width, etc., and displays these results on one screen.

Industrial-grade graphics card in M.2 format

Innodisk is aiming at the industrial embedded sector with the addition of a new ultra-slim 4K M.2 graphics card to its portfolio of expansion cards. M.2 has become one of the dominant form factors in the market and its foothold within the industrial embedded market is growing accordingly.

The 2280 M.2 card suits the needs of the automation, retail and medical markets for space-saving solutions.

The graphics card provides an easy method of expanding a system’s display options and can be fitted with ports to connect to devices using HDMI, LVDS and DVI-D signals. Conforming to an industrial-grade standard means that it is resistant to shock and vibration, and operational in temperatures from -40°C to 85°C. To further ensure stable operation, it complies with all relevant FCC and CE regulations.

Embedded systems do not always fit the common standards and as such require a unique approach. Therefore the Innodisk graphics card is compatible with both Windows- and Linux-based systems, with further customisation options available if needed.

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

For more information contact Coral-i Solutions, +27 11 315 5500, sales@coral-i.com

For more information contact Vepac Electronics, +27 11 454 8053, sales@vepac.co.za
Body-worn EMF monitor

For those working with high-intensity electromagnetic fields (EMF), such as in the near field region of radar antennas, broadcast transmitters or cellular base stations, it is vital to wear personal safety equipment (PSE) that gives a warning when critical EMF values are reached, to exclude health risks.

Narda Safety Test Solutions has now developed the RadMan 2 for this complex monitoring task, with future 5G applications also in mind. This small device that is worn on the body gives insistent, timely and reliable warning of impermissibly high levels of exposure to electromagnetic radiation.

The shaped frequency response of the personal monitor ensures that the correct alarm threshold is automatically set for the entire frequency range. The permitted limit values specified in the standards are variable, depending on frequency.

As the device has sensors for the E field (electric) as well as for the H field (magnetic), the distance between the field source and the person is immaterial – whether in a strong electric or magnetic field. The higher value of either will always trigger the alarm and will be displayed as a percentage of the applicable upper limit, e.g. as stipulated by ICNIRP. The warning itself cannot be missed, even in harsh, noisy and adverse conditions as it is bright, loud, and the device also vibrates.

Key features include:
- Starting and safely using the device is simple. The automatic sensor test checks that the sensors are functioning correctly as soon as the device is switched on, meaning that an external test generator is not needed.
- A special RF absorber between the sensor and the body ensures that the actual field strength is measured accurately and correctly during operation by eliminating effects of the body such as reflections, which could falsify the results.
- It is easy to release the robust, weatherproof device in its IP65 rated housing from its holder with one hand, such as to determine the field exposure isotropically when searching for leaks at cable connectors. This ensures the reliable display of all hotspots in both the E field and the H field, regardless of the orientation of the device.
- The built-in rechargeable batteries give 800 hours of operating time from a single charge cycle.

The new radiation monitor is available in two versions: the less expensive LT model for up to 8 GHz, with reduced features and fewer functions, and the XT with a range of up to 60 GHz. Exclusive to the XT version is the ‘RF detection’ mode with its tone search function, which allows for a precise isotropic search for leaks at arm’s length. As the field source is approached, the change in the pitch of the tone allows the operative to quickly, simply and reliably check that the antenna is actually switched off before getting too close. Finally, the ‘Pulse’ mode setting causes the alarm to respond much faster, allowing the reliable detection of brief, pulsed signals.

For more information contact Tobie Muller, Accutronics, +27 11 782 8728, tmuller@accutronics.co.za

New scan capabilities for EMI receiver

Keysight Technologies has added time domain scan (TDS) and real-time scan (RTS) capabilities to the N9048B PXE electromagnetic interference (EMI) receiver, enabling real-time measurements and diagnostics for faster electromagnetic compliance (EMC) certification.

EMC testing requires detailed and exacting methodologies to ensure that all emissions are accurately measured. Long test times impact test facility availability and reduce the number of devices that can be certified. It’s also easy to miss intermittent disturbance signals with conventional scan mode since long dwell time is required at each frequency.

The new TDS and RTS capabilities enable independent compliance test laboratories, as well as in-house self-certification labs, to shorten overall test time and easily perform gapless signal capture and analysis, certifying that a product meets regulatory compliance standards.

The N9048B PXE EMI receiver, with three frequency ranges up to 26.5 GHz, delivers full compliance with CISPR 16-1-1:2015 and MIL-STD-461G (2015). It provides full signal visibility, where the RTS provides gapless signal capture and analysis in up to 350 MHz bandwidth and simultaneously displays the frequency domain, time domain and spectrogram, with three EMC detectors.

For more information contact Tshiamo Mogakwe, Concilium Technologies, +27 12 678 9200, info@concilium.co.za
The ultimate wireless mesh for Industrial IoT in SA?

While the uptake of user-centric IoT (Internet of Things) technology is fairly slow due to various socioeconomic factors – such as the cost surrounding smart devices, insufficient power station capacity and limited and expensive Internet coverage – Industrial IoT might be easier to adopt, and better suited for a country like South Africa. Technology such as Analog Devices’ SmartMesh IP embedded products – which are among the industry’s lowest-power and most reliable standards-based wireless sensor networking (WSN) products – could improve a lot of things in South African industries.

With advanced network management and comprehensive security features, SmartMesh delivers reliable, scalable, energy-efficient wireless sensor connectivity. Using up to eight times less power than other solutions, SmartMesh provides energy-efficient wireless mesh sensing even in harsh, dynamically challenging RF environments.

How SmartMesh applications could benefit South Africa

As Africa’s most structurally developed nation, South Africa has experienced many construction booms – most of them in the five main economic areas. Analog Devices’ SmartMesh could help with predictive maintenance of the largely metal and concrete buildings which include industrial plants, data centres, commercial buildings, bridges and tunnels.

Because of South Africa’s geographical location, solar energy holds the most potential as a form of renewable energy. Placing thousands of SmartMesh nodes in utility-scale solar farms to operate within radio range of each other could, according to Altron Arrow Engineer Conrad Coetzee, “increase the run time and reduce maintenance requirements of the solar farms. Knowing the state of each solar panel or cluster can reduce maintenance costs and reduce cabling requirements. The technology could also be used in wind power generators for preventative maintenance and thus help reduce catastrophic failures.”

A large amount of South Africa’s population flocks to the five main economic areas. Navigating daily life in these areas could be improved through street parking applications, smart street lighting networks spanning multiple city blocks, and even commercial irrigation for golf courses, farms and residential areas.

With a shocking 2,09 million crimes reported in 2018 – more than 400 000 of which were commercial, shoplifting, hijackings and cash-in-transit heists, asset tracking has become a huge factor for all industries in South Africa. By placing networks on all vehicles, including rail cars, cargo containers, semi-trucks and aircraft, Analog Devices’ SmartMesh could track the location, status and condition of assets throughout the supply chain – making it easy for stakeholders to maintain total control of their assets at all times.

According to Coetzee, smart farming is also one of the areas of growth in the industrial sector, although slow due to political factors. A wireless mesh network could improve safety and security through early warning systems, animal tracking, efficient working, soil and plant notifications.

“This is still a big untapped market for the IoT industry, where there is a requirement for low-power, high-reliability and ‘always on’ networks,” says Coetzee. “By combining all of this together, the farmer can be in full control of the process and can plan for the future in terms of crop selection or the choice of livestock needed to sustain their farming.”

Analog Devices’ SmartMesh network consists of a highly scalable, self-forming, multi-hop mesh of nodes (known as motes, which collect and relay data) and a network manager that monitors and manages network performance and security, and exchanges data with a host application.

SmartMesh motes and managers are complete wireless sensor network solutions that combine a time-synchronised, channel-hopping link layer with hardware based on Analog Devices’ Eterna system-on-chip technology for a complete wireless networking solution with better than 99.999% data reliability, longer than 10 year battery life, and encryption, authentication and message integrity checks.

Providing low-power wireless mesh networks for demanding industrial process automation applications, SmartMesh customers include conglomerates with solutions for building automation, data centre energy management and renewable energy.

Over 76 000 SmartMesh enabled systems are deployed in 120 countries, securely connecting a variety of smart devices to applications delivering on smarter, greener, more efficient solutions. Analog Devices’ Paul Davies and Coetzee both believe that SmartMesh fits into the South African market due to the absolute reliability of the technology and its scalability – which can range from anywhere between a few sensors to thousands. They also assert that it is the only low-power RF mesh network suitable for many of today’s industrial applications.

For more information contact Conrad Coetzee, Altron Arrow, +27 11 923 9600, ccoetzee@arrow.altech.co.za
RF front-ends for 5G deployments

Sky5 LITE, recently unveiled by Skyworks, is a fully integrated front-end solution for mass tier 5G cellular applications. The baseband agnostic platform supports up to 100 MHz bandwidth for 5G new radio (NR) waveforms with flexible power management options.

Targeted for mass markets, Sky5 LITE interfaces with all leading chipset providers and equips early 5G adopters with differentiated architectures for an open ecosystem. It is joined by the Sky5 Ultra lineup for premium applications. Functional core blocks within the Sky5 family include primary transmit, diversity/MIMO and antenna management cores.

Wi-Fi and Bluetooth module

Murata Manufacturing has collaborated with Cypress Semiconductor to develop the Type 1LV (CYW43012) low-power, small form factor Wi-Fi and Bluetooth module. This product is designed to improve battery life in wearables, smart home products and portable audio applications.

Compared to the Type 1DX (CYW4343W), power usage in the Type 1LV is approximately 54% lower in DTIM 1, 60% in DTIM 3, up to 50% for 2.4 GHz Rx, and 28% for 2.4 GHz Tx.

Based on the Cypress CYW43012 combo chipset, the dual-band Wi-Fi 11a/b/g/n/ (11ac friendly) + Bluetooth 5.0 module provides data transfer rates up to 78 Mbps on Wi-Fi and 3 Mbps on Bluetooth. It supports a broad range of popular processors including PSOC6, i.MX RT, STM32, i.MX, and IP camera platforms, as well as Linux and RTOS based applications.

The Type 1LV uses sophisticated hardware mechanisms and algorithms to ensure that Wi-Fi and Bluetooth coexistence is optimised for maximum performance. An embedded IPv6 network stack can be used to keep the host processor in sleep mode while maintaining network connections. The module also supports BLE 2 Mbps, LE secure connections, LE privacy 1.2, and LE data packet length extension.

The device measures 10.0 mm (L) x 7.2 mm (W) x 1.4 mm (H), and is available with a reference antenna design for FCC/IC certifications and CE conducted test to provide a lower development cost and faster time to market.

For more information contact Callie Lombard, Hi-Q Electronics, +27 11 894 8083, callie@hi-q.co.za

GNSS module for lane-accurate positioning

New from u-blox comes the ZED F9K high-precision multiband GNSS (global navigation satellite system) module with built-in inertial sensors. The module combines the latest generation of GNSS receiver technology, signal processing algorithms and correction services to deliver down to decimetre-level accuracy within seconds, addressing the evolving needs of ADAS (advanced driver assistance systems) and automated driving markets.

The dead reckoning module builds on the u-blox F9 technology platform featuring compatibility with modern GNSS correction services to further improve positioning accuracy by compensating for ionospheric and other errors. The multi-constellation RTK (real-time kinematic) receiver module receives GNSS signals from all orbiting GNSS constellations. A greater number of visible satellites improves positioning performance in partially obstructed conditions, while increased satellite signal diversity delivers faster convergence times when signals are interrupted.

Inertial sensors integrated into the module constantly monitor changes in the moving vehicle’s trajectory and continue to deliver lane-accurate positioning when satellite signals are partially or completely obstructed, as is the case when the vehicle is in parking garages, tunnels, urban canyons or forested areas. When satellite signals become available again, the module combines inertial sensor data with GNSS signals to deliver fast convergence times and high availability.

By providing lane-accurate position information, the ZED F9K meets the needs of ADAS and autonomous driving applications, as well as head units and advanced navigation systems. The module’s accuracy and low latency also makes it ideal for automotive OEMs and Tier 1 customers developing V2X (vehicle to everything) communication systems. By continuously sharing their location with other traffic participants, these V2X systems contribute to increasing overall road safety and reducing traffic congestion.

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

Multi-constellation GNSS module

Telit’s new GE310-GNSS is an IoT (Internet of Things) module with GSM/GPRS, multi-constellation satellite positioning and Bluetooth functionality, packaged in a 270 mm² form factor.

The module enables original equipment manufacturers (OEMs) and system integrators in application areas such as asset management, utilities and telematics to meet demand for low-cost, highly compact devices, particularly in regional markets where 2G is forecast to maintain strong growth in terms of the number of IoT connections for many years.

The GE310-GNSS features a miniature form factor packaged in an LGA 94-round-pad format. It is optimised for compact devices such as health and wellness monitors, smart residential and commercial thermostats, commercial fleets, and IoT-connected grid equipment for smart utilities.

With support for Europe’s Galileo as well as other satellite positioning constellations, it is ideal for applications that require location awareness, while its Bluetooth 4.0 capability makes it easy for OEMs to add connectivity to proximal area network devices.

For more information contact Renaldo Fibiger, Altron Arrow, +27 11 923 9600, rdfibiger@arrow.altech.co.za
Half the power of existing Wi-Fi options: The combination of industry-leading transmit current (TX: 138 mA), receive current (RX: 48 mA) and sleep current (<40 µA) enables significant power-saving advantages for all IoT use cases. High throughput and fewer retransmissions help minimise power consumption by using less channel capacity.

The WGM160P module expands design possibilities and offers an easier way to create cloud-connected IoT products by combining an on-board Gecko microcontroller, host support, integrated antenna, precertification, large memory (2 MB Flash and 512 KB RAM), and extensive peripheral capabilities including Ethernet and capacitive touch.

The WFM200 module is the smallest pre-certified Wi-Fi system-in-package (SiP) device with an integrated antenna, making it a perfect fit for space-constrained designs. The module also opens up new industrial and outdoor applications with 105°C temperature support.

The WF200 transceiver IC provides a cost-effective way to add Wi-Fi to existing high-volume designs, works well with a variety of hosts (ranging from 8-bit to Linux-class processors) and supports antenna diversity.

Silicon Labs has introduced the next generation of its Wireless Gecko platform, Series 2, designed to make Internet of Things (IoT) products more powerful, efficient and reliable. Building on the leading RF and multiprotocol capabilities of the Wireless Gecko portfolio, Series 2 delivers the industry’s most versatile and scalable IoT connectivity platform. The initial Series 2 products include small-form-factor system-on-chip (SoC) devices with a dedicated security core and an on-chip radio delivering 2.5 times the wireless range of competing solutions.

The first products in Silicon Labs’ Series 2 portfolio include EFR32MG21 SoCs supporting multiprotocol, Zigbee, Thread and Bluetooth mesh networking, and EFR32BG21 SoCs dedicated to Bluetooth Low Energy and Bluetooth mesh. These SoCs provide ideal solutions for line-powered IoT products including gateways, hubs, lights, voice assistants and smart electric meters.


As the IoT expands an increasing range of products are benefiting from Bluetooth and Wi-Fi connectivity. Adding wireless connectivity to a product, however, can take significant resources and expertise. With Silicon Labs’ Wireless Xpress Bluetooth 5 and Wi-Fi modules, designers can reduce complexity and speed time-to-market through a configuration-based development experience. With on-board wireless stacks controlled through a high-level Xpress Command API for setup and control, Wireless Xpress devices require only modest resources from a host processor, enabling developers to add wireless connectivity to any microcontroller (MCU).

https://www.silabs.com/products/wireless/xpress

https://www.silabs.com/products/wireless/wi-fi

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Quectel's EG91 is a series of LTE category 1 modules optimised specially for M2M and IoT applications. It features cost-effective and low-power LTE connectivity, and delivers M2M-optimised speeds of 10 Mbps downlink and 5 Mbps uplink. These make EG91 an ideal solution for numerous IoT applications that are not reliant on high-speed connectivity but still require the longevity and reliability of LTE networks.

https://www.quectel.com/product/eg91.htm

Quectel's Cat.M1/NB1 & EGPRS module BG96 is a series of LTE Cat M1/Cat NB1/EGPRS modules offering a maximum data rate of 375 Kbps downlink and 375 Kbps uplink. It features ultra-low-power consumption, and provides pin-to-pin compatibility with Quectel's LTE module EG91/EG95, Cat NB1 (NB-IoT) module BC95, UMTS/HSPA module UG95/UG96 and GSM/GPRS module M95.

https://www.quectel.com/product/bg96.htm
Passive RFID using UHF delivers long-range benefits in the IoT

By Costica Dima, technical marketing manager - RFID, Avnet Silica.

For consumers, the impact of the IoT may be summarised as greater convenience. We have grown to expect certain things to happen ‘automatically’, without knowing how, and the IoT will accelerate and expand that.

For example, many people now use contactless payment, something that is enabled by short-range RF communications between a payment terminal and a bank card, mobile phone or smart watch equipped with the same technology. This avoids the need to physically insert a card into the payment terminal and enter a PIN; on the face of it, it may seem like a small thing, but as anyone who uses it regularly will appreciate, it can significantly speed up the purchasing process.

RF technology has the potential to change many more aspects of modern life. One of the most established forms of RF communication used in the IoT is RFID technology, and research shows that its adoption amongst retailers to tag clothing is set to increase massively before the end of the century. Tagging items allows them to be identified by a payment terminal as soon as they are presented, making the customer’s purchasing experience even more convenient.

RFID technology has been around for many years and its use in the IoT is entirely synergistic. Because each RFID device has a unique identity, it can be used to identify practically anything. When the reader is part of a connected system, it enables almost unlimited potential for new applications. Recently, the introduction of ultra-high frequency (UHF) RFID technology has further extended that potential.

UHF RFID

RFID is a contactless technology that can operate over a range from a few centimetres to several metres, using frequencies of 120 to 150 kHz (low frequency, or LF), 13.56 MHz (high frequency, or HF) and 860 to 960 MHz (ultra-high frequency, or UHF).

Most of the existing applications (such as identification, access control and payment) use passive devices; that is, the RFID device does not have its own power source, such as a primary cell. This is the primary feature of RFID devices and, in general, devices in the LF and HF frequency ranges receive their power through inductive coupling (or near-field), while UHF devices use electromagnetic wave (or far-field) propagation.

Standards organisations are actively developing the standards necessary to make RFID more widely deployable, which includes ISO and IEC as well as EPC Global; in 2009, ISO/IEC integrated UHF EPC Gen 2 into ISO 18000-6 as Mode C. RFID UHF bands vary in different countries and include frequencies between 860 MHz and 960 MHz (EPC global standard).

The most important characteristic in RFID system performance is range, or the maximum distance over which an RFID reader can either read information from, or write information to, the tag. Tag range is defined in terms of a successful read/write rate, expressed as a percentage. The rate will vary with distance, but it also depends on the RFID reader’s characteristics and how the operating environment affects the propagation of the signal.

In general, read and write ranges are different due to the different amounts of power required by the transponder chip for each of these operations. The main challenges involved with developing and operating a UHF RFID system reside in the reader and the passive tag, as outlined below.

Tag limitations

The most important tag limitation is the chip sensitivity threshold. This is the minimum amount of received RF energy that is needed in order to power the RFID chip.

- Antenna gain.
- Antenna polarisation. For maximum range this must be matched between the tag and the reader antenna.
- Impedance matching between the antenna and the RFID chip.

Reader limitations

- EIRP (equivalent isotropic radiated power). This determines the power of the signal transmitted by the reader in the direction of the tag.
- Reader sensitivity. This is usually defined with respect to a certain signal-to-noise ratio or error probability at the receiver.

In general, the range of passive UHF RFID systems is limited by factors such as the tag characteristics, the propagation environment and the RFID reader parameters. Typically, if reader sensitivity is high then the tag limitations prevail. However, tag range can be maximised by designing a high-gain antenna that is well matched to the chip impedance.

UHF RFID in the IoT

In order to support the use of UHF RFID as an IoT solution, a global alliance was formed in 2014 by Google, Intel, Impinj, Smartrac and AIM (the industry association representing the automatic identification industry). It now has over 160 members, including NXP Semiconductors.

Marketed as RAIN RFID, it has adopted the EPC Gen 2 specification, as incorporated into the ISO/IEC 18000-63 standard. If a solution is referred to as RAIN RFID, it will be using UHF RFID technology that complies with this standard and the alliance’s goals.

UCODE DNA makes toll roads simpler

Toll roads are becoming more common across regions including Europe, providing a solution to congestion through charges that help expand and maintain the transport infrastructure. Collecting tolls can often require the driver to slow down, but using UHF RFID it is possible to make the process transparent.

By working together, Avnet Silica, systems integrator Kathrein Solutions, and vehicle identification specialist Tönjes successfully developed a system that can identify individual vehicles travelling on a motorway at a range of 20 metres and speeds of up to 250 km/h. As such, the technology can be mounted in gantries over the motorway and collect data completely unobtrusively. This can be more reliable and carry a lower total cost of ownership than an image-based approach using cameras and vehicle registration recognition algorithms.

The system brings together the RRU 4500 UHF RAIN RFID reader unit developed by Kathrein, with the IDEPLATE and IDESTIX from Tönjes, which is also RAIN RFID compliant and enabled by the ‘UCODE DNA’ UHF RFID integrated solution developed by NXP.

The IDEPLATE is a number plate which replaces the vehicle’s existing plate, and contains the passive UHF RFID chip, while the IDESTIX contains the same technology housed in a simple label that is attached to the inside of the vehicle’s windscreen.

RFID revolutionises car rental

Using RFID technology to locate assets can streamline processes, including car rental. By implementing RFID in its rental vehicles, Sixt has reduced the amount of time it takes to locate keys for rental customers, but in addition it can now offer more precise time stamps on vehicle returns, more easily track a returned vehicle through its booking system, and more quickly unite a customer with their rental.

With 2200 branches worldwide and over 144 000 vehicles in its fleet, adding RFID has changed the way Sixt operates, reducing the average wait for customers picking up the keys to their rental vehicle from 3 minutes to just 20 seconds. As many branches are located in airports, servicing upwards of 600 rentals per day, this represents a significant improvement to the customer experience.
RFID and security

Every conversation about the IoT must also acknowledge the need for security in a more connected world. RFID is no exception, and as the technology has evolved it has introduced greater levels of security in terms of authentication and cryptography. The latest iteration of NXP’s UHF RFID technology, available through Avnet Silica, is UCODE DNA.

It adds high levels of security to its existing long-range UCODE UHF RFID portfolio, combining all the functionality and security into a single IC. It adds two 128-bit AES keys securely stored on the chip, that are used by the on-chip AES accelerator for cryptographic authentication. The keys are stored in an area of memory that is locked at production; the keys can be generated by NXP or by the customer, and are typically used for tag authentication and tag group authentication.

For more information contact Avnet South Africa, +27 11 319 8600, sales@avnet.co.za

Waveguide antennas for millimetre-wave

Pasternack has released a new line of waveguide antennas designed to address R&D, military/aerospace, experimental radar, test and measurement, and wireless communication applications from 40 GHz to 220 GHz.

The new range of millimetre-wave waveguide antennas consist of 85 new models that cover broad frequency ranges of 40 to 220 GHz, feature waveguide sizes ranging from WR5 to WR19, and offer gain ranging from 3.5 dBi to 25 dBi nominal.

Five categories are now available to address point-to-point and point-to-multipoint wireless applications including standard gain horn antennas to 220 GHz, conical gain horn antennas to 220 GHz, wide angle scalar feed horn antennas to 99 GHz, horn lens and omnidirectional antennas up to 99 GHz. All antennas in this series are RoHS and REACH compliant and are constructed with the highest quality materials and workmanship.

The new antennas are in stock and ready for immediate shipment with no minimum order quantity.

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

Sigfox-connected remote switch

Telemecanique Sensors offers a wireless solution to collect data from remote equipment and use this data, via the Internet, on a PC or mobile device. The XIOT cloud-connected switch (model XIOT11SESMRCL) is based on LPWAN (low-power wide-area network) technology, operated by Sigfox.

The rugged, standalone device uses antennas with a range of around 50 km and can operate for up to 10 years. When the contacts on a switch installed on a site change state, the transmitter sends a message to the IoT network, which is then routed to secure servers. This message is then delivered to one or more recipients as an alert on PC, tablet or smartphone.

Targeted applications include areas without electricity or which are difficult to access, such as agriculture, mining, oil and gas, and utilities.

For more information contact Electrocomp Express, 0860 10 20 20, sales@eexpress.co.za
Replacing the magnetron with solid-state devices in microwave ovens

Microwave ovens are much-used appliances in many kitchens today. Used not only for cooking food from frozen but also for reheating last night’s curry or the cup of coffee you left to go cold, they provide a compact, quick and convenient method of defrosting and heating all manner of food and drinks.

Despite cosmetic enhancements such as replacing a mechanical clockwork timer with a touchscreen display, they appear largely the same as when they were first introduced back in the early 1950s. Not much has changed on the inside, either: the magnetron, now a 70-year-old technology, is still the primary energy source.

Over the years we have all suffered and learned to live with the limitations of using a magnetron as the energy source. Capable only of operating at full power and nothing else, it has been down to human ingenuity to improve its overall cooking performance and make it appear capable of operating at different power levels.

Without doubt the most frustrating aspect of heating food, either when cooking or defrosting, is the annoying hot spots the magnetron produces in the item being heated. This is purely a product of the frequency used, typically 2.45 GHz, and its phasing within the microwave’s cavity. Achieving uniformity of heating is probably the most annoying aspect of using a microwave oven, with some parts of the food typically being over-cooked and others under-cooked.

The use of ‘stirrers’ within the waveguide to the cavity, and a rotating base or ‘turntable’ have been moderately successful in distributing the energy around the cavity to provide a more uniform pattern. Providing different power output levels has been achieved by controlling the on/off duty cycle of the power to the magnetron.

For example, an 800 W oven, when operating at 100 W, will most like deliver the full 800 W for roughly 8 seconds and then remain off for 52 seconds before repeating. Heating large items of food also relies on thermal conduction, so the heating cycle needs to be long enough for that to happen and for the core to be heated to a hygienic and safe level.

Another aspect of the magnetron is that its microwave energy output degrades over time, with most of them losing as much as 30% of power output over a period of four years. In the home, most users do not notice this; however, for industrial food manufacturing processes this requires a regular replacement regime to be in place.

Replacing the magnetron with solid-state power transistors and the associated process technologies of LDMOS and GaN have made this possible.

Magnetrons were able to accommodate large amounts of reflected power resulting from a mismatched ‘open’ cavity with dynamically changing load patterns as food changed state from uncooked (whether frozen or ambient) to cooked. By comparison, solid-state semiconductors were previously not robust enough to operate in this way, only operating with a matched load giving a voltage standing wave ratio (VSWR) approaching 1:1.

The semiconductor approach enables precise linear control of output power (amplitude) and frequency through digital circuitry. Also, rather than having just one output port as with a magnetron, multiple outputs or antennas can be used. This then permits control of the phasing between each output, and in so doing, helps with eliminating the hot spots during heating.

A digital control can also be used to detect the type of food to be cooked, by measuring the reflected energy, with this changing as food changes composition during heating. It is also possible, through phasing and frequency, to direct more energy to certain areas than others, opening up the possibility of heating, say, a chicken breast on the same plate as some mangetout, with both being cooked to perfection.

Such control allows more delicate foods to be cooked so that they retain moisture and nutrition, ensuring they remain tasty and healthy. In this way control sequences can be developed for popular meal types, and this concept is already gaining interest from manufacturers of prepared ready meals.

For example, Goji Food Solutions has pioneered the design of RF solid-state ovens that first scan the food in the oven to determine its volumetric and moisture properties before starting the cooking process. The oven then continues to monitor the food during cooking, adjusting amplitude, frequency and phase as necessary to achieve the best results.

When it comes to designing a solid-state oven, Figure 1 shows the principal components. Typically there will be two or four separate RF paths and antennas, with this approach giving most flexibility in terms of managing amplitude, frequency and phase. For a 1 kW oven, four 250 W outputs would be required.

This can easily be achieved through the use of four final-stage RF power transistors, such as...
the NXP MRF24300N device. Each transistor has a peak power output of 320 W when operating from a 32 V d.c. supply at 2450 MHz, and provides a 13 dB gain. Not only are such transistors considerably smaller than a magnetron, but they can also operate from relatively low voltages. By comparison a magnetron is bulky, heavy and requires a 3 kV supply, something that alone requires considerable space and isolation from other components.

To speed the process of prototyping a solid-state oven design, NXP has recently launched a series of development tools. These include the RFEL-500, a complete RF cooking lab in a single unit; the RFEM24-250, a single-channel 250 W output module; and the RFEP24-300, a 300 W pallet. All three units use the abovementioned MRF24300N RF power transistor in the final stage.

Comprised of two RFEM24-250 250 W RF modules, PC-based GUI software and data-logging capabilities, the RFEL24-500 – see Figure 2 – measures 33 x 43 x 13 cm and is a fully integrated fan-cooled RF development system for RF-based heating and cooking applications.

Capable of operating into unlimited VSWR loads, delivering up to 250 W per channel in the 2400 to 2500 MHz range, the NXP RF Energy Lab is ideal for both RF and non-RF engineers to test and prototype their oven concepts. Control is achieved by a USB to I²C interface to the two RF modules. The software provides complete control of the amplitude, frequency and phase of each output, in addition to featuring a frequency and phase-sweep function that helps with determining the best parameters to maximise energy transfer.

The RFEM24-500 – see Figure 3 – is a complete 250 W, 2,45 GHz RF subsystem. It features the signal source together with a three-stage RF amplifier, a Kinetis KW40 microcontroller, RF circulator and a 300 W termination load. The three-stage amplifier comprises an NXP MMA25312B, an NXP MHT1008N and an NXP MRF24300N. The RF circulator is a special RF component that serves to isolate the final-stage RF power transistor from reflected signals.

Output applied to port 1 appears at port 2, whereas anything applied to port 2 goes to port 3. In this case port 1 is attached to the RF output from the final stage via a coupler, port 2 is attached to the output socket (for connection to the oven cavity) and port 3 is attached to the 300 W on-board termination. Reflected signals coming back from the oven cavity end up being sensed for amplitude and terminated.

Figure 4 details the module inside the shielding and external heatsinks. Note the RF circulator at top right. Up to four RFEM24-500 modules can be synced up together. A suitable 30 to 32 V/500 W power supply is required, together with a means of cooling the module – typically thermostatically controlled fans and heatsinks.

For more information contact TRX Electronics, authorised Mouser independent representative in South Africa, +27 12 997 0509, info@trxe.com
Customers frequently ask me whether or not it is necessary for Otto Wireless Solutions, as the distributor of wireless products, to apply for and receive ICASA approval specifically for wireless modules, prior to selling them.

There are a lot of common misperceptions in the electronics design industry concerning this subject. Increasingly, I have heard this line from customers: “But I thought you (the supplier, Otto Wireless) don’t need to have ICASA approval on the modules, because I have to get ICASA approval on my finished product anyway.” So is this true? Does this statement hold water? Could we as Otto Wireless Solutions be wasting time and money by diligently acquiring ICASA approval for every product we sell?

Prior to looking for an official response, let me perhaps make our position clear: as a company, it is not only about ICASA. We strive to provide high-quality products to our customers, who can make use of any product we sell to them with absolute peace of mind, because what we have supplied is not only type approved, but has the local backing and technical expertise of a responsible company, invests in local testing and approval, and employs staff capable of providing technical support. When customers come to Otto Wireless Solutions, they know exactly what they are paying for, and accordingly, over time we earn the trust of our clients.

What does the law say about this? ICASA stands for Independent Communications Authority of South Africa. It is a regulatory body set up to regulate and enforce the Communications Act. Therefore, if one is uncertain, one can consult the Communications Act of 1996, which can be downloaded from various government websites.

The Act itself was set up with a number of specific agendas in mind, one of which was to make provision for the regulation of telecommunication activities other than broadcasting, and for the control of the radio frequency spectrum. Any supplier or customer who finds themselves unsure of whether or not they have an obligation to acquire ICASA approval, can simply download the Act, and review the opening clause of chapter VI, section 56 (1) which states: No person shall supply telecommunication facilities or equipment unless, subject to subsection (2), he or she has been registered by the Authority.

The definition of “equipment” may, at the outset, seem somewhat vague, but if one consults section 54, it explains that the Authority may prescribe what “equipment” entails. In summary, the need to ensure that GSM, LoRA, Wi-Fi and other RF modules which we sell are ICASA approved, is prescribed by law.

Once I explain the above to customers, they then sometimes fall back on argument number two, and this question is: “But if you as Otto Wireless Solutions have ICASA approval on device XYZ, then the product is approved and I can purchase from any supplier.”

This is also a misperception. The Act mentioned above is clear that it is both the certificate holder and the equipment which are ICASA approved. Secondly, the ICASA approval certificate lists the company name on the certificate, ensuring that both the device and the certificate holder are approved.

Lastly, the ICASA type approval certificate is double sided, and on the back it spells out the standard conditions, which oblige the holder of the type approval to notify ICASA of changes to the product, but also makes it clear that the certification itself is not transferable (see clause 1.5): This type approval certificate is not transferable and the holder shall not transfer it to any other person or entity, nor surrender it in any way in favour of another, except with the written approval of ICASA.

It is very clear that an ICASA type approval is valid only when purchasing from the certificate holder.

Which brings me to the underlying concern which some customers have expressed: does this mean that when we supply our ICASA approved (for example) LoRa module to a customer, and they design it into their application, is our ICASA approval null and void? Of course the device itself remains approved, but this approval does not carry forward to include the customer’s final product.

Once the customer has taken a product and used it in their application, it is the customer’s responsibility to have their final product ICASA approved. This is necessary because a client may have, for example, inadvertently amplified the device’s performance, or their product may, in some other ways, be operating outside of safety specifications.

This makes it necessary for clients to have their final products approved, regardless of whether or not they have decided to purchase an ICASA approved module.

So there is a benefit in purchasing ICASA approved modules. The benefit is in knowing one has purchased a product which is operating within ICASA’s type approval limitations. When submitting a final product for testing, which integrates the approved module into a design, the ICASA approval of the module can be put on the table, often mitigating the level of testing which needs to be carried out, and subsequently reducing the cost of product approval tests. If the final product is found to be failing EMC emissions, the module itself can be excluded as a potential cause of noise, because it operates within known and acceptable emission parameters.

In conclusion, when selecting a wireless module, purchasing an ICASA approved device or module from the approved supplier is critical. Not only does this start the design off with peace of mind, but in the long run it can very well save you valuable time and money.

For more information contact Otto Wireless Solutions, +27 11 791 1033, chris@otto.co.za

Chris Viveiros.
Using a COTS-based SDR platform for streamlined 5G development

Commercial-off-the-shelf (COTS) software defined radio (SDR) products have traditionally been used for military radar and communication applications because of their high performance and design flexibility.

The latest SDR products offer solutions with integrated I/O, ARM processors, and large FPGAs that include intellectual property (IP) for accessing, routing and processing digital data.

Combining these attributes with superior signal integrity, phase-coherent sampling and multi-channel transceivers, a COTS SDR system is an ideal choice for a 5G development platform. This article is intended to familiarise a new user with software defined radio in a multi-purpose COTS platform that can reduce the time to market of 5G products.

Each section of this article is divided into hardware, firmware and software sub-sections for additional clarity. The hardware section is the SDR printed circuit board (PCB) including components; firmware is internal FPGA code to create a logic design and implement digital signal processing (DSP) functions; and software is C code to control an FPGA with firmware and to perform any additional DSP functions.

**COTS SDR defined**

**Hardware**

SDR replaces legacy analog systems that consisted of an RF filter, analog down-converter (LO + mixer), bandpass filters and a demodulator (see Figure 1a). These fixed analog systems were limited to a specific platform like AM or FM radio, and needed to be replaced if another platform was required.

The primary function of SDR is to exploit digital signal processing techniques to support the ever-increasing complexity, precision and bandwidth of today’s radio traffic. Suitable data conversion is required between the antenna signals and the DSP operations for both receive and transmit functions.

An SDR receiver converts an RF signal from an antenna into digital samples with an A/D converter and uses subsequent DSP operations to extract the required information from the signal (see Figure 1b).

An SDR transmitter accepts digital information to be transmitted and then performs the necessary DSP operations to produce digital samples for a D/A converter, whose analog output signal drives a power amplifier (PA) for delivery to the antenna (see Figure 1c).

Because these radios are software defined, they can be programmed on-the-fly with new parameters in microseconds, or reconfigured for many different purposes by simply loading a new firmware image from internal or external memory.

An SDR is often implemented on a specialised PCB board called a mezzanine card. The current generation of these cards is a switched-fabric mezzanine card, an XMC or an FPGA mezzanine card (FMC). Figure 2 contains an image of an XMC and FMC mezzanine card with the corresponding functional block diagram to the right. Image A is an XMC card with four 200 MHz A/D channels, and image B is an FMC card with two 3,0 GHz A/D channels, and two 2,8 GHz D/A channels.

Each SDR board includes a precision timing system with a multi-bit, fractional synthesiser for variable sampling rates locked to an onboard OCXO, or a reference input signal (see Figure 2, page 20). These timing systems usually accept external synchronisation signals from a network time protocol (NTP) server or GPS receiver for the highly precise timing requirements of a radar or cellular system. The precision is also required for phase coherent sampling of the A/Ds, FPGA DSP data synchronisation, and D/A signal transmission.

The XMC example A/D has a 200 MSps maximum sampling rate that can capture a 100 MHz Nyquist bandwidth excluding filtering. A common technique with digital radio is to acquire channel information, or intermediate frequency (IF) bandwidth, by under-sampling the signal. Figure 3 (page 20) and its accompanying text explain the ‘fan-fold’ concept using multiple Nyquist zones.

**Firmware**

An FPGA consists of unconnected logical, arithmetic and signal processing building blocks that must be configured with firmware (IP) for operation. This is ideal for extreme programming flexibility, but complex because it requires development of the firmware. Some COTS SDR manufacturers provide FPGA IP for basic operation of their board to simplify the development process. This usually includes analog and digital I/O functions for acquiring and transmitting data, along with DSP IP for specific radio functions like DDCs, filters, channelisers and engines to transfer data to the system.

The DDC function requires three IP building blocks: the numerically controlled oscillator (NCO) local oscillator, a complex mixer, and digital filters to replace those functions of the legacy analog radio system (see Figure 1a, 1b). Figure 1b is a functional block diagram of the SDR with the DDC. The tuning stage of this
Theory sidebar: Nyquist zone sampling

1) The word ‘bandwidth’ is highlighted in the Nyquist theorem below to distinguish it from frequency when explaining the concept of undersampling.

2) Traditional fan-fold printer paper illustrates the location of Nyquist zones, which are defined as multiples of half the sampling frequency, \( f_s \). In our XMC example \( f_s = 200 \) MHz, and \( f_s/2 = 100 \) MHz, so successive Nyquist zones occur every 100 MHz.

3) All signal energy must fall within one Nyquist zone to satisfy both the bandwidth and frequency requirements of the Nyquist theorem. This example of a wideband signal shown in red crosses multiple zones and violates the single-zone rule.

4) To illustrate the result of sampling this signal, collapse the fan-fold paper and backlight it. All the signal energy above \( f_s/2 \) is aliased into the first zone. This can be corrected by using a low-pass filter to remove all signal energy above \( f_s/2 \).

5) Another example is a narrowband signal that falls entirely within Nyquist zone 4 (between 300 MHz and 400 MHz in this case). The signal can be properly sampled using a suitable bandpass filter that eliminates signal energy from all other zones.

6) Although the signal frequency is > \( f_s/2 \), all the energy is contained within one zone, satisfying the Nyquist theorem. Sampling above Zone 1 is called ‘under-sampling’.

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Figure 2. SDR implementation using mezzanine cards.

Figure 3. Nyquist zone sampling.
Under-sampling allows an A/D with a lower sample rate and higher dynamic range to capture a narrow bandwidth signal centred at a higher frequency without loss of information. In order for this to work correctly, the RF input path and the A/D must accommodate these higher-frequency signals. Our previous 200 MHz A/D example requires an A/C transformer with a higher than 400 MHz passband and adequate bandpass filtering (BPF) to reduce noise and additional harmonics from all Nyquist zones, excluding the fourth.

After meeting the Nyquist criterion for A/D sampling, the next stage is typically the digital down-converter (DDC). The DDC is often implemented as IP firmware within the FPGA. It performs frequency translation and bandwidth reduction as described in detail in the next section.

Software
Depending upon the application, the vendor-provided FPGA IP might meet the application specifications, but requires controlling software to operate the radio. The FPGA IP needs operational parameters sent across the system interface from a software program. This is the function of a board support package (BSP), normally written as C programming language callable routines for a Windows or Linux OS environment. The BSP contains library functions and pre-compiled example code that can be executed to test board functionality.

An example case for SDR is commanding the A/D to capture and transfer data to the FPGA for further processing in the DDC. This processed data can be stored to memory or transferred to the D/A section for conversion back to an analog signal and output for transmission. This is an example of a software program developed using the BSP software library functions and drivers. If any new FPGA IP is created by the user, then additional control software must be written for inclusion in the BSP package.

The latest COTS SDR technology
Hardware
Over the past 10 years, FPGA manufacturers like Xilinx have been improving technology by reducing the silicon fabrication structure size, and as a result the device size, weight and power (SWaP) values were reduced. In late 2008 the Xilinx Virtex-6 family was constructed using a 40 nm process, and had an average 2000 DSP slices per FPGA.

By 2017 the Ultrascale family used a 20 nm process and the FPGA DSP slices had increased to approximately 5,5 K. The latest system-on-chip (SoC) device from Xilinx, the RFSoC, consists of FPGA fabric with ARM processors, A/Ds and D/As, all on the same chip. The 16 nm technology has over 4,2 K DSP slices, four 1,5 GHz A53 ARM processors, two 600 MHz RS ARM processors, eight 4 GHz, 12-bit A/Ds, and eight 6,4 GHz, 14-bit D/As per device. This game-changing technology can be used by COTS manufacturers to provide multi-channel SDR transceivers for engineers developing 5G radio products.

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Figure 4 is a functional block diagram of one COTS implementation of the Xilinx RFSoC and is the central component of the 5950 3U VPX board from Pentek. The grey area is a fully connectorised RFSoC or system-on-module (SoM) that plugs into the 3U VPX carrier. This device can be controlled via the Gigabit Ethernet port similar to the previous generation FPGA, but the on-board ARM processors allow autonomous operation and the ability to communicate with or control devices locally, or on an external network.
**Firmware**

Previous generation FPGAs were programmed using a textual hardware description language (HDL) like VeriLog or VHDL. The latest AXI4 compliant IP blocks are included in Vivado from Xilinx. The IP Integrator tool from Xilinx has virtual graphical blocks that represent HDL code, which can be connected to one another via drag-and-drop wiring.

Figure 5 shows VHDL code on the left in contrast to the graphical block representation on the right. This more intuitive way to program allows someone new to FPGAs to wire together logical blocks that represent hardware like FIR filters and DDCs to create an SDR. This programming method supports fast integration of vendor-supplied, hardware-specific IP blocks with Xilinx IP blocks to create a working SDR system. Both IP block types can be combined to create a common library.

**Software**

These IP programming advances provided an opportunity for COTS vendors to create a single BSP module that corresponds to one IP module with all the necessary FPGA program parameters in one location. An example would be a clock control BSP module that corresponds directly to a clock control IP module.

**5G application specific example**

Figure 6 illustrates the difference between a distributed and centralised radio area network (D-RAN and C-RAN). The traditional D-RAN cell sites were initially being replaced by newer C-RANs to improve data transfer efficiency and reduce radio costs, but the latest 5G millimetre-wave massive MIMO applications require the separation to move the remote radio head (RRH) closer to the end user because of increased RF path loss.

Figure 7 is a functional block diagram of a C-RAN consisting of a base-band unit (BBU), RRH, GPS time and frequency reference, and an interconnect module. The selections in blue are possible COTS SDR locations. The BBU is located at a central office, or is a virtual network (the ‘cloud’) with access to multiple optical data lines for back-haul, and the RRH is in an external location closer to the end user.

The BBU and the RRH in this front-haul connection example can use a common public radio interface (CPRI), Open Base Station Architecture Initiative (OBSAI), or standard Ethernet depending upon system requirements. New front-haul concepts like extensible radio access networks (xRAN) and open radio access networks (oRAN) will be replacing these legacy interfaces in the future.

These various transfer mode options, combined with legacy cellular, 5G TF (Verizon specification), or the 3GPP 5G NR (New Radio) can be configured to form a complex heterogeneous network that will require a flexible development platform.

By way of example, consider a very simplified version of the process behind a cellular phone call: a user equipment (UE) signal is received by the LNA via the antenna in the RRH. This RF signal is then filtered and adjusted for gain before input to the A/D. The digitised I/Q sample data from the A/D is packetised in the digital radio for front-haul transport to the BBU via a radio data switch. The packetised data is converted into a bit-stream for FFT, MIMO algorithm, demodulation and channel coding.

This data is then managed by the internal transport switch, and re-packetised for back-haul transport to the main cellular network for identification and further processing. If a phone call is in progress, the user data will be sent out to another RRH using a CPRI, or Ethernet protocol over fibre for OTA transmission to the other party by the reverse process.

**Hardware**

Figure 8 is an example COTS SDR board used to emulate an RRH in a C-RAN system. A sub-section of the original C-RAN with the RRH is pictured on the left side of the figure and the COTS SDR RRH to the right. The blue encircled areas are equivalent.

The custom modular carrier card (light green area) contains Rx and Tx amplifiers, a
GPS receiver and an O/E transceiver module. The SoM (grey area) contains the RFSoC and all the connections for power management, data storage, and analog and digital I/O.

The incoming RF signal from the antenna is connected to the Rx LNA via a duplexer, isolating it from high power amplifier (PA) transmit levels, and connecting it to one A/D channel. This SoM and custom carrier combination can emulate the original RRH provided it has the necessary IP described in the next section.

**Firmware**

Once inside the FPGA fabric, the digital samples are decimated, frequency selected, or tuned, and filtered in the DDC. The DDC output samples can be streamed to the power meter module for measurement, and sorted in the threshold detector IP module.

These processed samples can be streamed to the ARM processors for crest factor reduction and digital pre-distortion routines before being up-converted in the DUC for re-transmission. The DUC is the reverse of the DDC using frequency translation, and interpolation instead of decimation.

The digitised I/Q sample data is packetised in the digital radio for transport to the BBU via a radio data switch, as in the sidebar description of a cellular phone call. Because of the variety of channels and data transfer protocols, it is necessary to calculate the maximum data throughput of your signal.

Ignoring encoding variations, an RRH with two antennas and a 5 MHz LTE channel bandwidth will have the following data transfer requirements:

- The 5 MHz channel requires at least 10 MHz sampling, or 10 MSps, to capture the information. There are two Bytes per 16-bit sample and two samples for I and Q.
- $SR_{max}$ (maximum sampling rate) = 5 MSps x 2 Bytes/sample x 2 for I and Q = 20 MBps x 8 bits/Byte = 160 Mbps per antenna.
- Two antenna inputs $= 160$ Mbps x 2 = 320 Mbps of data throughput and no issue for a CPRI port with a 10 to 25 Gbps capacity.

By comparison, a new 5G link with a 100 MHz channel and 8 antenna inputs increases the data transfer requirement to around 52 Gbps, requiring multiple CPRI ports.

**Software**

Depending upon the desired level of control, either BSP routines need to be created for the new IP and ARM processors, or the ARM processors in conjunction with the FPGA can be programmed to operate autonomously.

**Conclusion**

The purpose of this article was to familiarise a traditional radio engineer with the latest hardware, firmware, software and design tools available from COTS vendors to create an SDR system that can be used for a 5G development platform. These SDR platforms provide superior signal integrity performance, high test repeatability and modular assemblies that adjust to constantly changing 5G design requirements.

Future 5G implementations will require many development platforms for experimentation, and the use of a COTS system as a starting point will ensure an accelerated time-to-market.

For more information contact Rugged Interconnect Technologies, +27 21 975 8894, sales@ri-tech.co.za
Dual- and single-core DSCs

New dual- and single-core dsPIC33C digital signal controllers (DSCs) have been released by Microchip Technology, with more options to meet changing application requirements across memory, temperature and functional safety.

The aim is to help system developers to design high-end embedded control applications which need flexible options to provide scalability as projects increase in complexity.

The new dsPIC33CHS12MP508 enables support for applications with larger program memory requirements, while the dsPIC33CK64MP105 single-core DSC adds a cost-optimised version for applications that require smaller memory and footprint. Developers can scale across product lines using the new devices, which are pin-to-pin compatible within the dsPIC33CH and dsPIC33CK families.

The dsPIC33CHS12MP508 (MP5) family expands the recently introduced dsPIC33CH, with Flash memory growing from 128 KB to 512 KB, and triples the program RAM from 24 KB to 72 KB. This enables support for larger applications with multiple software stacks or larger program memory, such as automotive and wireless charging applications.

More memory is needed to accommodate AUTOSAR software, MCAL drivers and CAN FD peripherals in automotive applications. Implementing wireless charging in automotive applications requires additional software stacks for the Qi protocol and near-field communication (NFC), driving the need for even more program memory.

Using Live Update capability for real-time firmware updates is essential for high-availability systems but also doubles the overall memory requirement. In the dual-core devices, one core can function as a master while the other is designed as a slave. The slave core is useful for executing dedicated, time-critical control code while the master core is busy running the user interface, system monitoring and communications functions.

For example, having two cores facilitates partitioning of the software stacks for parallel execution of the Qi protocol and other functions such as NFC to optimise performance in automotive wireless charging applications. The dsPIC33CK64MP105 (MP1) family extends the recently introduced dsPIC33CK family with a cost-optimised version for smaller memory and footprint applications, offering up to 64 KB Flash memory and 28- to 48-pin packages. Package sizes are available as small as 4 x 4 mm. This compact device offers a beneficial combination of features for automotive sensors, motor control, high-density DC-DC applications or standalone Qi transmitters.

Both single- and dual-core dsPIC33C devices enable fast deterministic performance for time-critical control applications, providing expanded context selected registers to reduce interrupt latency and bringing faster instruction execution of math-intensive algorithms.

PMBus power modules

Renesas’ new encapsulated hybrid digital power modules offer high power density and efficiency for advanced FPGAs, DSPs, ASICs and memory. The ISL8210M and ISL8212M feature power density of 115 mA/mm² in a 12 x 11 mm package, with up to 95% peak efficiency.

Key features of the ISL828xM hybrid digital and ISL821xM analog power modules include 4.5 V to 16.5 V single-rail input voltage and 0.5 V to 5 V output voltage settings, ±1.5% output voltage accuracy over line, load and temperature, with remote sense and 256 output voltage options configurable through a simple pin-strap resistor setting.

Hybrid digital modules are SMBus²/²C/PMBus v1.3 compatible up to 1,25 MHz and they have seven switching frequency options from 300 kHz to 1 MHz. They have a selectable PFM/light-load efficiency mode and comprehensive fault protection for voltage, temperature and current.

For more information contact Shane Padayachee, Avnet South Africa, +27 11 319 8600, shane.padayachee@avnet.eu.
MPUs for open-source software-based designs

STMicroelectronics is applying its Arm Cortex expertise to expand the capabilities of its STM32 microcontroller (MCU) portfolio to applications requiring even more performance, resources and large open-source software. The introduction of the STM32MP1 multicore microprocessor series with compute and graphics support facilitates development of high-performance solutions for industrial, consumer, smart home, health and wellness applications.

STM32MP1 series microprocessor (MPU) products leverage the STM32 ecosystem from ST and its partners, including tools and technical support. Moreover, with the release of OpenSTLinux as a mainlined, open-source Linux distribution, it extends the STM32 family to address important customer requirements for real-time, power-constrained applications.

The flexible MPU architecture, which combines Arm Cortex-A and Cortex-M cores, performs fast processing and real-time tasks on a single chip, always optimised for power efficiency. For example, by stopping Cortex-A7 execution and running only from the more efficient Cortex-M4, power can typically be reduced to 25%. From this mode, going to standby further cuts power by 2 500 times, while still supporting the resumption of Linux execution in 1 to 3 seconds, depending on the application.

The STM32MP1 embeds a 3D graphics processor unit (GPU) to support human machine interface (HMI) displays, and supports a wide range of external DDR SDRAM and Flash memories. The chip integrates a large set of peripherals that can be allocated either to Cortex-A / Linux or Cortex-M / real-time activities.

To accelerate development, ST also released OpenSTLinux Distribution as a mainlined open-source Linux distribution. OpenSTLinux has already been reviewed and accepted by the Linux Foundation, Yocto project and Linaro. The distribution contains all the essential building blocks for running software on the application-processor cores. Enhanced STM32Cube tools, specially upgraded from the STM32Cube package for Cortex-M microcontrollers, can accelerate microprocessor development in terms of setting up MPU projects and configuring the on-chip resources.

The STM32MP1 series is available in a range of BGA packages. Two evaluation boards (STM32MP157A-EV1 and STM32MP157C-EV1) and two discovery kits (STM32MP157A-DK1 and STM32MP157C-DK2) are available.

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

MCUs for advanced security and physical protection

The new K32 microcontroller (MCU) series from NXP Semiconductors is optimised for energy efficiency in real-time embedded applications, and enables advanced security with physical tamper protection in a wide range of industrial and Internet of Things (IoT) applications. The power-efficient devices complement the recently launched performance-efficient LPC5500 MCU series.

Building upon the adoption of the Kinetics MCU platform, the K32 series targets energy efficiency for low duty-cycle applications with a wide operating voltage range, and ultra-low leakage power modes that support full SRAM retention and fast wake-up.

First to launch in the series is the K32 L3 family, a 72 MHz Arm Cortex M4-based MCU with an optional Cortex M0+. The device offers up to 1,25 MB Flash memory and 384 KB SRAM, with numerous serial communication interfaces, 12-bit 1 MSpS analog-to-digital converter (ADC), 10-bit digital-to-analog converter (DAC) and comparator, 32-bit PWM timer modules, and an external memory controller for flexible expansion.

The complete K32 L3 family is planned to support Flash sizes from 512 KB to 1,28 MB, but the full range is available for immediate development from the initial superset.

Other key features include: fast wake-up from 2 µA current with partial SRAM retention, and 7 µA current with full SRAM retention; and a single inductor, multiple output (SIMO) DC-DC converter to maximise energy efficiency, with the added flexibility to provide core power as well as two independent I/O rails, up to 1.8 V.

As little as 200 nA is consumed in always-on VBAT mode, with 32K low-power RTC oscillator and register retention and four tamper pins for physical tamper protection. The MCUs offer an uncompromised Root-of-Trust (RoT) with authenticated boot, encrypted firmware update and storage of public key hash in one-time programmable (OTP) memory. Hardware acceleration is provided for symmetric (AES-256, DES/3DES) and asymmetric (RSA 4096-bit public key, ECC) cryptography, along with SHA-256 hashing and true random number generator (TRNG) with 512 bits of entropy.

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

Time-to-digital converter

ams has introduced the AS6500, a new high-resolution time-to-digital converter (TDC) featuring CMOS inputs and compact packaging for use in space- and cost-constrained applications. It can measure time intervals as short as 5 ns with 10 ps precision.

The AS6500 is based on the existing ams TDC-GPX2, and offers resolution up to 10 ps on four channels and a sampling rate of up to 1,5 MSps. With high precision and a high sampling rate, light detection and ranging (LIDAR) and optical ranging systems in cars, drones and robots can make extremely detailed and accurate ranging measurements with a wide field of view, enabling them to perform accurate object detection and avoidance. In virtual- and augmented-reality applications, real-time 3D image rendering is supported by high sampling speeds and precision in one-centimetre detail.

The AS6500 is optimised for space, power and cost. Like the TDC-GPX2, it is an integrated four-channel converter IC offering single-measurement resolution of up to 20 ps RMS per channel in normal mode, and 20 ns pulse-to-pulse spacing. Operating in dual-channel high-resolution mode, it can achieve a maximum resolution of 10 ps RMS with 5 ns pulse-to-pulse spacing.

The AS6500 is housed in a new, smaller 40-lead QFN package with a footprint of just 6 x 6 mm, making it 56% smaller than the TDC-GPX2. Its highly integrated design, which includes a 2 MHz – 12,5 MHz reference clock input, means that few external components are required alongside the device.

Operating from a 3,3 V supply, the AS6500 typically consumes just 60 mW in normal operation, and draws 60 µA in standby mode. It supports CMOS interfaces from a host system, and provides its calibrated output as a digital signal over a standard serial peripheral interface (SPI), for easy data processing in a host controller or processor.

The AS6500 is ideal for optical applications including general-purpose laser distance measurement in 1D, 2D and 3D, speed control, vehicle/truck scanning, object recognition, time-of-flight spectroscopy, automated test equipment (ATE), biomedical technology and analytics.

ams supplies a development kit, the AS6500-QF_DK, which includes a programmer and GUI software for PCs, enabling users to configure and connect their start and stop signals and begin taking sample time measurements within minutes.

For more information contact Marian Ledgerwood, Future Electronics, +27 21 421 8292, marian.ledgerwood@futureelectronics.com
Designing PCBs for Mil Spec

In the field of electronics, Mil Spec – or Military Specification – has a very clear and understood meaning. It denotes equipment designed and made to exacting standards, in accordance with precise rules and regulations.

In the beginning – housekeeping
From the outset, it’s required that you keep careful notes on all meetings and discussions relating to the project. A project checklist is available from the IPC website – a great place to start.

The plans for the PCB need to be kept as the process unfolds and every little factor must be checked and redone before moving to the next stage. Good housekeeping is not only for your backup and reference when you need it, you will have to submit notes with your designs and include references in your Gerber files for the fabricators to reference.

At the very least, your notes must cite such details as the specific components the PCB will carry, with detailed assembly notes, core thickness, specific PCB materials to be used, surface finishes, stack-up information and any other key aspects and vital information which will influence the fabrication and processing of the PCB.

The essential differences
Okay, that’s the housekeeping. Now let’s take a look at some of the key areas where Mil Spec or IPC Class 3 PCBs differ from standard industrial and commercial PCBs (or IPC Class 1 and 2 products) and how this impacts the design and component accommodation.

Layout – a completely different emphasis
Commercial PCBs are usually designed for convenience. If they fail, they, along with their components, are replaced. IPC Class 3 PCBs are designed for test (DFT). Easy access is essential, so components can be thoroughly tested in isolation from the rest of the unit and, if necessary, replaced as quickly and effortlessly as possible. Disposal of the entire PCB with its components is not a consideration.

Vibration, heat generation and dissipation and unexpected shock, mechanical stresses and unanticipated spikes in current have to be considered and accommodated. For instance, will the unit survive an unexpected blast of searing heat, or the momentary shock of being accidentally dropped? Is the PCB located in the best possible position within the device to minimise the effects of these stresses?

At the layout stage, every eventuality has to be considered; the designer must try and allow for random extremes which might be encountered in the field.
The right components
Apart from withstanding extremely harsh conditions, MIL-PRF-31032 / ITAR or IPC Class 3 components must operate within extremely tight tolerance bands. For a unit to fulfill the precise function it’s designed for, all the components need to be high-quality and deliver almost exactly the performance their ratings say they will deliver.

Extra strength, from the ground up
Best practise in making Military Spec PCBs is to design cores as thick as possible, and definitely thicker than 2 to 3 millimetres. Thin cores will generate problems with heat dispersion, component isolation, physical strength and thermal expansion of the PCB itself.

Aspect ratios
The relationship of finished board thickness to hole diameter in Mil Spec PCBs must never exceed 10:1. Aspect ratios greater than this may well jeopardise the reliability of the board. Apart from this, boards with aspect ratios greater than 10:1 are more challenging, and therefore expensive, to make.

Signal distortion and shielding
Separating high- and low-frequency components is essential. Every precaution must be taken to avoid interference or distortion in Mil Spec equipment.

It is critical that signals of different types are shielded from each other. As a start, digital and analog circuits must be separated. High-current analog systems create waveforms which will interfere with the digital circuit’s waveforms. An effective method of separation is to isolate digital and analog circuits between their own ground planes. This will control any cross-talk which might otherwise happen.

Clock signals are particularly important, especially in more complex equipment which might be running more than one clock signal.

To ensure these critical signals are not degraded by other waveforms in the unit, the circuits carrying them should, where possible, be shielded with aluminium or a similarly effective material.

Echo-free trace routing
As most Military Spec equipment runs on higher-current circuits than standard commercial equipment, close attention must be paid to how the trace on the board is routed.

Turns sharper than 45° must be avoided and, in all cases, the path of the trace must curve as opposed to forming corners. If a corner is formed, problems can occur when the current reaches the bend. Reflections are generated which set up a ripple effect going against the flow, creating an unclear signal.

Thermal management
In high-performance equipment, designing to minimise the generation of heat and the management of the heat produced is critical. Components designed to dissipate heat within themselves, as opposed to dispersing it into the surrounding equipment, are to be preferred.

Where possible, PCBs should be designed with one side accommodating the components and the other side available to disperse heat. Horizontal or vertical heatsinks should be used wherever feasible.

Thermal management can also be aided by the use of ground planes and by exposing copper areas on the external boards to dissipate heat.

The right stuff
Specifying the right materials for substrates is critical.

For low-frequency applications, FR4, G10 (high-pressure fibreglass laminate), polyamide or cyanate ester are suitable, while high-frequency applications require Rogers series RO4003, duroids, polyamide or other Teflon-based materials.

Continued on page 28
The objective – compliance and certification
At the end of the day, the product being designed has to be certified as complying with the relevant regulations. The notes you make and the documentation you compile in accordance with the regulations you need your PCB to comply with, will be used to ensure you meet the standards set.

The same documents will also be used in copyrighting and intellectual property protection, as they record and lay out in great detail the materials used and the desired functions and performance you expect from the equipment you are seeking to protect.

For more information contact Cirtech Electronics, +27 21 700 4900, info@cirtech-electronics.com

Verotec VMEbus hardware chosen for anti-tank system

Verotec has been selected by a top 10 global defence contractor to supply seven different variants of VMEbus system hardware, backplanes and PSU sub-systems for a land-based US anti-tank system.

The systems are based on the ruggedised 6U, 84HP, 160 mm deep KM6-HD subrack system, fitted with one of seven different sizes of 5- to 16-slot passive termination backplanes according to the requirements of the individual application. A custom front panel is standard across all variants, as is a 6U PSU cassette.

KM6-HD, the ruggedised variant of the KM6 family, has been independently tested to MIL-STD-167 and has met its requirements both as an empty chassis and when partly and fully loaded with PCBs and modules. MIL-STD-167 is the globally accepted specification for shock and vibration test criteria in rugged applications, and conformance is an internationally recognised assurance that the tested equipment is suitable for use in hostile environments.

The KM6-HD subrack’s design includes positive guide locking with optional screw-down retention. Heavy-duty two-screw tie bar fixings in the 3 mm thick side plates give precision location, good rigidity and resistance to bowing or twisting.

To conform to the requirements of major backplane architectures such as VMEbus, VXI, VME64x, VPX, VXS, cPCI and PXI, an Iridite NCP conductive finish throughout and slide-in double swipe RFI continuity gaskets fitted to the 19” rack mounting angles and rear closing angles provide electrical continuity to adjacent panels in the front and rear apertures.

Side plates are solid; solid top and bottom covers may be fitted to preserve EMC integrity; EMC vent pattern covers that facilitate cooling are also available as standard. Front and rear closing panels provide a fully screened EMC environment, and inject/eject front panel handles, grounding clips, ESD clips and coding keys are available.

For more information contact Vepac Electronics, +27 11 454 8053, sales@vepac.co.za.
High-speed M12 connectors for transportation

Telegärtner’s range of connectors for railway and vehicle applications has been expanded with the introduction of a new product series. An add-on to the previous M12x1 connector series, the new series contains M12x1 X-coded connectors as plug and socket versions which are suitable for connecting to cables with both solid and stranded conductors, as well as offering 360° shielding. This shielding ensures safe and reliable data transmission.

The range is completed with factory-made cable assemblies for connections between end device and end device, or between end device and distribution point. The cable assemblies are available in multiple configurations and the packaging and cable printing can be individually customised.

As 8-pole, X-coded compact connectors in Cat. 6A, the M12 from Telegärtner can transmit data rates of up to 10 Gbps in accordance with IEC 61076-2-109:2014. Even in harsh environments, the high bandwidth is ensured by separating the four pairs with a cross shield (X-coding). Remote powering of end devices is also possible.

The expansion of communication infrastructure in rail and vehicle applications is advancing to make the onboard experience as comfortable and entertaining as possible for the passengers. In addition to real-time information about the train schedule, passengers want the flexibility to be able to work and surf the web onboard.

Besides the onboard applications for passengers, even more processes are being automated by the vehicle operators; for example, processes like security systems where the carriages will be monitored by IP cameras or traffic flows will be managed automatically by the individual trains. Therefore, train manufacturers are obliged to constantly improve their communication network infrastructure in the vehicles so they can offer a working, safe and reliable network.

The basic structure of the new Telegärtner connector with X-coding corresponds to the M12 system used worldwide. The robust M12x1 connector in Category 6A can be fitted on site without any special tools. The assembly-friendly connector also features very good shield contacting and covers a wide range of wire diameters (0.9 to 1.6 mm) and cable diameters (5.5 to 9 mm).

For connecting an IP camera, the passenger information system in carriages or other applications where high data rates need to be transmitted, Telegärtner also offers factory-made Category 6A connecting cables. The M12x1 X-coded connecting cables guarantee transmission rates of up to 10 Gbps and are available in different configurations and length variants from stock.

The over-moulded connectors are tested to IP67 against particle and water ingress. The M12x1 X-coded connecting cables have an S/FTP 4x2xAWG24/19 structure and a jacket material specially developed for transport applications. The cables pass the high requirements for fire safety regulations in the transport industry.

The connecting cables are supplied with Telegärtner printing on each cable and in Telegärtner packaging. If required, the packaging and printing can be adjusted to meet the customer’s specific requirements. Other configurations and adaptor cables, such as X-coded to D-coded or A-coded, are available on request.

For more information contact Webb Industries, +27 11 719 0000, prichards@webb.co.za

Board-to-board connectors

A new product series of robust board-to-board connectors from Phoenix Contact includes shielded connectors with a pitch of 0.8 mm and unshielded versions with a pitch of 1.27 mm.

The Fine Pitch series offers versatile solutions for the connection of several printed circuit boards (PCBs) within a device. Horizontal and vertical female and male connectors enable users to arrange PCBs in a mezzanine, coplanar or orthogonal layout.

Both product ranges include 12- to 80-position versions for currents up to 1.4 A and voltages up to 500 V a.c. With its EMC shielding, the Fine Pitch 0.8 mm product range is ideal for interference-free, high-speed data transmission at rates of up to 16 Gbps.

The contacts on both sides of the ScaleX contact system guarantee a long-term-stable electromechanical connection, even in the event of stress caused by shock or vibration. At the same time, the principle allows for a high level of tolerance for connectors that are positioned differently due to assembly. In addition, the insulating housing geometry reliably prevents the connectors from being interconnected incorrectly.

Pre-assembled IDC female connectors from the Fine Pitch 1.27 mm product range are available with flat ribbon cables in customised lengths on request, so they can be inserted into the device immediately.

For more information contact TRX Electronics, +27 12 997 0509, info@trxe.com
LEDs recognised for achieving natural light spectrum

Seoul Semiconductor’s SunLike range of natural spectrum LEDs, first announced in 2017, have gone on to be recognised as an innovative technology for human-centric lighting at global lighting awards held in Europe, China and USA.

Based on TRI-R technology developed by Toshiba Materials, the LEDs are designed to deliver light that closely matches sunlight's natural spectrum, to provide an optimised light source that maximises the benefits of natural light. Thus, the colours and texture of objects can be viewed more accurately, as they would be seen under natural sunlight.

Seoul Semiconductor believes its SunLike LEDs may also play a key role in minimising the negative effects of artificial lighting. While conventional LED technology produces light with a pronounced blue spike in its spectral output, SunLike LEDs implement a more uniform spectrum that more closely matches natural sunlight, lowering this blue light spike.

Some recent research indicates that this blue light spike may produce negative effects when viewed for prolonged periods of time during night-time hours, potentially interfering with natural human biorhythms. By employing new light sources powered by SunLike LEDs, lighting designers could be able to deliver a healthier light experience.

Interest in the link between light sources and human health is higher than ever before, as evidenced by the winners of the 2018 Nobel Prize in Physiology: Professor Jeffrey C. Hall, University of Maine; Professor Michael Morris Rosbash, Brandeis University; and Professor Michael Young, Rockefeller University. These researchers are credited with seminal discoveries about the cellular mechanisms for circadian biology.

For more information contact NuVision Electronics, +27 11 608 0144, gdeklerk@nuvisionelec.co.za

Infrared detectors

Würth Elektronik eSos is expanding its optoelectronics portfolio. Following infrared LEDs, the company now also offers a wide range of matching detectors. Developers of various infrared applications can be sure that the spectra of emitters and detectors match. All infrared components are available from stock at any time, and free samples can be requested.

Infrared (IR) light, invisible to the human eye, offers a huge number of possible applications – especially through the use of extremely compact components. In addition to classic light barrier installations, remote controls and smoke detectors, infrared can be used in many applications for data transmission.

Infrared even goes under the skin: an individual’s pulse can be monitored and blood pressure measured using fitness tracking watches. Another use would be security systems, such as eye, face and gesture recognition, which can also work with IR products.

Since the spectra and wavelengths of Würth Elektronik IR LEDs and photodetectors match perfectly, the modules are ideally suited for data transmission. Identical design of IR LEDs and photodetectors facilitate PCB design. The photodetectors are available in numerous designs, with or without daylight filter. All products are equipped with a gold wire for excellent contacting.

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

**SiC MOSFETs and Schottky diodes**

Microchip Technology announced, via its Microsemi subsidiary, the production release of a family of SiC (silicon carbide) power devices that offer ruggedness and the performance benefits of wide-bandgap technology. These products meet the need to improve system efficiency, robustness and power density in electric vehicles (EVs) and other high-power applications in the industrial, aerospace and defence markets. Microchip’s 700 V SiC MOSFETs and 700 V and 1200 V SiC Schottky Barrier diodes (SBDs) join its existing portfolio of SiC power modules. The more than 35 discrete products that have been added to the portfolio are available in volume, supported by comprehensive development services, tools and reference designs, and offered across a range of voltage and current ratings and package types.

The new parts offer efficient switching at higher frequencies and pass ruggedness tests at levels considered critical for guaranteeing long-term reliability. They perform favourably in these unclamped inductive switching (UIS) ruggedness tests that measure how well devices withstand degradation or premature failure under avalanche conditions, which occur when a voltage spike exceeds the device’s breakdown voltage.

The expanded SiC portfolio is supported by a range of SiC SPICE models, SiC driver board reference designs and a power factor correction (PFC) Vienna reference design. All the company’s SiC products are available in production volumes along with their associated support offerings. A variety of die and package options are available.

For more information contact Dirk Venter, Altron Arrow, +27 11 923 9600, dventer@arrow.altech.co.za

**Synchronous boost converter**

The superior properties of Li-ion batteries, such as high energy density, light weight, no memory effect, and less self-discharge, make them a very popular option in portable applications. ICs with boost topology are needed in portable applications since the voltage fluctuation of most Li-ion batteries ranges from 4.2 V (fully charged) to 3.0 V (fully discharged), while the post-circuit input voltage is up to 12 V or more.

Portable applications, such as Bluetooth audio, quick-charge power banks and portable POS systems, employ various boost products available in the market, including discrete controllers with external MOSFETs, non-synchronous boost converters with an external diode, and limited input/output voltage ranges or features. These solutions take up more space, require more components while providing less efficiency, and compromise performance in terms of noise and reliability.

The MP3432 from Monolithic Power Systems (MPS) operates from an input voltage as low as 2.7 V, supports an operating input voltage from 0.8 V to 13 V, and an output voltage up to 16 V. Furthermore, it integrates two synchronous MOSFETs with optimised features, such as a programmable switching current limit up to 21.5 A, up to 30 W of load power from a single-cell battery, pass-through mode in pulse-skip mode (PSM) operation, various operation modes, and high power density in a QFN (3 x 4 mm) package.

This converter eliminates the need for inefficient and bulky external Schottky diodes by integrating small 6.5 mΩ and 10 mΩ $R_{DS(on)}$ Power MOSFETs using MPS latest process technology, advanced circuit design techniques and packaging technology. It achieves peak efficiency up to 97% at a 4.2 V input voltage and more than 85% in the main operating range with excellent thermal performance.

The MP3432 adopts a constant-off-time (COT) control topology, which provides fast transient response and reduces the output capacitance, which further contributes to reducing the overall solution size.

For more information contact NuVision Electronics, +27 11 608 0144, gdeklerk@nuvisionelec.co.za
The Power PROFET BTS50010-1TAE from Infineon Technologies is a high-side switch designed to drive currents up to 40 A d.c. in 12 V systems. With an on-resistance down to 1,0 mΩ, the device is packaged in a D2PAK (PG-TO263-7). The device’s high energy robustness and inrush current capability up to 250 A support the requirements of motorcycle and scooter starters for the engine. It also addresses automotive, industrial and consumer applications, as well as any load with harsh switching demands. Switching robustness is in excess of 1 million cycles, and other features include a current mirror for load current measurement, ESG protection, low standby current and very low output leakage current.

For more information contact Dirk Venter, Altron Arrow, +27 11 923 9600, dventer@arrow.altech.co.za

Designers of portable Li-ion battery-powered electronics can add a USB Type-C (USB-C) charging system to their products with the MAX77860 3A switch-mode charger from Maxim Integrated Products. The device eliminates the need for a separate host controller and simplifies software development for applications such as financial point-of-sale terminals, power banks, industrial computers, scanners, radios, medical devices, charging cradles, portable speakers and game players. The MAX77860 integrates USB-C configuration channel (CC) port detection and a battery charger for 15 W applications. These integrated functions allow battery charging at the fastest rate possible under the USB-C specification. The CC pin detection feature also shortens the design effort by eliminating the need to support end-to-end USB port connection and allowing charging to start automatically.

For more information contact CST Electronics, +27 11 608 0070, sales@cstelectronics.co.za

The 5 V KE1xZ family of microcontrollers (MCU), made by NXP Semiconductor and based on the Arm Cortex M0+, enables embedded control systems in harsh electrical environments, with an integrated CAN controller, capacitive touch capability, Flash memory from 32 KB to 256 KB and SRAM from 8 KB to 32 KB. The 1 MSPs analog-to-digital converter and FlexTimer modules, combined with NXP’s Freemaster software tools library and Motor Control Application Tuning plugin (MCAT) enable brushless DC (BLDC) and other motor control systems. The KE1xZ family offers advanced noise immunity, water-tolerant touch and low-power wake-on-touch operation, essential features for the strict electromagnetic compatibility (EMC) standards of the industrial and home appliance markets. NXP’s touch IP enables a high level of stability, accuracy and ease of use, with continued responsiveness and functionality through wet conditions, and can sustain 10 V in conducted noise.

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

Texas Instruments expanded its portfolio of linear regulators by introducing the TPS7A78, which uses a unique switched-capacitor architecture to eliminate discrete components, including external inductors and transformers and miniature circuit breakers and interrupters, for tamper-resistant designs in applications including electronic metering in grid infrastructure and building automation. The chip is a non-isolated linear regulator that delivers up to 0.5 W from AC to DC with smaller, fewer components. This design optimises regulation through an active bridge, switch capacitor and integrated low-dropout regulator (LDO). This results in higher efficiency and a reduced capacitor size compared to linear regulators in traditional capacitor-drop solutions utilising a Zener diode.

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Coaxial Connectors

The SMA connector is designed for a frequency range of DC to 18 GHz at 50 Ω impedance. With its threaded-type coupling mechanism, it is perfect for securing your connection in intensive vibration environments.

For further information, please visit: www.we-online.com/coax