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## on the cover

In just a quarter of a century, Microtronix Manufacturing has grown from a small factory on the third storey of a building into an electronics contract manufacturing powerhouse with three facilities serving clients of all sizes and across the whole spectrum of market sectors. Turn to page 26 to read its CEO’s story about this remarkable journey.

For more information contact Microtronix Manufacturing, +27 11 792 5322, info@microtronix.co.za

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## regulars

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*Newest cutting-edge equipment, and an in-depth article on the design of high-speed PCBs with four layers.*
Jackson’s left hand rule

It is strange how sometimes, after first noticing something you hadn’t noticed before, it seems to pop up all over the place. It has been dubbed the Baader-Meinhof phenomenon, and it’s not so much a case of encountering something new, but encountering something that is new to you.

Lately a recurring theme in my life has been discovering inspirational people with particularly unique and interesting ways of looking at the world. One of those people is Richard Feynman, a 20th century American theoretical physicist who won the Nobel Prize in Physics in 1965. I wouldn’t normally think of theoretical physicists as the most engaging people, but I’ve watched a bunch of videos on Youtube where he talks about not only the intricacies of the physical world, but also more esoteric subjects such as the differences between knowing and understanding. If more people were exposed to such ideas at an early age, I have no doubt there would be more scientists in the world.

Another source of inspiration I found (again thanks to Youtube) is Henry Rollins, who is about as different from Richard Feynman as it is possible for a person to be. He was the lead singer in the hardcore punk band Black Flag in the 1980s, whose relentless energy has seen him turn his hand to acting, writing, starting his own publishing company, hosting radio shows, motivational speaking and activism.

Whereas Feynman’s inspiration came from observing, wondering about the nature of something and then seeking to understand and explain it, Rollins’ message is all about the power of the individual over the collective (but not at the expense of the collective) and he gains wisdom and energy from travelling and experiencing as many different things as possible. Albert Einstein had yet another approach, as he was said to have entered into a deep meditative state to find the inspiration for his most famous theories.

There is no right or wrong way of gaining inspiration, then, and no telling from where you might find the inspiration for his most famous theories.

So, I started brushing my teeth with my left hand, I started putting on my right shoe first instead of my left, and various other little changes. Although he didn’t refer to it as such himself, since I’m right-handed I’ve come to think of this as Jackson’s left hand rule. After two weeks I can’t say my teeth are quantifiably cleaner, but just by doing things differently to the norm I have started to think slightly more open-mindedly about how I approach certain aspects of my personal and work lives, and even if it doesn’t revolutionise my life, a change can sometimes be as good as a holiday.
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South Africa

- Würth Elektronik eiSos announced the appointment of NuVision Electronics (pictured) as a new South African distribution partner. “In our joint vision to build strong, service-focused relationships with South African customers, we are certain that NuVision will do the Würth Elektronik brand proud. Another exciting opportunity to deliver on our brand promise, “More than you expect!” stated Jason Page, field sales engineer at Würth Elektronik eiSos.

Overseas Companies

- Arm announced the acquisition of Stream Technologies, which will be integrated with the Mbed IoT Device Management platform to enable connectivity management of every IoT device regardless of location or network. Stream supports the physical connectivity across all major wireless protocols – such as cellular, LoRa, satellite, etc. – that can be managed through a single user interface.

- Toshiba has retained ownership of a 40% stake in its chip unit, and sold a majority stake to a consortium led by US private equity firm Bain Capital, for $18 billion. After being held up pending approval from Chinese antitrust regulators, the deal marks the end of a harrowing saga in Toshiba's history that nearly saw the company delisted from the Tokyo stock exchange.

Industry

- According to the Semiconductor Industry Association (SIA), the latest figures from the World Semiconductor Trade Statistics (WSTS) organisation show that worldwide sales of semiconductors reached $338.7 billion for the month of May 2018, an increase of 21.0% compared to the May 2017 total. Global sales in May were 3% higher than the April 2018 total of $37.6 billion. Year-to-year sales increased solidly across all regions: the Americas (31.6%), China (28.5%), Western Europe and North America witnessed early deployments of public LPWA networks, the Asia-Pacific, especially China, has been a pivotal market for driving large-scale adoption of NB-IoT and LoRa.

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- As illustrated in the graph below, IC Insights forecasts that China-headquartered companies will spend $11.0 billion in semiconductor industry capex in 2018, which would represent 10.6% of the expected worldwide outlays of $103.5 billion. Not only would this amount be five times what the Chinese companies spent only three years earlier in 2015, but it would also exceed the combined semiconductor industry capital spending of Japan- and Europe-headquartered companies this year.

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Technology

- The USA ascended to the top of the global supercomputer rankings for the first time in five years, with a machine dubbed Summit which is capable of 200 petaflops, or 20 quadrillion calculations per second. Summit was built at a cost of $200 million by IBM and Nvidia for the US Department of Energy's Oak Ridge National Laboratory. The machine boasts 4608 servers, 9216 central processing chips, 27 648 graphics processors, and weighs 340 tons.

- Worldwide industrial semiconductor revenues grew by 11.8% year over year, reaching $49.1 billion in 2017, according to IHS Markit, and are expected to grow at a compound annual growth rate (CAGR) of 7.1% through 2022. Texas Instruments maintained its position as the largest industrial semiconductor supplier in 2017, while Analog Devices’ acquisition of Linear Technology catapulted it into second position.

- Cellular and non-cellular LPWA (low power wide-area) network connections will grow globally at a 53% CAGR until 2023, driven by market growth in smart meters and asset trackers, according to a new report from ABI Research. In 2017, smart meters and asset trackers contributed to almost three quarters of all LPWA network connections, dominated by non-cellular LPWA network technologies. However, by 2023, non-cellular LPWA will cede its market share dominance to NB-IoT and LTE-M, as cellular LPWA moves to capture over 53% of LPWA connections. Regionally, although Western Europe and North America witnessed early deployments of public LPWA networks, the Asia-Pacific, especially China, has been a pivotal market for driving large-scale adoption of NB-IoT and LoRa.
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ORDER WITH CONFIDENCE
Hundreds of guests and members of the media gathered at an extravagant opening ceremony in East London on 5 June to witness the unveiling of what is said to be the biggest SMT manufacturing plant in Africa – possibly even the biggest in the southern hemisphere.

In the South African electronics manufacturing context, the name Yekani entered the fray when Yekani Multimedia bought a 38% stake in Vektronix, a contract manufacturer best known for its DSTV decoder production. In 2016 that stake rose to 100% and Yekani Manufacturing was born in 2017. Fast forward to the present and Yekani has used a R1 billion investment (funded by the DTI, banking institutions and the company itself) to build a new 28 000 square metre facility that is three times the size of the former Vektronix plant.

So what does R1 billion buy you? Besides the building itself, 11 SMT production lines boasting state-of-the-art equipment for what Yekani’s CEO, Dr Siphiwe Cele, hailed as the cornerstone of South Africa’s, and Africa’s, entrance into the fourth industrial revolution. Employing the latest cutting-edge technologies and processes, the facility truly epitomises the phrase ‘smart manufacturing’ and, once fully up and running (which is expected to happen within the next couple of months) it will have a placement capacity of close to 1,5 billion components per hour.

Speaking at the opening ceremony, Akhiro Yamasaki, director of Panasonic (whose pick-and-place machines are used in the factory), said that the new facility is one that South
Africa can be proud of as truly world-class. A Panasonic spokesman explained that the technology deployed goes beyond just equipment by addressing more complex issues such as cyber-security. He stated that this technology is not only state-of-the-art but also forward thinking, and will enable future advancements that will further improve productivity.

All that capacity requires a lot of people to run things, and the hope is that in the medium term the factory will create another 1000 jobs over and above the 500 or so currently employed. Cele underlined the role Yekani wants to play in helping employment in the East London area, with an emphasis on creating jobs for the youth and, in particular, women (who make up 90% of the staff at the existing plant in Wilsonia).

“Our technologically advanced facility is geared to manufacturing innovative technology products for clients in the automotive, defence, aerospace/aviation industries as well as consumers,” Cele stated. “We want the world to know that Africans are capable of pioneering new technology and that Yekani we have this belief that our strength lies within our biggest asset: our people.”

Such a huge undertaking requires a lot of business to keep the wheels turning, and Cele called on government to put its money where its mouth is and support its commitment to increasing local procurement by purchasing Yekani products. However, he also urged for support beyond the simple purchasing of products, and expressed the company’s eagerness to take on world-class technology development projects, backed by its newly formed R&D department.

Yekani has outgrown its contract manufacturing roots and is fast becoming a major player in the South African OEM market. It is already producing its own tablets, laptops and mobile phones, and aims to become the largest smartphone company in the country. It also makes a range of education devices (some of which have been supplied to the Gauteng department of education) which includes interactive whiteboards, touch-enabled LED displays, tablets and laptops. The company is also exploring digital radio as a technology with strong growth potential.

In his closing address, minister of trade and industry, Dr Rob Davies, said he envisions the new Yekani facility as a stepping stone for South Africa to move out of the losing position it occupied in the third industrial revolution, and into a winning place in the fourth.

**RS launches e-commerce website for sub-Saharan Africa**

RS Components was founded as Radiosparres in 1937 as a supplier of parts to the burgeoning radio market, and has evolved into a global distribution enterprise with operations in Europe, North America, Asia and now Africa offering a diverse portfolio of more than 500 000 industrial, maintenance and electronic components across 2500 global brands.

RS South Africa opened its doors in 1996, the flagship operation in Africa with 22 years of experience distributing products and components to engineers around the African continent. RS South Africa recently launched the Africa website www.rsonline.africa geared to meet the requirements of a growing continent with demand from various industries such as manufacturing, mining, automotive, utilities, electronics and industrial IoT. “Customers in Africa had access to our products prior to the website, however there were long lead times and higher freight costs depending on location,” says Brian Andrew, managing director of RS South Africa.

“With the new website customers receive their products much quicker and we can give additional markets in Africa access to our range through our e-commerce platform where they can pay via credit card. There is also an improved customer experience with our French and Portuguese speaking sales agents, so that customers can comfortably engage in their language of preference. So much is happening in Africa – we want our engineers, makers and maintenance professionals to have access to the widest range of products and the latest technologies to achieve their goals and to develop the products and solutions of the future. The rest of the world has easy access to these goods, now so does Africa.”

Andrew adds that RS is passionate about STEM education and globally supports a number of initiatives aimed at upskilling the next generation of engineers and technicians. This includes being a global distributor for Raspberry Pi (a credit card size single board computer at $35) which essentially functions as a PC and has sold over 15 million units worldwide. RS also supports numerous engineering endeavours such as solar car challenges, the SpaceX – Hyperloop challenge, development of 3D prosthetics, various robot prototypes, and initiatives that develop and improve satellite technology for space.

The new RS Africa website currently services the following countries: Angola, Botswana, Kenya, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, Swaziland, Tanzania, Zambia and Zimbabwe, with more to follow in the future.

For more information contact RS Components, +27 11 691 9300, sales.za@rs-components.com.

**Minister dismayed at local content in STBs**

The Department of Communications issued a statement in which the communications minister, Nomvula Mokonyane, expressed her concern about the lack of adherence to the 30% local content manufacturing rule on the part of some suppliers who manufacture government’s subsidised set-top boxes (STB) which are meant to enable migration from analog to digital television services.

The statement came in response to an ITWeb article which the minister claimed quoted her erroneously as saying that all contracted local manufacturers of government set-top boxes import decoders from abroad. The statement went on to say that “the Department of Communications has learnt that some local manufacturers contracted by state-owned-entity Universal Service and Access Agency of South Africa (USAASA) to manufacture these decoders are procuring non-compliant devices abroad and importing them into country. “This means that they are in fact contravening the local content quota prescription, which requires them to ensure that at least 30% of all decoder components are produced locally. This undermines government’s efforts to ensure that this project contributes towards boosting the country’s electronics manufacturing sector to stimulate job creation in the sector. Additionally, many of these imported decoders are found to be defective and not compliant with the local standards framework set by the SA Bureau of Standards. This has resulted in decoder recipients having to return them to government’s distribution agent – the SA Post Office.”

There are 27 manufacturing firms contracted by USAASA to produce decoders and antennas for government’s broadcasting digital migration project, at a cost of R4.5 billion. The minister also expressed concern about the cost per unit – government is currently paying R1700 per manufacturing of a single STB, including installation. She described these costs as unsustainable for government and called on public-private partnerships for help in implementing the broadcasting digital migration project.

The department is currently reviewing the implementation plan and the model around the broadcasting digital migration project; this process is set be concluded in the very near future.

For more information visit www.doc.gov.za.
The impact of localisation on revenue and supply chain

South Africa has a highly skilled, world-class electronics manufacturing industry and as a result of government policy as well as local capability, global electronic consumer brands are manufacturing their products in South Africa. This localisation results in employment creation as well as a series of activities such as logistics, supply chain and research and development of product design, industrialisation and processes.

Speaking at the 2017 Proudly South African Buy Local Summit in Johannesburg, Trade and Industry minister Dr Rob Davies highlighted that localisation is an important policy tool for industrial development in South Africa that will assist in growing the economy and the manufacturing sector, and he stipulated that it is government’s preference that state entities buy locally manufactured goods. “It is a widely deployed policy tool. If government decides to source products that are locally made, it will support the enterprises that are producing those products in our own economy, while creating and supporting jobs,” Davies said.

“Many projects are being implemented from a government level where they are looking for local IP creation and the conversion of that IP into finished products,” says Peter Griffiths, managing director of Arrow Altech Distribution (AAD).

This policy is resulting in numerous new startup businesses that have certain capacities – most likely in the IP creation or manufacturing and production space. The unforeseen impact of this localisation initiative is the need for creative supply chain and inventory management processes that align the time factor of project cash out- and in-flows. Projects require inventory, which raises three factors to consider: the order lead time, the time to bring the goods into the country, and the time to convert those goods from raw material to a finished good that is delivered and paid for by a customer.

“Arrow Altech is able to partner with companies, whether big or small, and plan their entire supply chain process,” says Griffiths. “These companies can then focus on their core competencies, be that product IP creation, product manufacturing or customer account service provision with AAD complementing this by adding supply chain.”

Localising revenue through value-driven business
Proudly South African CEO, Eustace Mashimbye, said at the recent Proudly South African Buy Local summit, held in March 2018, that exploration of local procurement policy is critical in addressing South Africa’s unemployment problem – reported at 26.7% in 2017.

An example of localisation procurement is the tender award to Tshwane East Manufacturing Centre (Temic), a Gauteng BEE Level 1 startup company, for the local manufacture and supply of 500 000 digital terrestrial TV antennas, called the DigiAnt, for the South African analog to digital conversion project.

Temic’s collaborative engagement with Poynting Antenna, AAD and Zealous Castings enabled it to successfully deliver this tender on time and in full compliance to governmental localisation requirements by complementing its core product manufacturing skill processes with the diverse capabilities and capacities of the entities above.

The driving force behind Temic’s localisation project delivery was driven by the workplace partnership of AAD’s Lucky Mkhize (manager: supply chain projects) and Temic’s Sydney Sihlali (production manager). Mkhize’s and Sihlali’s collective focus ensured that the diverse elements of physical product creation, namely material sourcing, workforce skill development, logistics and production management information system solutions were combined to ensure project delivery.

Key to success was the innovative, locally developed production management information system developed by Mkhize that captured real-time data of manufacturing processes at every stage. “By doing this, any problems on the production line that were slowing the process down could be identified and tweaked,” says Mkhize. “With this efficiency we have optimised the lines from producing 400 units per day to 3000 units per day.”

Mkhize and Sihlali collectively improved Temic workforce processes and skills across two shifts so that product quality and production output were maintained, resulting in the creation of over 100 jobs for the duration of the project. “A lot of workers had no workplace experience in this field, so we have done a lot of skills development through on-the-job training,” says Sihlali. “We have also monitored and implemented solutions on the line that allow for more efficient output.”

Another key aspect of the project was cash flow management that factored three time-based planning elements: the time to source raw material and components so they were available in production-ready kit lots, the time to process and convert kit lots to finished goods that were invoiced, and lastly the time to payment for the goods from the customer.

Edward Walker, Temic’s CEO, unpacked their business partner’s contribution by explaining: “Temic was able to keep focus on our core skills, customer account management and manufacturing while AAD provided material procurement and logistics, Poynting provided IP creation in the form of antenna design and component casting tools while Zealous provided moulded aluminium antenna component parts.”

“Arrow Altech works at understanding our customer’s vision and then adapts its service delivery to enable the delivery of that vision,” says Peter Griffiths. “This allows our customers to focus on their core competency, whether it is IP creation or manufacturing and assembly. Whatever that focus is, AAD will complement it by adding optimised material and logistical supply chain.”

For more information contact Lucky Mkhize, Arrow Altech Distribution, +27 11 923 9600, lmkhize@arrow.altech.co.za
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When we talk about the future or technology, we inevitably talk about renewables. We cannot, however, talk about technology or the future and not talk about the battery.

**Packing sunshine to use another day**

Granted, not all renewables come from the sun, but all renewables need to be packed away and stored for on-demand-use. It’s not long before data centres, buildings, and entire cities turn the current centralised power distributors into the redundancies and renewables become the primary energy source. Unlike the previous generation of electric car, killed in the ‘90s, this renewables drive is the one leaving all who oppose it in the dust.

Companies around the world such as Forbatt SA and Tesla are working relentlessly to package the energy from renewables, whatever the source. Whoever gets the ‘golden goose’ of stability, safety, energy density and cost right, will lead the way. Right now, in the lead is the lead-acid battery when we look at a solution for the African market. The drive is in full swing, and one of the companies hurtling straight down the fairway is Forbatt SA.

**Ready for the Western Cape**

The drive for sustainable African energy and power backup solutions has led Forbatt SA, the agent for the professional series of Forbatt lead-acid batteries, to the Western Province where it has established a new hub to support the local distributors.

According to Mark Dove, a director at Forbatt, the reason for the expansion to Cape Town is that “with the demand for alternate power on the rise and the predicted strain on the national power grid, it’s imperative that Forbatt SA has a presence in Cape Town and surrounding areas. The warehousing facility in Kuilsriver will hold stock, so local distributors don’t have to wait for shipments to come from Johannesburg. This distribution point will make it easy for our partners to get what they need quickly and conveniently.”

The facility, headed by Dr Russell Ruiters, is ideally situated to not only act as a hub, but also distribute a range of complementary products and accessories for the surveillance industry.

**Preparing for Africa**

When asked why Forbatt lead-acid batteries for the African market, as opposed to other chemistries and brands, Dove stated: “Forbatt has been in South Africa for over 20 years now and over 25 years internationally, so our longevity and staying power speaks for itself. In our expansion drive, our competitive advantage is that our product prices are fair, and Forbatt batteries are manufactured to the highest standards which are reflected in their durability, performance and low rate to the almost non-existent rate of returns. We have also partnered with an excellent customer service team for a great all-around sales experience.”

When asked about his predictions for the continent, Dove asserted that “solar applications will become the way forward across the continent. We are already actively involved in the drive through our distribution channels with links into Africa.”

As for energy solutions for Africa, Dr Ruiters believes durability and reliability are key considerations. “I would rate Forbatt batteries among the most reliable and stable SLA (sealed lead-acid) batteries, one of the top performing batteries in the South African market and the definite winner for Africa,” he said.

**Preparing new builds for new markets**

Forbatt SA is not waiting around for others to solve Africa’s problems. It has actively provided energy and power backup solutions for several sectors including the security, IT, automotive, energy, medical, communications, construction and financial services industries, and is rapidly expanding into the solar, medical and water management industries. It has introduced the FB26-12 and FB65-12 batteries, which focus on solar, UPS and telecom applications, while the new FB18-12G concentrates mainly on UPS and access applications.

When asked about his predictions for battery technology and renewables for the African markets and how Forbatt is gearing up, Dove stated his belief that gel type technologies are set to take centre stage for massive storage and power backup technologies. “Forbatt is geared to take on and meet the demands of the African market by ensuring we maintain our very high levels of quality control and introduce ever improving gel type technologies,” he concluded.

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The team of six, made up of undergraduate computer science and engineering students from the Universities of the Witwatersrand and Limpopo, was one of 12 teams from around the world that participated in the prestigious challenge from 25 to 27 June 2018.

The students showcased computing systems of their own design, adhering to strict power constraints and seeking to achieve the highest performance across a series of standard high-performance computing benchmarks and applications. South Africa has been participating in the international competition since 2013 and won it in 2013, 2014 and 2016, coming second in 2015 and 2017. It is one of the few teams that consists entirely of undergraduate students, and that sends different students each year.

Before participating, the members of the team received extensive training from the Centre for High Performance Computing (CHPC), an initiative of the Department of Science and Technology and the Council for Scientific and Industrial Research (CSIR).

The CHPC’s Director, Dr Happy Sithole, said that the placing was “a significant achievement for South Africa,” and that the CHPC hopes to increase the number of students who received exposure of this kind in the field of high-performance computing. “In the past six years we have had 36 students performing well on the world stage,” he said.

The South African team was chosen from 10 participating teams at a national student cluster supercomputing competition held in December last year. Team selection for the national competition takes place at the CHPC’s Winter School, which is designed to impart critical knowledge for building a cluster. This includes using Linux systems, the basic software stack of a cluster, and considerations that should be taken into account when choosing hardware. Team selection concludes with an assignment that requires each team to build a prototype cluster in the cloud.

After all their hard work, this year’s team – Meir Rosendorff, Joshua Bruton, Kimessha Paupamah, Katleho Mokoena, Nathan Michlo and Njabulo Sithole – said that they planned to hire bicycles and cycle around Frankfurt “doing touristy things”.

For more information contact Nox Moyake, CHPC, nmoyake@csir.co.za.
Hardware-accelerated security for resource-constrained IoT devices

By Mark Patrick, Mouser Electronics.

Security and the IoT (Internet of Things) are inextricably linked, yet it is apparent that far too many end-points are still being brought to market with little or no security features. In the recent past, manufacturers may have underestimated the resolve of hackers targeting seemingly innocuous devices such as connected thermostats, but high-profile instances of data losses have made the threat only too apparent.

Through cloud connectivity, unsecured end-points can easily become open windows into an organisation’s back office, exposing customers’ financial details to the criminal element.

While these cases have successfully raised awareness of the problem for both manufacturers and consumers, understanding the solution could still be a hurdle. Implementing security is difficult, particularly in headless devices like IoT end-points and even more so for devices based on very low-resourced microcontrollers. For embedded developers in particular, security can be an unknown domain that demands an entirely new set of skills and technologies.

Chain of trust
While technologies, such as the Advanced Encryption Standard (AES), are now implemented as hardware blocks in many microcontrollers, and do a great job of turning plain text into something that can only be deciphered by the intended recipient, the process of encryption and decryption relies on keys. In order to be useful both parties need to have the relevant key, which is where security gets really interesting.

Key management is arguably the most critical part of a security protocol. They must be generated, distributed and stored in a way that shields them from nefarious elements. The IoT is expected to comprise tens of billions of devices in the near future, so while AES is largely accessible, key management in the IoT could be viewed as the real problem with adding security to end-points.

In effect, every single one of those billions of IoT end-points needs to be identifiable in a unique way, in order to know with certainty that it is genuine and authorised to be part of the network. Only then can it be trusted with the key(s) required to implement cryptography.

There are further implications with this topology; keys that have been distributed to trusted end-points are typically generated and stored centrally, in a database. If that database is compromised, all of the keys stored and, therefore, all of the devices in the field with those keys, also become compromised. That means every single key needs to be regenerated and redistributed. Not all IoT end-points will be equipped with over-the-air updates and if they are, it may not be implemented securely, which just compounds the problem even further.

Secure at every level
Often, discussions about security in the IoT focus on the exchange of data over the network, or the way those communication channels may be exploited. But encryption is also used to

Continued on page 14
secure a design, more specifically the firmware in an embedded device, typically referred to as Secure Boot.

In order to validate the firmware hasn’t been changed it needs to be signed and, again, this requires a key. However, storing the key locally in Flash is an inherently insecure solution and one that introduces even more design complexity.

For security reasons, keys are typically installed at the time of manufacture, a process referred to as provisioning. To preserve the chain of trust, keys must be unique and auditable, a process that large manufacturers are empowered to handle in-house but smaller developers need to source; relying on a key provider, known as Certificate Authorities (CA). Once the device is put into service, or commissioned, it becomes a unique and authenticated device on a network.

Local provisioning
Using a CA also incurs a cost for every key issued, which can have implications for low-cost IoT end-points. In addition, many end-points will be based on low-resource microcontrollers that may not have the processing power required to execute complex cryptography algorithms in an efficient way.

To address these challenges a new class of device has emerged, one that provides security functions for resource-limited embedded devices. These crypto engine authentication devices provide hardware features for the secure storage of keys, but they go much further.

The ATECC508A and ATECC608A are members of Microchip’s CryptoAuthentication family and provide a number of security functions. This includes protecting firmware and other digital data through secure boot features, and the secure storage of that data. They can also be used to authenticate the device itself and thereby protect against counterfeit goods; this could be used to validate a peripheral or daughter board, for example, as well as other removable media (such as print cartridges). Figure 1 (page 13) shows how the device might be used in an embedded design.

But perhaps the most relevant function these devices provide, in terms of the IoT, is the authentication of an end-point’s identification and support for key agreement and key creation for message encryption. These co-processors effectively provide hardware-based execution of public key algorithms at high speed, offloading it from the host processor.

Both elliptic curve digital signature algorithm (ECDSA) and elliptic curve Diffie-Hellman algorithm (ECDH) functions are supported and each device has a unique 72-bit serial number. The built-in RNG (random number generator) supports the cryptography functions and is designed to meet the requirements specified by the National Institute of Standards and Technology (NIST).

Deep dive
The devices are capable of implementing a complete asymmetric key cryptographic signature solution using a public and private key, up to 1000 times faster than a software-based implementation. It follows the elliptic curve cryptography and ECDSA signature protocol using hardware-acceleration of the P256 prime curve standard from NIST. This covers a wide range of functions including private key generation, ESDSA public key signature verification and signature generation, and ECDH key agreement.

Despite integrating all these advanced features the devices are small and low-power enough to be used in practically any IoT application. The host processor, which could now be an ultra-low-cost 8-bit microcontroller without any security features, communicates with the CryptoAuthentication device over either I²C or single-wire interface, so it only requires a single GPIO. The serial bus can operate at up to 1 Mbps and it is possible to connect several CryptoAuthentication devices to a single bus, in applications that use removable hardware or media, for example.

The two devices are largely compatible although the ATECC608A introduces some new features, such as secure boot function with I/O encryption and authentication, several new commands (including AES encrypt/decrypt) and an updated NIST SP800-90 A/BC RNG. It also includes a self-test command that can be configured to execute at power-up.

Secure key storage
Both devices are able to generate a private key and store it, so that it is never divulged to any other device. The public key associated with a stored private key is returned when the key is generated or can be calculated at a later time along with other secure elements derived from the private key.

As the key is generated and stored in the device itself during provisioning, there is no need for a central database. Figure 2 illustrates the various ways provisioning can be achieved using the CryptoAuthentication devices, for large, small or prototype volumes, without the need to invest in a hardware secure module (HSM).

With growing demand for security solutions developed specifically for IoT end-points and other resource-constrained devices, developers now have a viable alternative to ‘security through obscurity’ or power-hungry, software-based implementations.

For more information contact TRX Electronics, authorised Mouser partner in South Africa, +27 12 997 0509, info@trx.ee.
New release of electromagnetic simulation software

Altair has released the 2018 versions of its electromagnetic (EM) simulation software FEKO, WinProp, Flux and FluxMotor. These electromagnetic solver tools, part of the company’s HyperWorks platform, are widely used to accelerate the global design process for the automotive, aerospace, defence, communications, consumer electronics, energy and healthcare industries.

“We are excited by the latest release of our electromagnetic tools to support our customers as they move toward broad deployment of products relevant to e-mobility and communications, Industry 4.0 and the Internet of Things. The range of applications covers electromagnetic problems across the whole frequency range from DC into THz, integrated within Altair’s multiphysics modelling environment for multidisciplinary system optimisation,” said Ulrich Jakobus, senior VP for EM solutions at Altair.

The 2018 release of HyperWorks broadens functionality, simplifies workflows and enhances the user experience. For example, a novel workflow has been implemented in FEKO 2018 that facilitates characterising multi-layered dielectrics. With this, transmission loss and bore-sight error can be computed for arbitrarily shaped radomes more efficiently and with greater flexibility than ever before. Another example is the addition of new features in Flux 2018 bringing new capabilities for CAD geometry simplification and meshing, improving workflow, and increasing flexibility with the ability to solve faster in 3D using new high-performance computing resources.

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Cloud-based service for BLE designs

Nordic Semiconductor has launched ‘nRF Connect for Cloud’, a free service for cloud-based evaluation, test and verification of Bluetooth Low Energy (BLE) designs employing Nordic’s nRF51 and nRF52 multiprotocol BLE Systems-on-Chip (SoCs).

nRF Connect for Cloud features an intuitive workflow and offers much of the functionality of Nordic’s ‘nRF Connect for Desktop’ and ‘nRF Connect for Mobile’ which are popular applications used for building and developing BLE products. nRF Connect for Cloud also supports an extensive range of standard Bluetooth services together with proprietary services such as nRF UART.

Operating with all popular browsers, nRF Connect for Cloud uses Web Bluetooth application programming interfaces (APIs) to push and extract data to and from the cloud, enabling the developer to test and modify the behaviour and performance of prototypes. By using the front-end and visualisation features of nRF Connect for Cloud, historical data can be extracted from databases and analysed in a browser. The product also allows engineers to monitor and interact with remote wireless Internet of Things (IoT) designs, enabling the collaboration of geographically separate development teams on a single project.

nRF Connect for Cloud is supported by the nRF Gateway app available for iOS and Android-powered mobile devices. The app enables Nordic BLE devices to use a smartphone-enabled Internet gateway to convert BLE messages to ReST/MQTT/IP protocols for cloud interoperability.

The Gateway app communicates with the nRF Connect for Cloud back-end hosted on Amazon Web Services (AWS) and is based on software as a service (SaaS) components. By leveraging AWS industry-grade components, the app implements end-to-end data and device connectivity, guarantees reliability, and scales from a few to hundreds of BLE devices.

nRF Connect for Cloud currently supports BLE solutions but future versions will also support Nordic’s nRF91 low-power, global multimode LTE-M/NB-IoT system-in-package (SiP) for cellular IoT. nRF Connect for Cloud works out-of-the-box with the Nordic Thingy:52 IoT Sensor Kit, Nordic nRF5 development kit and software development kit (SDK) examples. A quick-start guide is available from www.nrfcloud.com.

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Software for PXI test instruments

National Instruments announced the release of its InstrumentStudio software for NI PXI modular instruments. InstrumentStudio improves the live, interactive use model for modular instruments and makes debugging while running tests more intuitive. Engineers in the aerospace, automotive and semiconductor industries can benefit from a more effective workflow for test system development.

InstrumentStudio evolves the concept of single-instrument soft front panels into a unified, multi-instrument environment, so engineers can capture screenshots and measurement results in one view from their suite of instruments. InstrumentStudio can also save project-level configurations for specific devices under test that can be repurposed later or shared with colleagues. This efficiency is key for testing high-mix devices and provides test repeatability at a convenience to the engineer or technician.

At different stages in the product design cycle, test engineers often waste valuable time correlating measurements between similar tests that ultimately use different hardware. And in production test, engineers who need to debug on the manufacturing floor may invest in separate hardware either for monitoring their tests or debugging their automated test equipment.

InstrumentStudio addresses these challenges by exporting configuration files to programming environments that reproduce settings, thereby simplifying measurement correlation. Additionally, test engineers can monitor PXI instrument behaviour by running InstrumentStudio while test sequences execute in parallel, streamlining the debug process.

InstrumentStudio is included with the purchase of an NI PXI instrument. Engineers can also download the complimentary software from www.ni.com/instrumentstudio for use with existing NI products.

For more information contact Test Dynamics, +27 62 217 0063.

32-bit MCUs with robust chip-level security

Microchip announced the new SAM L10 and SAM L11 families of 32-bit microcontrollers (MCUs) which address the growing need for security in Internet of Things (IoT) endpoints by protecting against the increasing risk of exposing intellectual property (IP) and sensitive information.

The new MCU families are based on the Arm Cortex-M23 core, with the SAM L11 featuring Arm TrustZone for Armv8-M, a programmable environment that provides hardware isolation between certified libraries, IP and application code. Microchip enables robust security by including chip-level tamper resistance, secure boot and secure key storage which, when combined with TrustZone technology, protects customer applications from both remote and physical attacks.

Both MCU families offer the low power consumption, as well as capacitive touch capability with elevated water tolerance and noise immunity. When benchmarked for power consumption, the SAM L10 received a ULPMark score of 405, which is over 200% better performance than the nearest competitor certified by the Embedded Microprocessor Benchmark Consortium (EEMBC). Microchip uses proprietary picoPower technology to provide industry-leading low power consumption in active and all sleep modes.

In addition to TrustZone technology, the SAM L11 security features include an onboard cryptographic module supporting Advanced Encryption Standard (AES), Galois Counter Mode (GCM) and Secure Hash Algorithm (SHA). The secure boot and secure key storage with tamper detection capabilities establish a hardware root of trust. It also offers secure bootloader for secure firmware upgrades.

Microchip has partnered with Trustonic, a member of Microchip’s Security Design Partner Programme, to offer a comprehensive security solution framework that simplifies implementation of security and enables customers to introduce end products faster.

Microchip has also partnered with Secure Thingz and Data I/O Corporation to offer secure provisioning services for SAM L11 customers that have a proven security framework.

The SAM L10 (DM320204) and SAM L11 (DM320205) Xplained Pro evaluation kits are available to kick-start development. All SAM L10/L11 MCUs are supported by the Atmel Studio 7 Integrated Development Environment (IDE), IAR Embedded Workbench, Arm Keil MDK as well as Atmel START, a free online tool to configure peripherals and software for accelerated development. START also supports TrustZone technology for configuring and deploying secure applications.

A power debugger and data analyser tool is available to monitor and analyse power consumption in real-time and fine-tune the consumption numbers on-the-fly to meet application needs. Microchip’s QTouch Modular Library, 2D Touch Surface Library and QTouch Configurator are also available to simplify touch development.

The SAM L10 and SAM L11 devices are available now in a variety of pin counts and package options in volume production quantities.

For more information contact Dirk Venter, Arrow Altech Distribution, +27 11 923 9600, dventer@arrow.altech.co.za, Shane Padayachee, Avnet South Africa, +27 11 319 8600, shane.padayachee@avnet.eu
**50 GHz digital step attenuator**

pSemi (formerly Peregrine Semiconductor) showcased its 5G millimetre-wave (mmWave) products at the 2018 International Microwave Symposium. These parts included a 40 GHz switch, two 60 GHz switches and the world’s first single-chip digital step attenuator (DSA) to support the entire 9 kHz to 50 GHz frequency range.

The PE43508 is a 6-bit, 50 Ω DSA that offers wideband support from 9 kHz to 50 GHz. It covers a 31.5 dB attenuation range in 0.5 dB and 1 dB steps, and is capable of maintaining 0.5 dB and 1 dB monotonicity through 50 GHz. This high-performance DSA features low insertion loss, fast switching time and low attenuation error. The PE43508 also delivers glitch-safe attenuation state transitions, which eliminates the positive glitch.

Offered as a flip-chip, monolithic die, the PE43508 is easy to use and ideal for mmWave applications including 5G test and measurement, 5G wireless infrastructure, point-to-point communication systems and very small aperture terminals (VSAT).

For more information contact Andrew Hannay, RFiber Solutions, +27 82 494 5466, sales@rfibersolutions.com.

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**Wireless temperature sensor evaluation board**

The DC2126A is a high-accuracy wireless temperature sensor, powered from ambient light, built using Analog Devices integrated circuits. A 24-bit delta-sigma ADC (analog-to-digital converter) reads a thermistor biased from a precision voltage reference. A switching power supply harvests energy from the built-in solar panel, and automatically switches over to the internal battery when no ambient light is available.

At the core of the board is the LTP5901-IPM, SmartMesh IP wireless mote (node), which provides the ultra-low power wireless mesh connectivity with greater than 99.999% data reliability and communicates the temperature to a central access point (manager). The LTP5901-IPM has onboard an ARM Cortex-M3 processor, which can be loaded with user-developed application code using the SmartMesh IP On-Chip software development kit. In the DC2126A, custom application code controls the duty cycling of the voltage reference, samples readings from the ADC and sends the data packet through the SmartMesh IP network.

The DC2126A can be easily added to the DC9000B SmartMesh IP Starter Kit, or any SmartMesh IP network. Temperature readings are sent through the mesh network to a demonstration PC software GUI that displays temperature, and whether the DC2126A is running on solar power or on battery.

For more information contact Conrad Coetzee, Arrow Altech Distribution, +27 11 923 9600, ccoetzee@arrow.altech.co.za
The buzzword for this is smart railways: increasingly intelligent trains and infrastructures allow closer, more precise monitoring and hence tighter train scheduling. This improves track utilisation while at the same time increasing the reliability of timetables. In smart railway systems, rigid maintenance cycles can also be exchanged for a more efficient, on-demand service. This not only saves costs but also increases reliability because the need for maintenance is detected before a failure occurs.

In passenger transport, electronic ticketing helps to improve passenger satisfaction. With more differentiated data on passenger numbers, utilisation can be predicted more accurately and capacity planned in real time based on this big data. In freight transport, smart railway systems can, for example, offer Web-based timetables for individual wagon locations. This makes trains a real alternative to road transport, as customers can now plan and track smaller batches more accurately.

Big demand
The digital transformation of the rail transport market leads to immense investments: in the next 10 years, the market for rail transport technology is expected to grow at more than 22% CAGR (compound annual growth rate) worldwide.

If you look at Europe, one of the specific projects planned is to equip all of Italy’s more than 4000 unguarded level crossings with safety systems to minimise the risk of accidents. In Sweden, the signal box logic is due to be replaced with SIL-level certified components. Just like the previously installed systems, they must be highly robust to be able to operate reliably for years in the harsh conditions typical for the railway sector.

Railway standards are a must
What’s needed is a new generation of safety-critical management and control systems. Just like the previously installed systems, they must be highly robust to be able to operate reliably for years in the harsh conditions typical for the railway sector.

How to design such systems is specified, for example, by the EN 50155 standard. It stipulates the required resistance to extreme temperatures, rapid temperature changes, vibration, shock and electromagnetic interference. But that alone is not enough.

So are SIL standards
Systems where an error or failure may pose a risk to human life or the environment, or cause large financial losses, must meet high functional safety requirements. As a result, smart railway technology often needs to meet the extensive international safety requirements of EN 50128/IEC 62279 for software, and EN 50129/IEC 62425 for hardware. And providing proof of compliance with these requirements is neither an easy nor a quick task.

Certification documentation – a killer job
In a new design, getting the required documentation into place to demonstrate compliance with the safety standards can double or even triple project costs as well as the length of the project. Relevant specifications for functional safety in the railway market include the RAMS (Reliability, Availability, Manageability, Safety) criteria of EN 50126/EN 50128 for software and EN 50129 for hardware. They all require new documentation effort, which solution providers prefer to keep to a minimum.

Pre-certified hardware reduces documentation effort
The strategic lever for a significant reduction of the documentation effort is the use of pre-certified hardware as it is largely based on standardised technology. So, assuming there was a solution provider with specific knowhow of 501xx compliance requirements, it would be possible to delegate this part of the documentation to this supplier.

Two advantages would ensue: Firstly, it would save the costs of in-house documentation. Secondly, it would save valuable time, which in the competitive race for the most innovative solutions is one of the most crucial factors. Whoever is first-to-market, has the greatest market opportunities, enjoys market exclusivity and is in a position to define key standards. But what should such pre-certified hardware for the various tasks look like?

UIC recommendations for hardware implementation
In its ‘Global Vision for Railway Development Report’, the UIC makes three clear recommendations:

1. Instead of the often closed existing systems, new configurations should be built as

Figure 1. The MEN Train Control System (menTCS) with SIL 4 pre-certified components is deployed in a variety of safety-critical rolling stock and wayside applications.
modular designs. This makes it easier to adjust systems for different applications and promotes the efficient re-use of already existing designs. For instance, modular systems can be deployed in different configurations both in train management systems as well as in wayside installations that control switches or signals. Modular systems also allow faster, more cost effective maintenance as individual modules can be replaced directly in the field. Last but by no means least, they are future-proof because expansions are easy to implement by adding extra modules or swapping in more powerful ones.

2. In addition, the systems should be based on open standards. This is to ensure that the total system design has a long life cycle and that it will not become obsolete if a vendor drops out. This also boosts cost efficiency because when components can be purchased from different manufacturers, this often brings cost advantages.

3. So-called white-box designs are further recommended. Unlike the currently prevailing proprietary black-box designs, where the hardware and software components are inseparable and there is no option to make adjustments, they aim to provide a transparent system structure. This allows flexible system adaptations for different tasks, interface standards and communication protocols and guarantees their interoperability. This is an important prerequisite for achieving cross-border security and communication in rail transport in the medium to long term.

Modular COTS platforms based on the CompactPCI standard by the PCI Industrial Manufacturing Group (PICMG), which has been maintained since 1997 and is specially developed for extremely robust, modular designs with passive backplanes, fulfill these requirements in general. However, they only describe the basic technology and do not, per se, include the certification and documentation necessary for EN 50155 and EN 50126, EN 50128 and EN 50129. For solution providers to gain the maximum benefit from the use of such modular COTS platforms, it is therefore imperative to extend this standard to railway technology.

The menTCS platform
MEN Mikro Elektronik is the first company worldwide to have recognised this need and has expanded its comprehensive EN 50155 compliant CompactPCI product portfolio with a system that is specially designed for safety-critical railway applications and pre-certified for EN 50126, EN 50128 and EN 50129.

The new menTCS MEN Train Control System with SIL 4 pre-certified components (Figure 1) shortens the certification process for solution providers. Thanks to its modular design, it can be adapted for all types of different applications. For example, in rolling stock the menTCS is an ideal solution for automatic train operation (ATO), automatic train protection (ATP) or enhanced train control (ETC). In wayside applications, it can be used to control signals and switches up to safety level SIL 4.

System architecture
The heart of menTCS is the MH50C central controller. It houses the central control logic in the form of a CompactPCI-based multi-processor board that is pre-certified for EN 50155 and EN 50126, EN 50128 and EN 50129.
Figure 3. The menTCS MH50C controller supports flexible expansion with up to 63 modular remote menTCS I/O boxes that are connected via a redundant, real-time ring topology.

Figure 4. The menTCS platform is the world’s first system that is independent of the final application, since it separates the safety-critical control functions from the non-critical I/O communication.

Figure 5. The PACY I/O framework unifies the communication between the safe domain with custom-specific safety application software and the I/O domain.

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and can be customised with up to six extension cards depending on the requirements of the application – see Figure 2 (page 19).

In addition, up to 63 modular menTCS I/O boxes are available to connect remote I/Os to the central menTCS controller. This makes sense for installations in high-speed trains where each passenger car needs its own I/O box to connect the sensors and actuators.

The modular expansion concept is also proven for wayside installations such as signalling systems, where the modular menTCS I/O boxes can be used to control certain sections of track as required. In this case, the menTCS I/O boxes are connected via an Ethernet-based ring topology (Figure 3). This not only simplifies the wiring, but also greatly increases reliability because two redundant communication channels can be used.

The components of the modular family concept, which can be certified separately, can also simplify the development of complete, customised 19-inch systems if this is needed.

**Flexible extensions and interfaces**

The modular I/O concept of the standardised menTCS architecture gives developers great flexibility and makes it very easy for them to equip the controller and the remote I/O boxes with communication interfaces via CompactPCI-based cards. For connection with a TCN network, MVB interface boards can be used. Additional onboard components and control units can be connected via RS-485, CAN, Profinet and other fieldbuses or communicate for IoT connectivity via WLAN, GSM-R, GPS, GLONASS or Galileo, or as standard routers and switches via Ethernet.

**Scalable safety**

Since all safety-critical menTCS modules are pre-certified to the highest SIL 4 safety level according to EN 50128 and EN 50129, they fulfill all requirements that may arise in safety-critical railway applications – from SIL 2 for ATO systems to SIL 4 for signalling applications. This allows developers to focus exclusively on the software, without regard to the hardware. Depending
on the final application, the security level of the hardware can be determined at any time and without engineering effort.

**Safe domains reduce the software development effort**
The menTCS hardware platform is designed so that the safety-related control software is clearly isolated from the peripheral software that is not relevant for the certification. It achieves this by executing the individual safety-critical control functions in separate safe domains, thereby keeping them apart from the general, non-critical I/O functions (Figure 4). This isolation is done both on the hardware and the software level.

Thanks to this stringent separation the more complex safety-critical programming is confined exclusively to the safe domains, which simplifies the software development and also makes SIL certification easier and faster. Next to the reduced hardware documentation effort, this is the second major lever for significant cost savings compared to in-house developments.

**High safety SIL 4 controller boards**
At the core of the menTCS MH50C controller sits the SIL 4 certified F75P CompactPCI PlusIO SBC processor board. This single board computer integrates three Intel Atom E680T processors. Two redundant processors perform the safety-critical control functions. They are linked to PCIe via an FPGA, which handles the synchronisation of the application checkpoints to SIL 4 for the required 2oo2 redundancy. The third processor is responsible for overall I/O communication.

Thanks to market-wide, long-term experience with these processors, all hitherto found safety-critical bugs are known and documented. As long as the available board guidelines are adhered to, no systematic errors that may affect the safety behaviour can occur.

**Safe domain with QNX Neutrino**
For safety-critical applications, the menTCS MH50C controller integrates the QNX Neutrino real-time operating system, which is specifically tailored to the integrated hardware. Compared to proprietary operating systems, this integration alone saves developers and OEMs around two million Euros in project costs and lets them avoid all the risks associated with certification. The board support package for the implementation of QNX Neutrino is SIL 4 pre-certified on the menTCS platform and therefore offers the highest degree of reliability from the outset.

QNX Neutrino uses a microkernel architecture that strictly isolates the software processes from each other, which prevents the performance and behaviour of other processes from being affected. This in turn guarantees that the system remains in a safe state at all times, since even malware can have no influence on the safety-critical processes. In addition, QNX Neutrino supports the separation and flexible adjustment of the CPU bandwidth.

The safety-critical applications can be programmed via C or Ada, as well as on model basis - for example in SCADE or soft PLC programming environments. Developers can often remain in their familiar development environment, which minimises costly re-certifications. Other operating systems, such as Green Hills’ INTEGRITY, PikeOS from Sygo or Wind River VxWorks, can be implemented upon request.

**Framework for unified I/O communication**
To simplify I/O handling in the safe domain, MEN Mikro Elektronik has integrated the PACY I/O framework (Figure 5) into the safe domain, which introduces a transparent abstraction layer between the safe domain and the I/O domain. This means that identical functions are always addressed the same way in the same domain, and become independent from the actual execution of the inputs and outputs.

With PACY, it does not matter whether a command addresses a relay or a digital I/O. This makes the integration of menTCS much simpler and more flexible. Train and track systems with different sensors and actuators for the same functions can now be equipped with identical...
Continued from page 21

control systems, which not only immensely simplifies retrofits but also the roll-out of new technologies.

PACT is implemented as a flexible framework on a modular basis, which enables flexible expansion with individual, customer-specific modules as well as communication with any C application. In future, developers will also be able to define PACT function blocks that combine multiple tasks in one macro command. This way, frequently used processes, such as the emergency braking function, can simply be activated without the need to re-program them for each case. Communication between the safe control and the safe brake is done within the I/O domain.

I/O domain with Linux

Since the third Intel Atom processor handles the technical I/O connection completely separately from the safe domain (see Figure 6), it is guaranteed that the I/O domain will never influence the safe control logic. MEN Mikro Elektronik uses a pre-integrated and pre-certified Linux OS for this purpose. This gives customers access to a fully developed and proven ecosystem with off-the-shelf tools and drivers that they can use right away. Additional OS are available upon request.

The communication between the safe system and the I/O cards of the menTCS controller and I/O boxes is based on the EtherCAT protocol. EtherCAT is a real-time Ethernet standard with real-time cycles of less than 5 milliseconds that meets all requirements for safe communication with the menTCS components.

EtherCAT requires no switches as it supports the ring topology via redundant communication channels. It utilizes the security protocol Fail Safe over EtherCAT (FSFSoE) to reliably detect altered, duplicated or lost data packets. The entire I/O communication path therefore functions as a Black Channel, which provides the required functional safety during communication.

Conclusion

The application-ready menTCS platform from MEN Mikro Elektronik is well suited for all safety-critical smart railway applications. It offers train and track operators, as well as third-party and automation suppliers, many advantages. Large OEMs, which currently dominate the market of SIL-enabled applications, stand to gain just as much from these innovative platforms as young startups and professional makers, who may have less interest in the technical requirements but want to implement innovative IoT-enabled smart railway solutions.

It is even possible to downsize the menTCS platforms to make them suitable for simpler railway applications such as infotainment or video surveillance of doors and passenger compartments. This way, extremely multifunctional solutions can be implemented with a single technology platform at any time.

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UPS in PC/104 footprint

TBP4xxx modules from Tri-M Technologies are extended temperature, maintenance free, high cycling backup energy modules that, when combined with a Tri-M HESC or HPSC smart charging power solution, create a complete uninterruptible power system (UPS) in a PC/104 footprint.

The TBP4xxx is designed for hostile environments of extreme temperatures and vibration. This rugged backup energy module is ideal for applications that have either a large number of discharge cycles or where a ‘maintenance free’ solution is required, such as remote and hard-to-access locations.

The modules are available in 500, 1000, 2000 and 4000 Joules and mate directly to the bottom of HESC or HPSC power supplies. Designed to MIL standards, they can be fully charged in less than a minute, are capable of 500 000 cycles, and are immune to negative effects due to deep discharge.

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Figure 6. The menTCS F75P controller board is SIL 4 certified and comes with three Intel Atom E680T processors - two redundant ones for safety features, and one for I/O communication.
Miniature PC for demanding IoT applications

Brandwagon has announced local availability of the fitlet2 computer for demanding Internet of Things (IoT) applications. Based on the Intel Atom x7-E3950 processor (of the so-called Apollo-Lake processor generation) with up to 16 GB RAM and storage options ranging from eMMC to 2.5” SSD, fitlet2 is a highly versatile miniature PC for IoT. Its functionality can be further extended with 2nd generation Function and Connectivity Extension T-Cards (FACET cards).

Like all other Compulab mini-PCs, fitlet2 is completely fanless, operates across a wide temperature range and is sold with a 5 year warranty. It measures only 112 mm by 84 mm, making it one of the smallest full-featured PCs on the market. All metal die-cast housing is used for fanless passive heat dissipation. There are several optional versions of the housing, including a low-profile 25 mm option and an industrial top cover for direct mounting.

According to Compulab's chief product officer, Irau Stavi, “IoT gateways have to be small, affordable and reliable. Furthermore, each IoT application requires a slightly different set of features. The most effective way to meet this requirement is by integrating an application-specific module into the gateway. fitlet2 achieves this flexibility with FACET cards.”

The FACET cards available for fitlet2 include:
- FC-LAN with two additional Gbit Ethernet cards (for a total of four).
- FC-PCIe and FC-CEM with support for both 4G cellular modem and Wi-Fi that, together with dual Gbit Ethernet, makes a capable miniature IoT gateway.
- FC-USB adds four USB ports for a total of eight.

Additional FACET cards are under development, including ones for making fitlet2 a Power over Ethernet (PoE) powered device, one for integrating a 2.5” HDD/SSD and one for optical LAN.

RFSoc board for radar and DRFM

Pentek introduced its first product in the Quartz architecture family, the Model 5950 – an eight-channel A/D and D/A converter, 3U OpenVPX board based on the Xilinx Zynq UltraScale+ RFSoc FPGA. The low latency benefits of the architecture support DRFM (digital RF memory) and radar applications that were previously not possible with earlier generation products.

Designed to work with Pentek’s Navigator Design Suite tools, the combination of Quartz and Navigator offers users an efficient path to developing and deploying FPGA software and IP for data and signal processing. The Xilinx Zynq UltraScale+ RFSoc Processor integrates 8 RF-class A/D and D/A converters into the Zynq FPGA fabric and quad ARM Cortex-A53 and dual ARM Cortex-R5 processors, creating a multichannel data conversion and processing solution on a single chip.

Complementing the RFSoc’s on-chip resources, the Quartz board architecture adds:
- 18 Gb of DDR4 SDRAM; sophisticated clocking for single-board and multi-board synchronisation;
- high signal-integrity connectors for RF inputs and outputs;
- x8 PCIe Gen 3 link; an 8 lane, 28 Gbps optical interface supporting a built-in dual 100 GigE interface or customer installed protocols;
- 12 LVDS general purpose I/O pairs for specialised interfaces;
- QuartzXM eXpress module design for flexible development and deployment; and factory-installed application IP.

The Model 5950 is pre-loaded with a suite of Pentek IP modules to provide data capture and processing solutions for many common applications. Modules include DMA engines, DDR4 memory controller, test signal and metadata generators, data packing and flow control.

The board can be used out-of-the-box with the built-in functions requiring no FPGA development. It comes pre-installed with IP for DRFM, triggered waveform and radar chip generator; triggered radar range gate engine, wideband real-time transient capture, flexible multi-mode data acquisition and extended decimation.

Technical specifications

The front end accepts analog IF or RF inputs on eight front panel MMCMX connectors with transformer-coupling to eight 4 GSps 12-bit A/D converters delivering either real or complex DDC samples. With additional IP-based decimation filters, the overall DDC decimation is programmable from 2 to 128.

The eight D/A converters accept baseband real or complex data streams from the FPGAs programmable logic. Each 6,4 GSps 14-bit D/A includes a digital up-converter with independent tuning and interpolations of 1x, 2x, 4x and 8x. Each D/A output is transformer-coupled to a front panel MMCMX connector.

The Model 5950 supports the VITA-66.4 standard providing eight 28 Gbps duplex optical lanes to the backplane. With two built-in 100 GigE UDP interfaces or a user-installed serial protocol, the VITA-66.4 interface enables gigabit communications independent of the PCIe interface.

Streamlined IP development

Pentek’s Navigator Design Suite includes the Navigator FDK (FPGA design kit) for custom IP and Navigator BSP (board support package) for creating host software applications.

The Navigator FDK includes the board’s entire FPGA design as a block diagram that can be edited in Xilinx’s Vivado tool suite; all source code and complete documentation is included. Developers can integrate their IP along with the factory-installed functions or use the Navigator kit to replace the IP with their own. The Navigator FDK Library is AXI-4 compliant, providing a well-defined interface for developing custom IP or integrating IP from other sources.

The Navigator BSP supports Xilinx’s PetaLinux on the ARM processors. Users work efficiently using high-level API functions, or gain full access to the underlying libraries including source code. Pentek provides numerous examples to assist in the development of new applications.

With a 3U VPX SPARK, development systems are ready for immediate operation with software and hardware installed. In many applications, the SPARK development system can become the final deployed application platform.

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

www.dataweek.co.za
A home for the Raspberry Pi

By Anke Beck and Jan Maksel, Phoenix Contact.

The Raspberry Pi has exceeded many of its creators’ expectations. Many amateur developers use the miniature computer to automate processes within their own home, for example. At the same time, a growing number of companies and institutions are discovering the advantages of using the Raspberry Pi in their commercial building automation and industrial applications.

Creative ideas have emerged in areas ranging from development environments and prototype construction, through to low-cost mini-controllers and data-loggers. The devices are used to control the climate in buildings or as data collecting systems in mass production test setups, for example.

Demands for shorter turnaround times and lower costs towards development and series production, not to mention trends such as Industry 4.0 and the Internet of Things, are helping to foster the success of the Raspberry Pi and other single-board computers (SBCs).

Electronics developers have relied on ready-made electronics modules for some time, buying more complex modules that feature microcontrollers, RAM and Flash memory in order to combine them with their own I/O boards. This approach is advantageous because module components that are complex and often too expensive to buy in smaller quantities are already available on the mass market.

The Raspberry Pi is such a component. It is a high-performance computer that comes with many I/Os as well as an extensive software suite. It can also be upgraded with expansion boards – either developed in-house or purchased from outside vendors.

Device solutions for professional applications

The Raspberry Pi requires high-quality, functional housing and connection technology in order to be used in professional applications. The devices need to be assembled and used in installation distributors or control cabinets in a safe way and in accordance with the applicable standards – especially if they are part of commercial building and industrial automation solutions.

Many commonly-available housing solutions can only accommodate the Raspberry Pi board. They are mostly used as table-top housings and can be attached to a wall. However, they do not enable rail-mounted assembly in a cabinet. These housings are available in many colours and designs and are made with plastic, metal or even wood. The connections, also known as GPIOs (general purpose input/output), are fed out using ribbon cables.

Meanwhile, mounting rail housings for the Raspberry Pi offer a standardised and reliable method of assembling the module in situ in a control cabinet or installation distributor. Furthermore, the housings allow expansion boards to be integrated and GPIOs to be connected using industrial-grade plug-in connectors. They also allow a device system to be assembled using bus connectors.

Finally, many housing solutions can be lined up on mounting rails next to one another while allowing for the reliable and convenient connection of HDMI, USB and micro-USB power cables as well as RJ45 connectors. The Phoenix Contact RPI-BC housing, compatible with the Raspberry Pi A+, B+, B2 and B3 series (Figure 1), offers all of these features. An adapter is required to connect a USB cable to the A+ model.

Connection technology and expansion boards

It is essential to have simple and reliable wiring – when connecting sensors to the GPIOs, for example – if the Raspberry Pi is being used in a production environment. Furthermore, wiring should be
completed quickly, and connecting GPIOs to expansion boards should not require additional time-consuming steps, especially during assembly.

The RPI-BC allows GPIOs to be connected to expansion boards using Phoenix Contact PTSM plug-in connectors, which are available with a pitch of 2.5 mm. The push-in connection allows the connectors to be wired without using tools. The expansion boards, which can also be snapped into the housing without tools, leave ample room for the user to add their own circuit designs.

Compatible wire-wrap boards are available for simple circuitry. The expansion boards connect ‘automatically’ to the Raspberry Pi and to the bus system when the device is assembled, since the corresponding PTSO terminals, which are soldered onto the expansion boards, plug directly into the GPIOs of the Raspberry Pi and the bus slot (Figure 2).

The micro-SD card is an important component of the Raspberry Pi since it serves as the computer’s ‘hard drive.’ It would be disastrous if someone – an unauthorised user, for example – were to remove this storage medium from the device while it is in operation. The RPI-BC prevents this since the little slot where the card is inserted can be closed off with an adhesive seal after the card is put in place. This seal then leaves behind a residual trace on the surface of the device if the card is removed.

Mounting rail bus connectors for easy wiring

Bus connectors are widely used for device development and are especially popular when developing modular device systems. Most systems have a power supply unit (PSU), a central processing unit (CPU) and many I/O units, allowing for various system configurations to be put together conveniently. Bus connectors significantly reduce the amount of time it takes to wire modules in the mounting rail since they power the modules and enable them to communicate with one another.

Similarly, it is beneficial to use bus connectors, such as the H-Bus for the RPI-BC, when developing devices with the Raspberry Pi. They allow the Raspberry Pi to serve as a CPU and the additional modules as I/O modules, for example. The H-Bus can then take care of communication with the GPIOs and I/O modules. The modules can be assembled on the mounting rails simply by plugging them in (Figure 3).

Summary

Single-board computers are not a recent invention. They were already being used in the 1970s for development and production systems. However, today’s microcomputers feature two innovations. First, they are significantly more powerful, more reliable and less expensive, thanks in part to the growing market for smartphones and tablets. Second, there is strong demand from today’s industrial and building automation solutions for low-cost control and monitoring products.

However, the single-board computer, its operating system and software, cannot fully function as a complete and usable standalone device. High-quality, functional electromechanical components such as mounting rail housings and interfaces are necessary to use single-board computers in an industrial or semi-industrial environment in control cabinets or installation distributors.

At the same time, amateur developers would also be pleased to have professional solutions that meet their needs. Manufacturers of electromechanical products have taken these requirements to heart. The RPI-BC housing and the corresponding connection technologies for Raspberry Pi boards are a step towards new, forward-looking markets.

For more information contact Richard Schoonebeek, Phoenix Contact, +27 11 801 8200, rschoonebeek@phoenixcontact.co.za
From zero to 100 million placements a month in 25 years

By Mike Goodyer, CEO of Microtronix.

Microtronix was started in 1993 in a small factory on the third storey of a building in Fontainebleau. Our first asset was a small 300 mm Seho wave soldering machine and we had about seven staff members, our primary focus initially being the assembly of gaming machines and cashless card systems for casinos – cashless gaming being a relatively new concept in those days.

In 1996 we moved to our own premises up the road, still in Fontainebleau, and from there expanded our work to include the military sector and some new contract manufacturing clients. Our staff grew to about 20, many of whom are still with us today. During this time, we became the primary manufacturer for a company called Stella Vista who were a leading LED signage company in SA and had acquired a major contract for signs around the country as well as for the cricket World Cup at the time.

As a result of this contract Microtronix then made its third move, to the south of Johannesburg, together with Stella Vista where we learnt a lot about LEDs and LED technology. We stayed in the Turfontein area together with Stella Vista for a further five years, in what used to be similar to a Chinese sweat shop. The rent was cheap, the machines tightly squashed together and no air conditioning – finally in 2002 Microtronix moved back to Randburg (Strijdompark) into our current premises that was custom built for the purpose of electronics assembly.

Over the next 15 years the Microtronix ‘family’ grew its customer base, its staff and of course its fleet of machinery. We are proud to say that most of our staff who joined us along the way are still here today, as well as the majority of our customers – both have stayed with us through the good times and the bad.

In 2017 the company had way outgrown the existing premises despite overflowing into the mini factories behind our main building. In 2015 Microtronix took a bold step and acquired two old buildings down the road totalling 10 000 m². 2016 was spent renovating and customising the new buildings and transforming the new facility into a modern state-of-the-art, highly efficient manufacturing facility.

In October 2016, approximately a year later, half of the factory staff and all the high-speed Universal machines moved to the new building down the road with a view to play in the infamous set-top box (STB) tender for government. The new factory layout soon proved to be a great step and our efficiencies rose sharply and costs dropped to a point where we were surprisingly able to compete with Chinese prices head on head.

At this time, together with our tenacious empowerment partners, BUA Africa, and a Chinese technology partner, Skyworth, we were able to get a small share of the local STB market, non-government driven, and slowly and incrementally grew this market to a point where we now produce approximately 80 000 to 100 000 boxes per month. At the same time, existing customers such as TV board manufacturers, vehicle tracking and metering clients were able to enjoy the benefits of more efficient and lower-cost manufacturing.

In November 2017, Shaun Rampursad, the BUA Microtronix factory COO, proudly reported that for the first time ever the factory had reached a target of 100 million placements in a month. Since then Microtronix has acquired another high-speed Universal line and recently installed a Fuji six-module line that steadily runs just over 100 000 placements per hour.

In May 2018 the MX group combined, produced just over 220 000 different PCBs and reached a new record of just over 180 million placements in that month. With just over 40 pick-and-place machines and 500 staff we really can offer the SA market world-class manufacturing on their doorstep.

Microtronix has over the years always adopted the attitude that we can look after all our customers no matter how big or small they are. We always knew that having separate facilities would be a mitigating factor when...
considering our clients’ risk, and to this end within the group we have three separate facilities: the small prototype and specialised manufacturing factory, SM-Tech, based in Pretoria; the medium-sized factory, Microtronix Manufacturing, at our head office in Strijdompark, taking care of the majority of our medium sized customers; and finally as the plan fell into place, a very high-volume factory down the road, BUA Microtronix, enabling us to keep our large volume clients from migrating to China when the volumes seemed to warrant this.

On a final note, the current hot topic is the worldwide shortage of resistors and chip capacitors, and again on a light-hearted note, what we believed was going to be a huge liability may just turn into a great asset for the company and our clients, as Microtronix currently has a massive inventory of excess stock built up over the years.

During a recent upgrade of our stores, Microtronix has installed an X-ray component counting machine which enables us to count components on reels within a few seconds. A full list of available parts will be posted on our website in July for anyone to access during this period of component shortage.

Again, as always, a sincere thank you to our loyal staff and customers for sharing in this wonderful journey from zero to 100 million placements per month over 25 years.

For more information contact Microtronix Manufacturing, +27 11 792 5322, info@microtronix.co.za
Flying probe tester

The Flying Probe S2 testers from SPEA are designed for the highly demanding test requirements of today’s electronics. Their entire force/measurement unit has been placed directly on the axis, so that rather than just probes flying over the board, this serves as a ‘flying tester’ able to achieve zero distance between the probe and the signal forcing/measurement. This results in faster test and very clean signals, ensuring the most accurate measurement performance.

This ATE system is based on innovative linear motors and drivers on XYZ axes: materials, motion technology and motion balance are designed to guarantee extraordinary accuracy with no change, drift or calibration required. Sticky boards and flex circuits contacting is fast and reliable, as is miniaturised device testing. Even the 008004 package (0,25 x 0,125 mm) is testable with this unit.

The flying probers also extend the range of test techniques to include LED colour and intensity test. LED flying sensors perform the high-speed measurement of the wavelength and intensity of the light emitted by LED, in compliance with the most stringent specification. 3D laser test is another test feature, whereby laser flying sensors measure the UUT profile, detect tombstoning and check the height of components.

100% short circuits are detectable with just one test per net from the first prototype thanks to the new nodal impedance test, which provides a quality and productivity enhancement compared to the conventional short circuit test techniques.

Finally, power-on test with all the probes and HV test can be performed in addition to in-circuit test, functional test, open pin scan, boundary scan and high-resolution colour optical test. The system instrumentation is configured for 8-wire measurements.

Contactless SMD component counter

The XRHCount from VisiConsult is a contactless counting system for surface mounted electronic components. To prevent production line stops the system delivers the exact amount of components directly into warehouse management databases.

Combined with an unmatched speed and accuracy this system will revolutionise slow and costly processes.

When it comes to the necessity of counting components before or after the assembly process, most manufacturers are still using the old fashioned approach of manual counting devices. XRHCount makes use of VisiConsult’s X-ray expertise in order to speed up this time consuming process.

The cabinet has a footprint of 1,25 x 0,85 m, a height of 2,2 m and is certified by the German TÜV. Significant is that there is no X-ray leakage, an automatic drawer, automated label printing and an interface to all common warehouse management systems. The system is also designed to provide maximum safety and an ergonomic working position for the operator. XRHCount supports components on reels, belts and in trays.

The system can reduce a component counting process from up to 5 minutes to as little as 10 seconds, with a mean accuracy of 99,9%. While a barcode scanner and label printer interface is provided, its AI (artificial intelligence)-powered automatic type estimation makes barcode scanning obsolete. Powered by CountingCloud, the estimator has access to a global online type database with thousands of reference component types. In case of a new type the operator reports the reel to the VisiConsult development team through a single click. Regular updates covering all reported types worldwide are shipped on a regular basis.

For more information contact Testerion, +27 11 704 3020, info@testerion.co.za

Factory in a box

Mycronic has joined a Nokia-led group of 12 electronics industry players to offer a plug-and-play ‘Factory in a Box’ mobile solution for next-generation electronics assembly. The fully automated in-line solution, which fits in a portable cargo container, includes the Mycronic MY700 jet printing and dispensing platform, among other equipment. It can be packed, transported and brought back into service in a matter of hours.

Target applications include but are not limited to extra capacity in peak periods, prototyping around new product introductions or shutdowns due to natural disasters. The collaboration was driven by the expected changes in manufacturing sparked by Industry 4.0, including cloud-based solutions, robotics and new electronics manufacturing Internet of Things (IoT) solutions.

According to Clemens Jargon, VP global dispensing, Mycronic’s MY700UX offers a dual advantage: “since it is equipped with dual lanes and dual heads, it allows manufacturers to handle any solder paste or assembly fluid deposit with absolute precision and unmatched speed. The compact unit thus combines solder paste jet printing with jet dispensing of adhesives, UV materials, epoxies and more – with micrometre precision and at speeds of more than one million dots per hour.” Nokia says it was also attracted to the unit’s robust yet compact design, which fits well into the confines of the mobile cargo container.

For more information contact Techmet, +27 11 824 1427, info@techmet.co.za.
Printer for professional 3D printing

The Ultimaker S5 3D printer targets the professional end of the market across a number of applications and meets engineering requirements from the creation of prototypes to full end-use, industrial-grade components and parts. Headline features of the machine include continuous operation, large build volume, advanced connectivity, dual extrusion, an open filament system and the ability to print with a wide range of materials, including third-party filaments.

The S5 brings together the Ultimaker 360-degree holistic approach with the integration of hardware, software and materials. This results in an easy-to-use and highly reliable manufacturing solution with full settings alignment to meet the needs of engineers, designers or specialists working in many different fields from architecture to medical, as well as use in universities and other academic institutions.

Offering low total cost of ownership, and designed for use by multiple users, the printer employs silent stepper drivers, making it ideal for use in an office or studio environment. A further key element is the printer’s open and flexible platform, which enables users to align the machine with their existing processes to create a highly efficient workflow.

Major features include the printer’s build volume of 330 x 240 x 300 mm, which makes it suitable for printing larger objects, and the machine’s active multi-point bed-leveling system. This monitors the flow of material and ensures a perfect first layer by compensating for variations in build-plate topography and then automatically correcting errors during the printing process to deliver high-quality parts.

The printer has also been designed to use a very wide range of materials from PLA and Tough PLA to advanced plastics such as Nylon, PC and even composite materials. Support for other widely available materials includes ABS, CPE, CPE+, TPU 95A, PP, PVA and Breakaway. However, Ultimaker’s extensive know how of materials, combined with the use of its Cura 3D printing software, means that almost any industrial filament can work with the printer.

The S5 also offers a high build-plate temperature of up to 140°C, which is required by materials such as PC. However, in addition to the printer’s standard glass build plate, a more resistant build plate made from aluminium will also be available to customers. This makes the machine suitable for the building of very large objects made from engineering materials such as ABS or PC.

For more information contact RS Components, +27 11 691 9300, sales.za@rs-components.com

Cleaning agent concentration tester

The Zestron EYE product family celebrated its latest automated cleaning agent monitoring solution for PCB and stencil cleaning processes at SMT Hybrid & Packaging 2018 in Nuremberg.

In addition to the established Zestron EYE inline measuring system and the self-sufficient CM module, the mobile, battery-powered Zestron EYE Mobile measuring device is now available. The device guides the user quickly and easily to a precise concentration measurement result. Configurable measuring profiles enable process monitoring even for several machines with different settings and cleaning agents.

When concentration in the cleaning bath starts to deviate from the set point, e.g. by drag-over, the practical dosing recommendation function is useful. The result is a recommendation with the appropriate cleaning agent or DI-water addition in order to obtain optimum concentration within the wash tank.

For more information contact Electronic Industry Supplies, +27 11 726 6758, hreispty@iafrica.com
Automated fluid dispensing platform

Nordson ASYMTEK’s Helios SD-960 series is a new automated dispensing system for medium and bulk volume deposits of single- (1K) and two-component (2K) materials in electronics manufacturing and printed circuit board assembly.

The Helios system is ideal to deposit volumes greater than 1 cc, and line widths and dots that exceed 1 mm, but it can deposit volumes down to 0.3 cc and line widths as narrow as 0.3 mm. The system supports highly abrasive thermal interface materials (TIM), silicones, epoxies and grease for applications such as potting, sealing, gasketing and structural adhesives.

The system was made specifically to accommodate large parts and substrates. The frame is 200 mm taller and the robotics 150 mm higher than a standard dispensing platform for more overhead clearance. An optional bulk fluid hose enclosure can provide added vertical clearance for securely routing remote bulk-feed hoses and to accommodate larger valves and mixers. There are two conveyor options: standard chain or double-wide chain. A large purge container holds volumes up to 2 litres.

Helios can be equipped with Nordson ASYMTEK dispense valves or Nordson 1k- or 2k-metering systems. When used with metering systems, the controls can be integrated so that the operator sees the metering system’s monitor from the same position as the machine control. This allows the operator to focus on the dispensing area during operation.

The Helios system comes with Nordson ASYMTEK’s Fluidmove software, providing dispense programming control in a familiar Windows environment. Closed-loop controls maintain control and accuracy of the dispensing process. An optional needle sensor is available to monitor the positioning of large needles that deliver bulk amounts and a laser height sensor automatically calibrates for substrate height.

A camera system enables programming and fiducial recognition, and an optional large-capacity, integrated weight scale provides mass flow calibration to ensure that dispense volumes remain within defined process limits through weight-controlled dispensing and automatic calibration.

The Helios system accommodates a variety of bulk fluid supply options. Various size reservoirs, fluid regulators, booster pumps, level sensors and more can be selected to fit the specific fluid and application requirements.

For more information contact Techmet, +27 11 824 1427, info@techmet.co.za.

Soldering station for heavy-duty production

PACE Worldwide introduced the ADS200, a new high-power, low-cost production soldering station, at the IPC APEX Expo 2018.

The ADS200 features the new TD-200 Cool-Touch Handpiece, with its sleek and ergonomic aluminium handle designed to stay cool and comfortable during continuous production soldering.

Blue Series tip-heater cartridges integrate a high-accuracy sensor with a robust heater, delivering up to 120 Watts of power. Unlike curie point systems, any temperature can be selected (from 193°C to 454°C) without changing the cartridge. The quick-change cartridges can be quickly swapped while hot, and achieve set temperatures instantly, yet they are cheaper than most other cartridge style or curie point tips.

PACE’s new AccuDrive temperature control technology delivers enhanced thermal performance and highly accurate temperatures, without the need to change tip cartridges or calibrate. Its advanced electronics provide instantaneous load sensing and on-demand power to quickly reflow solder joints at the lowest, safest temperature required, regardless of the mass of the application.

Intended for extreme, multi-shift production use, the ADS200 features a rugged, all-metal design including housing, soldering iron and tool stand. The system is intuitive and easy to operate by setting the temperature with arrow keys.

For more information contact MyKay Tronics, +27 11 869 0049, mykay@iafrica.com.
Designing high-speed PCBs using four layers

By Lee Ritchey, president, Speeding Edge.

There is an ever-growing demand for high-performance electronics products to use printed circuit boards (PCBs) with an absolute minimum layer count. When the luxury of many signal and power layers are available to a PCB designer, there is far more flexibility to route the signals and to deliver multiple rails of power to support these very high-speed signals and processors.

In a four-layer PCB, this task is especially challenging due to the limited number of power and signal layers available to the designer.

Much research has been done and many papers have been published stating that it is necessary to have closely spaced power and ground planes in order to provide power plane capacitance to supply switching current at very high speeds to wide parallel buses such as PCI and DDR. Yet, these same buses function properly in four-layer PCBs that do not have any detectable interplane capacitance. Examples of products that function at very high data rates with four-layer PCBs are most desktop PCs as well as high-performance game consoles such as the Microsoft XBOX 1.

Figure 1 illustrates a typical stackup of a four-layer PCB with the planes L2 and L3 close to the outer layers, so that the signals on the two outer layers have correct desired impedances. Because of this build up, the distance between the two planes is fairly large, in this case 48 mils (1.2 mm). But to create any useful plane capacitance, the plane separation must be less than 4 mils (0.1 mm). So the question arises: how can a high-speed design work with such a stackup?

The design problem

The problem that first arises when a high-speed design does not have adequate interplane capacitance to support the switching-current transients associated with modern logic systems, is EMI failure due to the high-frequency energy radiating from the product. If the lack
of capacitance is severe, logic failures can also appear.

To understand the source of this problem, it is useful to examine what occurs when high data rate signals switch from a logic 0 to a logic 1. Most CMOS logic signals are series terminated as shown in Figure 2 (page 31).

When a logic state switches from 0 to 1, there is a requirement for current or charge from the power supply system. Figure 3 (page 31) shows the voltage waveforms at the driver output (red) and at the load or input (yellow) for the circuit in Figure 2. As the signal travels down the transmission line, its parasitic capacitance is charged up to \( V_{DD} \) by transferring charge from the power system capacitance to the line capacitance.

The diagram in Figure 4 is the current waveform that must be supplied by the power distribution system (PDS). To understand the frequencies that make up the current waveform in Figure 4, one must convert from the time domain to the frequency domain, and this is accomplished by using a Fourier transform. Figure 5 shows a Fourier transform of the switching waveform for the circuit in Figure 2 which has a clock frequency of 30 MHz.

The red waveform at the top of Figure 5 is the current waveform, with the positive-going excursion illustrating the current being drawn from the PDS when switching from 0 to 1, and the negative-going excursion illustrating the charge being removed from the parasitic capacitance of the line while switching from 1 to 0. Notice that the first frequency is about 85 MHz, it is not a harmonic of the 30 MHz clock frequency, and there are no harmonics of the 30 MHz clock frequency in the spectrum.

Traditional EMI rules suggest that EMI is a function of clock frequency, however the transform in Figure 5 shows that this is not true. The events that make up the frequency spectrum in Figure 5 are as follows: the lowest frequency in the spectrum will be set by the round trip delay of the transmission line, and the highest frequency will be set by the rise time of the signal.

Those who have experienced EMI failures may recognise the spectrum in Figure 5. The
reason is, if the PDS capacitance is not capable of supplying this charge, there will be voltage variations (ripple) on VDD with this frequency spectrum. Any CMOS output that is at a logic 1 shorts its transmission line to VDD, hence these variations will appear on that line. If this line exits the product it will quite simply serve as an antenna, radiating its energy into space and thus causing the EMI failure.

Solving the EMI problem
The PDS will need to be redesigned if an EMI problem such as above occurs when providing the charge needed at the frequencies involved in the switching event. This means that physical capacitors with sufficient capacity must be added to the PDS so that when charge is drawn from them to support the switching activity, the drop in voltage (ripple) is small enough to eliminate the EMI problem.

If a system fails EMI, this is a red flag that the power delivery system does not have enough of the right kinds of capacitors to support the switching events during normal operation.

The frequency at which a capacitor is useful as a source of charge is determined by its value and the parasitic inductance inherent in connecting it to the PDS. The problem we have is that all real capacitors perform at a narrow band of frequencies limited by the parasitic inductance inherent in their design, in addition to the inductance added when connecting these capacitors to the power planes in the PDS.

Figure 6 shows the equivalent circuit of a typical capacitor. Notice that there are three components involved: ESL is the equivalent series inductance of the capacitor (to which the inductance of the mounting structure must be added); ESR is the equivalent series resistance of the capacitor (and its mounting structure) and C is the capacitor itself. This combination is often called a series-resonant circuit.

Figure 7 is the impedance vs. frequency of the capacitor in Figure 6. Notice that at both low and high frequencies the impedance is very high. The bottom of the curve is called series resonance. At the one frequency the reactance of the inductance and the capacitance cancel each other and the resultant impedance is the ESL or equivalent series resistance. It is at this frequency that it is easiest to deposit charge onto the capacitor and extract it to support the switching events. At values above and below the series resonance, the capacitor is unable to participate in the switching activities.

For the 1 µF, 0.1 µF and 0.01 µF capacitors commonly specified in most application notes from IC manufacturers, analysis of the impedance vs. frequency plots shows that the 1 µF capacitor is series resonant at about 5 MHz, the 0.1 µF capacitor is series resonant at about 18 MHz and the 0.01 µF capacitor is series resonant at about 40 MHz. These frequencies are applicable to the capacitors before they are mounted onto a PCB. The mounting structures necessary to connect them to the power planes will add additional inductance, driving the series resonant frequencies even lower.

None of the commonly specified capacitors are capable of supplying the frequencies seen in Figure 5, resulting in excessive ripple on VDD, hence possible EMI problems.

Solving the inadequately performing capacitor problem
The foregoing discussion has shown that the capacitors usually specified in application notes cannot provide the high-frequency switching currents required by high-speed logic circuits.

In a presentation entitled ‘Power Bus Decoupling on Multilayer PCBs (by Todd Hubing, ...
Some caution needs to be exercised though when applying this kind of signal layer copper fill. Notice that in Layer 3 the added copper fill is adjacent to signals in Layer 4. Clearly, this will alter the impedance of the trace in L4, sometimes to such an extent that it may create a signal integrity problem. Therefore, if impedance matching is important on a trace or group of traces, one should rather avoid filling the adjacent layer with copper.

**Caveats when designing high-speed four- or six-layer PCBs**

The interplane capacitance associated with closely spaced power and ground pairs provides a very low impedance between the two layers. When a stackup has multiple power and ground layer pairs, all of the ground layers will be connected to each other at the AC frequencies contained in the switching signals. It is thus possible to change signal layers when routing, without a concern that the return currents will have a path from plane to plane. Similarly, when a signal crosses a split in a VDD plane (such as to accommodate two or more VDD voltages in the same plane), there won’t be a problem.

Please note that in a four-layer PCB with no plane capacitor, this does not apply. In this case, in order to have a continuous path for the return current, the signal traces must begin and end on the same layer and they must not cross any plane splits.

**Summary**

By following these carefully created guidelines, it is indeed possible to replace high-layer-count PCBs with four-layer PCBs. And for today’s high-speed and high-performance electronics product demands, this solution can be a much more efficient and cost-effective approach.

For more information contact EDA Technologies, +27 12 665 0375, sales@edatech.co.za.
Outdoor telecoms connectors

The Telecommunications Outdoor Connectors (TOC) range of cable connectors from Telegartner is used in many applications including data and telecommunications in mobile radio, process, utility and traffic automation, and a host of security applications.

Demonstrating its flexibility, the TOC series can be installed even in harsh conditions within a temperature range from -40°C to 85°C.

To lock and seal the connection, only a few turning movements are necessary and no further procedures are required. This enables fast, error free, easy installation in addition to the TOC’s high transmission reliability, resilience and increased flexibility in the network design.

The TOC series RJ45, which comes with the field-assembly RJ45 plug MFP8 Cat.6A and RJ45 keystone AMJ-S Module Cat.6A, is available as a set. They can be attached to solid and stranded cables with outer diameter up to 9,5 mm on site without the need for special tools. For line extensions, the TOC coupler IP68 is the best option.

The MPO/MTP LC duplex ranges offer flexibility and ease of installation. Installers can work with pre-terminated cables, and by means of the elongated release latch the plugs can be mated and unmated into SFP transceivers or adaptors effortlessly, even in confined installation environments. For line extensions, the TOC coupler IP68 is the best option and it can be easily integrated with no effects on the performance of the connection.

For more information contact Cor Bredenhann, Webb Industries, +27 84 034 7777, cor.bredenhann@jasco.co.za.

Fire resistant cables

Axon’s Vibraflame cables are fire resistant wires and composite cables designed to withstand extreme temperatures ranging from -196°C to +1565°C. This makes them an optimal solution for applications in steel and aluminium plants, oil refineries, glass factories, offshore rigs and military equipment.

Vibraflame composite cables can be used as power, control or coaxial cables depending on the application. Axon also offers extension and compensating cables for thermocouples insulated with Vibraflame insulation able to resist temperatures up to 1050°C.

Different versions are available: single wires, multi-core cables or large cross section multi-core cables, shielded cables and armoured cables. They are resistant to heat, water, chemicals, acids and lubricants, and their insulation type is fire resistant and avoids flame propagation by creating a thermal barrier that protects the conductor and maintains dielectric characteristics.

For more information contact Hiconnex, +27 12 661 6779, info@hiconnex.co.za.

Connecting is a snap

Lever-actuated PCB connectors

Phoenix Contact offers a new comfort for conductor connections. LPC/LPCH 6 PCB connectors combine the reliability of the Push-in spring connection with the optimized usability of a lever actuation. In this way you can connect conductors of up to 10 mm² faster and more intuitive than ever before.

For more information:
JHB: 011 801 8200
CT: 021 930 9666
DBN: 031 701 2701
PE: 041 364 0415
www.phoenixcontact.co.za
Industrial push-pull connector

Harting’s PushPull V4 has been developed for cabling Ethernet in industrial buildings and consequently become the IEC standard.

Since Ethernet has now penetrated into the field, it was time to set a standard for industrial device cabling with the new version of this proven interface. Among other things, it now offers a new housing material which also withstands very aggressive chemicals, a lock, and more flexible cable entry.

When it comes to modularisation and the demands of Industry 4.0, users favour simple and fast handling just as much as robustness and the resulting usage spectrum. Industrial production processes are becoming ever more modular and more flexible, and cabling and connection technology must take this into account. Downtime during conversion work costs a system operator money, and naturally must be kept as brief as possible.

If production is relocated or switched over, Harting’s PushPull system can also be used to disconnect and reconnect the industrial lifelines in seconds. To further optimise this process, the company gave the PushPull V4 a facelift when developing the second generation of the connector.

Thus, the PushPull V4 Industrial has a new housing material, which additionally protects it against extremely aggressive chemicals such as cutting oils in turning and milling centres. These and other aggressive operating materials present increased challenges for the connectors used in the application. Optimised for future applications, the PushPull now also meets the toughest requirements.

In order to make locking the connector even more secure, the new version has an additional anti-rotation device which secures the PushPull locking element in the plugged state and ensures more process reliability against unintentional pulling.

Process reliability is also guaranteed by the connector’s simple and intuitive operation. Consequently, the second generation of the PushPull has only one cable clamp instead of three, with a larger cable diameter of 4.5 – 10 mm.

To increase the speed of the plug-and-play principle, the second generation PushPull has been fitted with two different colour markings. The first is used to provide a quick overview of whether the connector and the socket are correctly aligned with one another and that plugging can be done without problems. The second colour coding serves to ensure the correct arrangement of plug and socket. If an application features numerous PushPull connectors installed side-by-side, the installer will have an easier time keeping an overview – a simple yet tried and tested means to eliminate incorrect wiring and save time during assembly.

In keeping with the building-block principle, old and new PushPull components are compatible with each other.

For more information contact Harting South Africa, +27 11 575 0017, za@harting.com.

PCB terminal blocks

The identically shaped TDPT PCB terminal blocks from Phoenix Contact are a solution for market-specific devices in a uniform design. Thanks to their identical size, device manufacturers are free to choose either the screw or the push-in spring connection, without having to adapt the PCB or device design.

The PCB terminal blocks are available with pitches of 5.08 mm, 6.35 mm and 10.16 mm, and are suitable for conductor cross sections from 0.2 mm² to 16 mm². Depending on pitch and connection cross section, they can transmit currents of up to 76 A and voltages of up to 1000 V. All versions feature enhanced touch-proofness in accordance with IEC/UL 61800-5-1.

For more information contact Richard Schoonebeek, Phoenix Contact, +27 11 801 8200, rschoonebeek@phoenixcontact.co.za.
Terminal connectors for electrical appliances

The Molex MUO 2.5 series of terminal connectors has been designed to replace closed-end (CE) terminals and reduce harness-assembly lead times, as well as improving quality, reliability and processing. The MUO 2.5 connectors can simplify the termination process by eliminating tangled wires, reducing the number of quality issues and potentially even negating the need for extra inspections. Typical applications that can benefit from these devices include equipment such as air conditioners, fan heaters, floor-heating and HVAC systems, as well as other appliances such as refrigerators and washing machines, or anywhere terminations are required.

The traditional closed-end termination of connectors typically requires skilled workers and needs extra steps for crimping. Improper crimping is a risk, and extra inspection of the crimp area is required, as this kind of termination can be unstable. Crimping also requires manual sorting, which may lead to damage of the assembly or causation of other quality issues.

Closed-end terminations are typically done as an early step in the assembly process, which can significantly lengthen lead times as well as increasing the cost of stocking. However, the MUO 2.5 termination process delivers a high level of manufacturing flexibility, as it can be set up at any stage of the production workflow.

Features of the MUO 2.5 connectors include:
- two separated retainers to protect cables and secure the terminal position, which also prevent wire entanglement and eliminate electrical shock hazards;
- a simple water-exhaust function that is designed to prevent water from permeating inside.

For more information contact RS Components, +27 11 691 9300, sales.za@rs-components.com.

Sealed power contactors

Gigavac’s GV Series contactors meet the demand from customers looking for a sealed solution that can handle switching sizeable DC loads.

With voltage ratings from 12 V d.c. to 1200 V d.c., the contactors are rated to switch loads in excess of 400 A and interrupt short circuit currents to 3500 A (voltage dependent).

Like all Gigavac advanced switching solutions, these contactors can be mounted in any axis or orientation and are sealed to withstand virtually any harsh environment.

All GV Series power contactors meet RoHS and CE conformance requirements.

The Gigavac line of EPIC sealed contactors includes GX industrial contactors and MX mil-grade / heavy-duty contactors, in addition to the HV line of relays rated from 1,5 kV up to 70 kV.

For more information contact Denver Technical Products, +27 11 626 2023, denvertech@pixie.co.za.
With efficacy of up to 170 lm/W, the industry’s smallest LES, and lower package thermal resistance than other COB (chip-on-board) LEDs, lighting designers using Luxeon Gen-4 LEDs can create new styles featuring denser arrays, smaller optics and simplified construction. In addition, colour consistency within a 3-step MacAdam ellipse gives freedom from binning to simplify component purchasing and luminaire production while ensuring uniform appearance from unit to unit.

High colour fidelity is another strong suit of the latest Gen-4 Luxeon COB LEDs, which have a CRI of up to 90. Consistent rendering of all wavelengths makes them ideal for colour-critical lighting in areas such as retail displays, showrooms, healthcare centres, laboratories and industrial-inspection areas. Applications like high-bay and low-bay lighting, downlights, spotlights, and architectural or general outdoor lighting can also benefit from the brightness, clarity and efficacy of Luxeon Gen-4 LEDs.

All units are hot-tested at 85°C, which gives an accurate indication of performance and reliability in real-world operating conditions and removes additional testing burdens from lighting manufacturers.

For more information contact RS Components, +27 11 691 9300, sales.za@rs-components.com.

RS Components is stocking the newly launched Lumileds Gen-4 Luxeon COB LEDs, enabling smaller, simpler luminaires to deliver bright and vibrant lighting.

When used with green LEDs, such as Vishay’s VLMTG1400, the photodiode’s small size and high sensitivity enable slim sensor designs for optical heart rate detection in wearable devices such as fitness trackers and smart watches. In these devices, the VEMD8080’s rectangular shape allows several light emitting diodes to be placed close to the radiant sensitive area to maximise the signal. When combined with 660 nm and 940 nm dual colour emitting diodes, the photodiode is ideal for SpO2 measurement in medical monitors.

The VEMD8080 features a ±65° angle of half-sensitivity, temperature range of -40°C to +85°C, and 950 nm wavelength of peak sensitivity.

For more information contact Dirk Venter, Arrow Altech Distribution, +27 11 923 9600, dventer@arrow.altech.co.za
Gas discharge tubes for high temperatures

Bourns announced the release of the Model 2036 series of high-temperature rated, surface mount gas discharge tubes (GDTs). The three-electrode GDTs have stable operating characteristics over an operating temperature range of -55°C to +125°C, making them ideal for remote outdoor communications equipment as well as environmentally exposed industrial equipment requiring over-voltage protection.

The devices offer a robust current handling capability of 10 kA on an 8/20 µs current waveform as well as 2 kA on a 10/350 µs. The three-electrode design also provides balanced voltage limiting in response to a common mode surge event. The new parts are RoHS compliant.

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

DC-DC railway converters

RECOM has extended its DC-DC railway converters RPA100H and RPA200H to now include 15 V and 48 V output versions, making these 10:1 input voltage range converters suitable for a wider range of applications in railway and electromobility.

Due to the wide range of input voltages in railway systems, typically three different versions of the same design are necessary to cover all of the input voltages from 24 V d.c. up to 110 V d.c. The RPA100H-RUW and RPA200H-RUW allow an all-in-one solution as their 10:1 input voltage range accommodates all standard input voltages of 24 V, 36 V, 48 V, 72 V, 96 V and 110 V d.c. in a single product, including all of the EN50155 transient limits.

These converters are now available with 12V, 15V, 24V or 48V outputs to power a broader selection of rolling stock and high-voltage battery applications. The converters have a consistently high efficiency over the entire input voltage range and operate over a wide operating temperature range from -40°C to +93.5°C (when baseplate cooled). The case is fitted with threaded inserts to allow secure mounting to the PCB or bulkhead for use in high shock and vibration environments. They are certified to CE and UL/IEC/EN 60950 and come with a three year warranty.

For more information contact Brabek, +27 21 706 3162, info@brabek.co.za.

Step-down converter with integrated passives

Würth Elektronik eiSos has expanded its product family of MagI³C power modules with the compact MagI³C VDRM (variable step-down regulator module) in an LGA-16EP package. The module has an input voltage range of 4 to 18 V for converting voltages from the 5 V, 9 V or 12 V bus.

The very compact component (9 x 9 x 3 mm) offers scalability of currents (1 A / 2 A / 3 A) and high efficiency up to 93%. As a fully integrated DC-DC voltage converter, MagI³C VDRM contains the power stage, the regulator, the inductor, as well as input and output capacitors. Only two resistors are necessary in the external circuit to define the output voltage.

The LGA-16EP package of the MagI³C VDRM displays good thermal behaviour, and the rated current of up to 3 A can be drawn up to an ambient temperature of 85°C. The intensity of electromagnetic radiation is far below the limit stated in the EMC standard EN55022 class B. The power module is also particularly suitable for applications in industry, testing and measuring technology, medical technology and in telecoms systems.

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

Discover the slim line AMJ-S Module Cat. 6A.

The fully shielded AMJ-S Module Cat 6, for 10 Gigabit Ethernet offers undreamt-of possibilities to cabling specialists.

www.dataweek.co.za
Cypress Semiconductor unveiled the PSOC 4700 series of microcontrollers (MCUs) that uses inductive sensing to detect touch inputs for products using metal surfaces. The MCUs are based on a 32-bit Arm Cortex-M0+ core and integrate programmable analog and digital blocks. The devices can support up to 16 sensors to implement digital functions or custom algorithms for interfaces in various form-factors, including buttons, linear and rotary encoders, proximity sensing or free-form. The inductive-sensing solution provides superior noise immunity for reliable operation, even in extreme environmental conditions.

Arrow Altech Distribution, +27 11 923 9600.

u-blox announced its UBX-P3 chip for vehicle-to-everything (V2X) wireless communication based on the DSRC/802.11p standard. Offered in a compact 9 x 11 mm form factor, the UBX-P3 supports various design options for flexible deployments in the vehicle and the road-side infrastructure. It concurrently communicates on two channels, which means that safety and service messages can be processed continuously to provide greater safety in traffic. Alternatively, it can be used to enable the chip to simultaneously communicate on the same channel using two antennas, thus providing vehicles full coverage with no blind spots.

RF Design, +27 21 555 8400.

Microchip Technology announced that its CEC1702 hardware cryptography-enabled microcontroller (MCU) now supports the Device Identity Composition Engine (DICE) security standard, providing a simple way to add fundamental security to embedded products. A new CEC1702 IoT development kit for Microsoft Azure IoT is also available, offering designers everything needed to easily incorporate the DICE security standard in their products. DICE is a simple and reliable method that can be implemented in the hardware of security products during manufacturing. The architecture breaks up the boot process into layers and creates unique secrets along with a measure of integrity for each layer, automatically re-keying and protecting secrets if malware is present.

Tempe Technologies, +27 (0)11 455 5587.

Texas Instruments introduced three new amplifiers with maximum supply voltages ranging from 27 V to 36 V, whose combination of high speed and high precision allows designers to create more accurate circuits for error-sensitive applications. The high bandwidths of the OPA2810 and OPA189 enable high-gain configurations and faster response times for more accurate measurements. Designers can use the THS3491 current-feedback amplifier’s wide small-signal bandwidth, high slew rate and output current of ±420 mA to achieve low distortion and high output power levels. The THS3491 is capable of 10 Vpeak-to-peak output levels at 200 MHz into 100 Ω loads.

Future Electronics, +27 21 421 8292.

The VIPer11 off-line converter with embedded 800 V avalanche-rugged MOSFET from STMicroelectronics enables equipment makers to design tougher auxiliary power supplies and power adaptors. Its 26 V d.c. drain-start voltage allows an ultra-wide line input voltage range and it enhances flexibility in numerous consumer and industrial applications. The high-voltage converter enables flyback, boost or buck/boost power supplies powered directly from the rectified AC line or other DC sources to generate the desired output voltage using a simple voltage divider. High efficiency is assured across a wide load range, even at 5 V output voltage thanks to the logic-level MOSFET feature, and minimum consumption of 10 mW enables extremely low standby power.

Avnet South Africa, +27 (0)11 319 8600.
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