FEATURING: • Telecommunications, Wireless, IoT, RF & Microwave • Interconnection, Switches, Relays, Cables & Keypads
Many distributors make claims

We simply have the largest selection of products in stock

TRX Electronics
Authorised Mouser Partner in South Africa
Tel: 086 111 2844 | trx.e.com
Earlier this year SIMCom’s SIM7000E module was successfully tested at Vodaworld ahead of Otto Wireless Solutions promoting the device to the end-user market. The module has subsequently received the local regulatory approval by ICASA and is currently being evaluated for metering applications by a prominent supplier to the industry, as well as several design houses in other, unrelated applications. Find out more by turning to page 22.

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

Interconnection, switches, relays, cables & keypads .................................................16
Read about Hiconnex Industrial’s new facility manufacturing HARTING connectors for a major South African railway project.

Telecommunications, wireless, IoT, RF & microwave ..................................................22
Spotlight on new products and solutions, with particular emphasis on the burgeoning LPWAN market.
Hell hath no fury like a woman scorned

With South Africa celebrating Women’s Day on 9 August, and in fact the entire month as Women’s Month, I would like to take this opportunity to honour some of history’s most famous female engineers and inventors. This is not intended to be a comprehensive list, but rather a look back at some of the more significant contributions made by women during times when the engineering landscape was even more male-dominated than it is today.

**Ada Byron**

Ada Byron was the daughter of famed poet Lord Byron, she was born on the 20th of December, 1815. Ada was so ahead of its time that it wasn’t until 1837 as the successor to his equally famous title for a person whose job it was to perform computations, the Analytical Engine, a mechanical characterisations of long power transmission lines. After becoming the University of Texas first ever female electrical engineer in 1912, Clarke later went on to become the first American female professor of electrical engineering, at the same university in 1943. In the years between, she struggled to find work as an engineer and went to work for General Electric as a supervisor of computers (in those days computer was the title for a person whose job it was to perform mathematical calculations). During this time she invented the Clarke calculator, a simple graphical device that solved equations involving hyperbolic functions, leading to much more accurate characterisations of long power transmission lines. Ada Lovelace, in the world of computing, the name Charles Babbage is legendary for his invention of the Analytical Engine, a mechanical general-purpose computer first conceived in 1837 as the successor to his equally famous difference engine. It is astounding to think that, comprising an arithmetic logic unit, control flow in the form of conditional branching and loops, and integrated memory, the Analytical Engine was so far ahead of its time that it wasn’t until more than a century later, in the 1940s, that the first general-purpose computers could actually be built, and the same logical structure still serves as the basis for computer design today.

If Babbage is the father of computer architecture, Lovelace is the mother of programming, as it was she who recognised the true extent of the machine’s potential. The daughter of famed poet Lord Byron, she was the first person credited with seeing beyond the mere number-crunching possibilities.

Her contribution is best summed up by the words of South African-born historian of computing and Babbage specialist, Doron Swade. As quoted by Wikipedia, Swade said: “Ada saw something that Babbage in some sense failed to see. In Babbage’s world his engines were bound by number...What Lovelace saw – what Ada Byron saw – was that number could represent entities other than quantity. So once you had a machine for manipulating numbers, if those numbers represented other things, letters, musical notes, then the machine could manipulate symbols of which number was one instance, according to rules. “It is this fundamental transition from a machine which is a number cruncher to a machine for manipulating symbols according to rules that is the fundamental transition from calculation to computation – to general-purpose computation – and looking back from the present high ground of modern computing, if we are looking and sifting history for that transition, then that transition was made explicitly by Ada in that 1843 paper.”

Unfortunately, I write this column against the backdrop of a gender controversy that is raging in the South African engineering sector. Manglin Pillay, CEO of the South African Institute of Civil Engineering (SAICE), sparked it off when he expressed his opinions in an article in the July issue of Civil Engineering magazine about women in STEM (Science, Technology, Engineering and Mathematics) industries. It is not hard to see what the furor is about, as the following are just two of the contentious points he put forward: “…the fact that more women occupy high-profile executive posts is tremendous, not because of gender but because of appetite for workload and extreme performance requirements at that level… The reason why women do not occupy these positions is that women choose to have the flexibility to dedicate themselves to more important enterprises like family and raising of children than to be at the beck and call of shareholders who will wake you up in the middle of the night to attend to shareholder aspirations.”

His article has drawn widespread ire, with the lobby group WomEng going so far as to describe it as misogynistic and issue a petition calling for his removal. The SAICE has called an emergency meeting of the night to address shareholder aspirations. "The SAICE has called an emergency meeting of the night to attend to shareholder aspirations. "

There is much progress that still needs to be made to address gender inequality in the engineering sector, and no number of columns I write can fix the problem. Perhaps by dragging the issue into the spotlight and inciting public outcry, Pillay’s comments might ironically end up spurring a movement towards a positive change.
The 4th edition of the IEEE Global Electromagnetic Compatibility Conference (GEMCCON), is coming to Stellenbosch in the Cape Winelands of South Africa.

The conference will cover many topics in EMC, including special sessions on:
- Radio frequency interference.
- Time domain metrology.
- EMC in large installations.

**Invited speakers**

**Keith Armstrong**, Cherry Clough Consultants, United Kingdom - Techniques and Measures to Manage Functional Safety and Other Risks with Regard to Electromagnetic Disturbances.

**Sarel van der Merwe**, ITC Services, SA - A Brief History of EMC in South Africa.

**Frank Leferink**, University of Twente, Netherlands - Risk Based vs Rule Based EMC in Large Installations.

**Ferran Silva**, Universitat Politècnica de Catalunya, Spain - Time Domain Measurement Methods in EMC.

**Paul van der Merwe**, MESA Solutions, SA - EMI Measurements on Renewable Energy Plants.

7 to 9 November 2018  www.gemccon2018.emcss.org
**Overseas**

**Business**
- Silicon Labs reported financial results for its second quarter ended 30 June 2018. Revenue established a new all-time record, achieving the high end of guidance at $217 million, up from $205 million in the first quarter. Second quarter diluted earnings per share (EPS) were $0.32 based on net income of $14.28 million. The company expects revenue in the third quarter to be in the range of $224 to $230 million.

- RS Components delivered second quarter revenue of $2.29 billion, an increase of 4% year on year, and an increase of 1% as compared to the prior quarter. Its board of directors authorised a $5 billion share repurchase programme based on the strength of its capital structure, and its confidence in the company’s ability to drive long-term growth and strong cash flow.

- STMicroelectronics reported second quarter net revenues of $2.27 billion for its 2018 second quarter, and net income of $261 million or $0.29 diluted EPS. This represents an 18% year-over-year revenue growth, and keeps the company on track to achieve its goal to grow annual revenues between 14% and 17% for 2018.

- Texas Instruments reported second-quarter revenue of $4.02 billion, net income of $1.41 billion and earnings per share of $1.40. Its third-quarter outlook is for revenue in the range of $4.11 billion to $4.45 billion, and earnings per share between $1.41 and $1.63.

- Cypress Semiconductor reported record revenue of $624.1 million, a 7.2% increase sequentially, for its second quarter. Net income and diluted EPS were $27.7 million and $0.07 respectively, compared to the previous quarter’s figures of $9.1 million and $0.02.

- In its third fiscal quarter, Infineon Technologies’ revenue grew by 6% from 1836 million Euros to 1941 million Euros quarter-on-quarter. Rising demand and a stronger US dollar caused revenue to grow in all four segments, i.e., automotive, industrial power control, power management and multimarket and chip card and security. Net income for the three-month period totalled 271 million Euros, compared with 457 million Euros in the previous quarter.

- Maxim Integrated Products reported net revenue of $633 million for its fourth quarter of fiscal 2018 ended 30 June, a 2% decrease from the $649 million revenue recorded in the prior quarter, and a 5% increase from the same quarter of last year. Net income was $194.2 million and diluted earnings per share were $0.68.

- On Semiconductor announced that total revenue in the second quarter of 2018 was $1455.9 million, up approximately 9% compared to the second quarter of 2017, and up approximately 6% as compared to revenue in the first quarter of 2018. Diluted earnings per share were $0.35 based on net income of $155.3 million.

**Companies**
- The long-anticipated merger between NXP Semiconductors and Qualcomm has been called off, with the announcement by Qualcomm that it has terminated the purchase agreement after Chinese authorities failed to grant approval for the deal by the prescribed deadline. Qualcomm was obliged to pay NXP $2 billion in termination compensation.

- RS Components has signed an official contract to become a digital partner of high-reliability interconnect manufacturer Glenair. Glenair specialises in military qualified, industrial and commercial products for use in harsh environments. It makes a broad range of connectors, backshells, cable assemblies and accessories. RS has been trading with Glenair for many years and currently stocks over 400 Glenair products, notably Micro-D and circular connectors aimed at the defence and industrial markets.

**Industry**
- The Semiconductor Industry Association (SIA) announced worldwide sales of semiconductors reached $117.9 billion during the second quarter of 2018, an increase of 6.0% over the previous quarter and 20.5% more than the second quarter of 2017. Global sales for the month of June 2018 reached $39.3 billion, an uptick of 1.5% compared to May, and a surge of 20.5% compared to the June 2017 total of $32.6 billion. Cumulatively, year-to-date sales during the first half of 2018 were 20.4% higher than they were at the same point in 2017.

- IC Insights forecasts that the 2018 global electronic systems market will grow 5% to $1622 billion while the worldwide semiconductor market is expected to surge by 14% this year to $509.1 billion, exceeding the $500.0 billion level for the first time. If the 2018 forecasts come to fruition, the average semiconductor content in an electronic system will reach 31.4%, breaking the all-time record of 28.8% that was set in 2017.
Conical Technologies and Mini Circuits invest in education

Conical Technologies, a local supplier of electronic and RF and microwave components in South Africa, has committed to donating a percentage of all its sales of Mini-Circuits components in South Africa to Eco Children, a non-profit organisation committed to improving education in rural South Africa.

This commitment was kicked off with a donation of R25 000 that will be used in the organisation’s bursary programme. Eco Children currently supports ten talented children in the Hoedspruit area through its bursary programme, partnered with the Make a Difference Leadership Foundation.

Daniel Haywood, CEO of Conical Technologies, distributor of Mini-Circuits, said they have made this commitment because they believe it is essential to invest in education in South Africa. “The importance of education cannot be underestimated and we believe this partnership will do a great deal to help an organisation such as Eco Children to perform their mandate of sowing seeds of change and improving education in the underprivileged rural areas of South Africa,” he said.

Corné Havenga, CEO of Eco Children, said she was thankful for the donation and confirmed that the money would be channelled to the organisation’s bursary programme. “We believe in the potential of the children we work with and with sufficient support they can change so much. Partnerships like this will do a great deal to help us plan our expenses and know how we can structure programmes like our bursary programme,” she explained.

Haywood continued and said he challenges other companies in the electronics industry to follow suit and pledge to donate regularly to organisations that work to improve education in South Africa. “As an industry, we need to invest in education to ensure we have resources to work in this industry. Everyone in the industry has experienced the lack of human resources and we believe this is a small step in the right direction to address this issue. There are talented children who just need a bit of support to be able to form a part of the information and electronics industry,” he stated.

For more information about Eco Children, visit its website at www.ecochildren.co.za or if you would like to donate, contact Corné Havenage at corne@ecochildren.co.za.
Africa has 20% of the world’s population but only 4% of its Internet data access. This digital divide, with low Internet connectivity reach, particularly in rural areas, is both economic and geographic in nature. A recent report by the UN highlighted that over four billion people in the world are not connected, with Africa having the lowest penetration (22%) and the highest gender divide (25%). The UN further estimates that $400 million (just under R5 billion) allotted to bridging the gender digital divide remains unspent.

A team of international researchers, coordinated by Professor Andrew Forbes from the School of Physics at the University of the Witwatersrand (Wits) and Professor Ling Cheng of the School of Electrical and Information, gathered in South Africa recently to address this problem. Their solutions were published in the international journal *Nature Photonics*.

The divide can be broken down into two parts: an affordability gap due to low disposable income, and a geographical gap due to lack of infrastructure. If South Africa’s gap was to be addressed by state-of-the-art optical fibre then an additional 160 000 km of fibre would be needed. This is possible but very expensive. But getting people connected is a priority, particularly for South Africa, where broadband has been estimated to have the potential to raise GDP by R130 billion and create 400 000 jobs.

The Wits team is concentrating on bridging the divide by connecting communities with free-space optical (FSO) links – a network of communication channels through air, much like Wi-Fi but much faster and with a longer reach. “Light holds tremendous promise for fast connections across medium distances,” explains Professor Andrew Forbes, team leader of the collaboration and Distinguished Professor in the School of Physics where he heads up the Wits Structured Light Laboratory. “Even Google, Facebook and SpaceX have exotic proposals for Africa that include drones and other aerial vehicles delivering connections in a blanket manner. We are working on point to point solutions with sustainable photonics that are home-grown.”

“Internet is not a luxury but a right,” says Mitchell Cox, a PhD engineering student working on the project. Existing FSO systems are able to comfortably sustain gigabit connection speeds over multi-kilometre distances. “With further research and development into advanced digital signal processing and coding schemes, this may be increased dramatically with relatively little expense,” says Professor Ling Cheng.

The team is working towards a multi-hop FSO link that will cover tens of kilometres across the digital divide. Forbes points out that working with this team of scientists and engineers has allowed some of the most recent scientific findings to be rapidly and efficiently deployed to tackle this challenge. The Wits team has already made several technical advances to address the issues involved and is about to embark on a commercialisation programme with a local listed company.

For more information contact Schalk Mouton, University of the Witwatersrand, +27 11 717 1017, schalk.mouton@wits.ac.za.
Input invited for SADC engineering study

In 2011, the SADC (Southern African Development Community) ministers of science and technology endorsed an engineering needs and numbers study, to get a better understanding of the actual numbers of engineers, technologists and technicians in the SADC countries and the needs of SADC member states to allow for better planning for the attainment of sustainable development in the region.

Subsequent scoping workshops have taken place with member countries and, in early 2017, SAICE Professional Development and Projects (SAICE-PDP), a not-for-profit sister organisation to the South African Institution of Civil Engineering (SAICE), was appointed to carry out the study.

The overall objective of the study is to get a better understanding of the engineer, engineering technologist and technician capacities in the SADC region to allow for better planning and implementation of infrastructure programmes to support the SADC Industrialisation Strategy, which has a long-term scope spanning from 2015 to 2063.

The strategy identifies lack of adequate infrastructure and lack of adequate skills and capacities in science, technology, engineering and mathematics (STEM) as being among the binding constraints for industrial development. The outcomes of the study will also serve as input towards the implementation of key SADC policies and frameworks such as the SADC Master Plan on Infrastructure Development, Protocol on Education and Training, and Protocol on Science, Technology and Innovation.

Dr Allyson Lawless, civil engineer and team leader for the SAICE-PDP study, has urged companies in the SADC region’s engineering sectors to complete an online survey to make the study as comprehensive as possible. Available until a 7 September 2018 cut-off date, and accessible via the short URL, www.dataweek.co.za/*SADCsurvey/, the survey is tailored to inform the study on the following factors:

• The support of engineering graduates from higher education.
• The engineering skills base per country and mobility of engineering personnel.
• Sectors in which engineering skills are required, the roles they play, and how increased capacity can contribute to growth.
• Policies relating to engineering development and the regulation of engineering professionals.
• Development and economic trends relating to each sector.
• Projects planned for each country and the region.

For more information contact Dr Allyson Lawless, SAICE-PDP, +27 11 476 4100, allyson@ally.co.za.

www.dataweek.co.za
CSIR showcases mine safety technologies

The topic of safety in mines has been in the South African news for all the wrong reasons, not just lately, but for much too long and at the cost of far too many lives.

The CSIR has been developing a range of technologies to combat the problem, and showed them off at an event at the Mandela Mining Precinct in Johannesburg in late July.

Among the technologies displayed was a robot platform equipped with safety inspection sensors to enter mines during safety periods. Known as ‘Monster’, the robot aims to assess and identify risks for underground mines. Ground penetrating radar (GPR), which is being researched as one of the South African Mining Extraction, Research, Development and Innovation (SamerDi) Advanced Orebody Knowledge technologies, was also displayed. This technology contributes to the Zero Harm objective, by enabling miners to visualise potentially hazardous geological structures in the hanging wall that could lead to falls-of-ground.

The CSIR also developed a pedestrian detection system, which uses a range sensor to determine the distance to each identified person and tracks each person to determine if and when a collision is likely to occur.

Addressing the media, CSIR mining experts, Dr Dave Roberts, Dr Shaniel Davrajh and Dr Michael van Schoor, said the organisation is working hard to come up with cutting-edge technologies to improve safety in the mines. While commenting on the role the CSIR is playing in supporting the South African mining industry, CSIR principal researcher, Dr Roberts, said the organisation was identified as a primary research provider to the Mine Health and Safety Council (MHSC) Centre of Excellence.

“The CSIR has core skills and competence in all of the strategic research areas of the MHSC from a safety perspective. The organisation has invested significantly in laboratories and continues to provide human resources for the provision of services to the sector. We have offerings in support of occupational health and safety (OHS) in mining with infrastructure, such as mechanical testing, a steel wire rope testing facility, water laboratories and a self-contained self-rescuer testing facility,” said Singh.

Principal engineer, Dr Davrajh, highlighted the importance of using robotic technologies in the mines. He said using these technologies could assist in reaching some of the areas that are not accessible during an incident. “A robot equipped with safety inspection sensors will enter the mine during a safety period. It becomes very difficult and dangerous for humans to enter into the mine after an incident,” he elaborated.

Principal geophysicist, Dr van Schoor, talked about the use of GPR technology for rock mass stability investigations, saying there was a need for reliable rock mass stability determination. “Managing health and safety risk in a mine requires real-time monitoring and quantification of the underground hazards and the exposure of personnel and equipment to such hazards.”

Another technology that was exhibited is an early-warning and monitoring system called RockPulse, which will assist mines with listening to raw micro-seismicity, extracting micro-fracture features and analysing the resulting series of features to detect large instabilities taking place in the rock mass in time.

For more information contact David Mandaha, CSIR, +27 12 841 3654, dmandaha@csir.co.za.

Win a single-wire EEPROM evaluation kit

The DM160232 serial memory single-wire evaluation kit from Microchip Technology is an easy-to-use interactive user tool, which demonstrates the advanced features, functionality and low-power operation of the AT21CS series of serial EEPROM devices.

The AT21CS series is a family of serial EEPROMs that utilises the single-wire interface (SWI) protocol. The family software addressing scheme allows up to eight devices to share a common single-wire bus. The device is optimised for use in many industrial and commercial applications where low-power and low-voltage operation are essential.

Some applications examples include analog sensor calibration data storage, ink and toner printer cartridge identification, and management of after-market consumables. The family is available in space-saving package options and operates with an external pull-up voltage on the SI/O line.

Key features of the device include internal variable voltage from 1.7 V to 3.6 V, support for USB base board firmware update via the Flexible In-system Programming (FLIP) software utility, and it contains a AT90USB1287 and 8-bit AVR microcontroller. Supported devices of the evaluation kit include the AT21CS01 and AT21CS11.

For your chance to win a Microchip serial memory single-wire EEPROM evaluation kit, visit http://page.microchip.com/dataweek-eprom.html and enter your details in the online entry form.
Battery Guys specialises in the design and manufacture of battery packs and offers turnkey solutions to its customers in the electronics market. The company has been supplying battery solutions since 2008 and its team has extensive experience within the battery industry, with a focus on delivering high-quality products and professional service to all its customers.

Battery Guys has a national presence, with its head office in Johannesburg and sales offices in Cape Town and Durban. With experienced staff and a large range of stock in each office, it is able to assist customers throughout the country with all battery solutions.

“To ensure we offer the best solutions we have aligned ourselves with premium quality brands, such as Forbatt, Sanyo, Saft, Dyno and Energizer to name but a few,” explains Troy Browne, national sales manager. “Our technical knowledge and capabilities across all chemistries ensures the correct solutions are supplied based on customers’ requirements.”

Battery Guys has been distributing Forbatt sealed lead-acid (SLA) batteries for the past 10 years and Browne says the company considers itself proud to be associated with one of the leading lead-acid brands in South Africa. Battery Guys supplies Forbatt batteries into a variety of markets, such as electronics, security, tracking, monitoring, medical, military, solar and UPS amongst others.

Forbatt offers a comprehensive range of SLA batteries to suit most applications, including recent additions to the 12 V range in the form of 9 Ah, 26 Ah and 65 Ah models. “The Forbatt battery has proven to be dependable in multiple fields and surpassed many of our customers’ expectations. The quality and reliability of the Forbatt SLA is one of the key factors why Battery Guys has aligned itself with the Forbatt brand,” Browne concludes.

For more information contact Battery Guys, +27 11 452 3914, sales@batteryguys.co.za

RS Components has launched a global design challenge on its DesignSpark engineering and maker community website, offering a winning prize worth £1500 of products from the RS range.

The ‘Summer of Sound’ competition tasks contestants to create a new musical experience with the aid of technology. This could range from the invention of a completely new electronic musical instrument, or hack of an existing acoustic instrument, to the development of a radical new digital musical interface. To qualify, the design must be authentic and produce an audible musical sound.

“At this time of year, when many people are geared up for festival season (in Europe), it is apt to launch a design challenge that inspires innovation amongst those with a passion for music and technology,” said Mike Bray, VP of DesignSpark at RS. “It also illustrates how the creative and engineering disciplines overlap, a message we are keen to deliver, especially to the younger population in the face of a shortage of engineering skills. We are very excited to see what ideas the challenge will bring and, who knows, it may uncover a ground-breaking new musical approach to take to stages and arenas around the world.”

The Summer of Sound design challenge runs until 17:00 on Friday 28 September 2018. Entries submitted after the deadline will not be eligible.

Contestants are required to detail their project in an article submitted to the DesignSpark website, supported by video footage of the design in action. For more information, and to enter the competition, visit www.rs-online.com/designspark/enter-our-summer-of-sound-design-challenge. Terms and conditions apply.

For more information contact RS Components, +27 11 691 9300, sales.za@rs-components.com.
How to make a pocket-sized white noise generator

Noise in electrical circuits is typically the enemy, and any self-respecting circuit should output as little noise as possible. Nevertheless, there are cases where a well-characterised source of noise with no other signal is entirely the desired output.

Circuit characterisation is such a case. The outputs of many circuits can be characterised by sweeping the input signal across a range of frequencies and observing the response of the design. Input sweeps can be composed of discrete input frequencies or a swept sine. Extremely low frequency sine waves (below 10 Hz) are difficult to produce cleanly.

A processor, DAC and some complex, precise filtering, can produce relatively clean sine waves, but for each frequency step, the system must settle, making slow work of sequential full sweeps featuring many frequencies. Testing fewer discrete frequencies can be faster, but increases the risk of skipping over critical frequencies where high Q phenomena reside.

A white noise generator is simpler and faster than a swept sine wave because it effectively produces all frequencies at the same time with the same amplitude. Imposing white noise at the input of a device under test (DUT) can quickly produce an overview of the frequency response over an entire frequency range. In this case, there is no need for expensive or complex swept sine wave generators. Simply connect the DUT output to a spectrum analyser and watch. Using more averaging and longer acquisition times produces a more accurate output response across the frequency range of interest.

The expected response of the DUT to white noise is frequency-shaped noise. Using white noise in this fashion can quickly expose unexpected behaviour such as weird frequency spurs, strange harmonics and undesirable frequency response artifacts. Furthermore, a white noise generator allows a careful engineer to test a tester. Lab equipment that measures frequency response should produce a flat noise profile when measuring a known flat white noise generator.

On the practical side, a white noise generator is easy to use, small enough for compact lab setups, portable for field measurements, and inexpensive. Quality signal generators with myriad settings are attractively versatile. However, versatility can hamper quick frequency response measurements. A well-designed white noise generator requires no controls, yet produces a fully predictable output.

Noisy discussion

Resistor thermal noise, sometimes called Johnson noise or Nyquist noise, arises from thermal agitation of charge carriers inside a resistor. This noise is approximately white, with nearly Gaussian distribution. In electrical terms, the noise voltage density is given by $V_{\text{noise}} = \sqrt{4k_BT}$, where $k_B$ is the Boltzmann's constant, $T$ is the temperature in Kelvin, and $R$ is the resistance.

Noise voltage arises from the random movement of charges flowing through the basic resistance, a sort of $R \times I_{\text{noise}}$. Table 1 shows examples at 20°C. A 10 MΩ resistor, then, represents a 402 nV/√Hz wideband voltage noise source in series with the nominal resistance.

<table>
<thead>
<tr>
<th>Resistor</th>
<th>Noise voltage density</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 Ω</td>
<td>0.402 nV/√Hz</td>
</tr>
<tr>
<td>100 Ω</td>
<td>1.27 nV/√Hz</td>
</tr>
<tr>
<td>1 kΩ</td>
<td>4.02 nV/√Hz</td>
</tr>
<tr>
<td>10 kΩ</td>
<td>12.7 nV/√Hz</td>
</tr>
<tr>
<td>100 kΩ</td>
<td>40.2 nV/√Hz</td>
</tr>
<tr>
<td>1 MΩ</td>
<td>127 nV/√Hz</td>
</tr>
<tr>
<td>10 MΩ</td>
<td>402 nV/√Hz</td>
</tr>
</tbody>
</table>

The gain up resistor-derived noise source is fairly stable as a lab test noise source, as $R$ and $T$ variations affect noise only by square root. For instance, a change of 6°C from 20°C is a change of 293 kΩ to 299 kΩ. Because noise density is directly proportional to the square root of temperature, a change of 6°C temperature leads to a relatively small 1% noise density change. Similarly, with resistance, a 2% resistance change leads to a 1% noise density change.

Consider Figure 1: a 10 MΩ resistor R1 generates white, Gaussian noise at the positive terminal of an op-amp. Resistors R2 and R3 gain the noise voltage to the output. Capacitor C1 filters out chopper amplifier charge glitches. The output is a 10 µV/√Hz white noise.

Continued on page 12

<table>
<thead>
<tr>
<th>R_{\text{noise}} (nV/√Hz)</th>
<th>Amp $e_n$</th>
<th>Total input referred</th>
</tr>
</thead>
<tbody>
<tr>
<td>402 nV/√Hz</td>
<td>300</td>
<td>501,6 nV/√Hz</td>
</tr>
<tr>
<td>402 nV/√Hz</td>
<td>250</td>
<td>473,4 nV/√Hz</td>
</tr>
<tr>
<td>402 nV/√Hz</td>
<td>200</td>
<td>449,0 nV/√Hz</td>
</tr>
<tr>
<td>402 nV/√Hz</td>
<td>150</td>
<td>429,1 nV/√Hz</td>
</tr>
<tr>
<td>402 nV/√Hz</td>
<td>100</td>
<td>414,3 nV/√Hz</td>
</tr>
</tbody>
</table>
PIC® & AVR® MCUs
Together Your Possibilities are Unlimited

You have a desire to make technology smarter, more efficient and accessible to everyone. Microchip has a passion for developing products and tools that make it easier for you to solve your design problems and adapt to future needs. Microchip’s portfolio of more than 1,200 8-bit PIC® and AVR® microcontrollers is not only the industry’s largest—it incorporates the latest technologies to enhance system performance while reducing power consumption and development time. With 45 years of combined experience developing commercially available and cost-effective MCUs, Microchip is the supplier of choice due to its strong legacy and history in innovation.

Key Features
- Autonomous peripherals
- Low-power performance
- Industry-leading robustness
- Easy development

The Microchip name and logo, the Microchip logo, PIC and AVR are registered trademarks of Microchip Technology Incorporated in the U.S.A. and other countries. All other trademarks are the property of their registered owners.
© 2018 Microchip Technology Inc. All rights reserved. DS30010130A. MEC21168Eng03/18

www.microchip.com/8bitEU
signal. Gain \((1 + \frac{R_2}{R_3})\) is high - 21 V/V in this example. Even if \(R_2\) is high (1 MΩ), the noise from \(R_2\) compared to the gained up \(R_1\) noise is inconsequential.

An amplifier for the circuit must have sufficiently low input-referred voltage noise so as to let \(R_1\) dominate as the noise source. The reason is that the resistor noise should dominate the overall accuracy of the circuit, not the amplifier. An amplifier for the circuit must have sufficiently low input-referred current noise to avoid \((I_{in} \times R_2)\) to approach \((R_1 \text{ noise} \times \text{gain})\) for the same reason.

**How much amplifier voltage noise is acceptable?**

Table 2 (page 10) shows the increase in noise from adding independent sources. A change from 402 nV/√Hz to 502 nV/√Hz is only 1.9 dB in log volts, or 0.96 power dB. With op-amp noise ~50% of the resistor noise, a 5% uncertainty in op-amp \(V_{\text{NOISE}}\) changes the output noise density by only 1%.

A white noise generator could employ only an op-amp without a noise-generating resistor. Such an op-amp must exhibit a flat noise profile at its input. However, the noise voltage is often not accurately defined and has a large spread over production, voltage and temperature. Other white noise circuits may operate based on a Zener diode with far less predictable characteristics. Finding an optimal Zener diode for stable noise with μA of current can be difficult, however, particularly at low voltage (less than 5 V).

Some high-end white noise generators are based on a long pseudorandom binary sequence (PRBS) and special filters. Using a small controller and DAC may be adequate; however, making sure that the DAC does not produce settling glitches, harmonics or intermodulation products is something for experienced engineers. Additionally, choosing the most appropriate PRBS sequence adds complexity and uncertainty.

**Low power zero-drift solution**

Two design goals dominate this project:

- An easy to use white noise generator must be portable; that is, battery-powered, which means micropower electronics.
- The generator must provide uniform noise output even at low frequencies – below 0.1 Hz and beyond.

Considering the preceding noise discussion and these critical constraints, the LTC2063 low-power, zero-drift op-amp fits the bill.

The noise voltage of a 10 MΩ resistor is 402 nV/√Hz; the LTC2063’s is roughly half. The noise current of a 10 MΩ resistor is 40 fA/√Hz; the LTC2063’s is less than half. The LTC2063 fits neatly into a battery application inasmuch as its supply current is 1.4 μA typical, and total supply can go down to 1.7 V (rated at 1.8 V). Since low frequency measurements by definition require long settling times, this generator must remain powered by a battery for extended periods of time.

The noise density of the LTC2063 input is roughly 200 nV/√Hz, and noise is predictable and flat over the frequency range (within ±0.5 dB). Assuming that the LTC2063’s noise is 50% of thermal noise and op-amp voltage noise changes 5%, output noise density changes only 1%.

Zero-drift op-amps do not have zero 1/f noise by design. Some are better than others and, especially for current noise, it is more common that the wideband specification is wrong or that 1/f noise is much higher than suggested in the data sheet. For some zero-drift op-amps, the data sheet noise plot does not go down to the mHz frequency region, possibly masking 1/f noise.

A chopper stabilised op-amp could be a solution to keep the noise flat at very low frequency. That said, the high frequency noise bump and switching noise must not spoil the performance. The data shown here supports the use of the LTC2063 in the face of these challenges.

**Circuit description**

The thin film \(R_1\) (Vishay/Beyschlag MMA0204 10 MΩ) generates most of the noise. The MMA0204 is one of few 10 MΩ options to combine high quality with low cost. In principle, \(R_1\) could be any 10 MΩ, as signal current is very small, so 1/f noise can be neglected.

It is best to avoid low-cost thick film chips of questionable accuracy or stability for the primary element of this generator. For best accuracy and long-term stability, \(R_2, R_3\) or \(R_4\) could be 0.1% thin film – for example, TE CPF0603. \(C_2/C_3\) could be one of most dielectrics; \(C_0G\) can be used to guarantee low leakage current.

**Implementation details**

Loop area \(R_1/C_1/R_3\) should be minimised for best EMI rejection. Additionally, \(R_1/C_1\) should be avoided.
Horticulture LED Lighting

New horticultural products from the high power ceramic series. Specially chosen wavelengths (450 nm, 660 nm and 730 nm) increase photosynthesis, optimizing plant development and growth. With outstanding PPF-value, small size and low power consumption, the WL-SMDC is the future choice for horticultural lighting. Available ex stock. Samples free of charge.

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

For a short introduction of Horticulture LEDs read our Application Note:
www.we-online.com/AN-Horti

- High efficacy
- Individually adjustable color spectrum for each plant
- Full color spectrum available incl. white, UV and IR-LEDs
- Low thermal resistance
- Electrically neutral thermal path
- One footprint for all colors
Microchip Technology announced new two- and three-channel power monitoring devices that measure from 0 V to 32 V on a single chip, offering designers solutions that are easy to adopt and improve power measurement accuracy. The two-channel device is also the industry's first with native 16-bit resolution, providing leading flexibility across a wide measurement range.

The PAC1932/33 devices include precisely what is needed to measure power on a single integrated circuit (IC), integrating multiple channels in a single package for applications such as point-of-sale systems, ATMs and building automation. This reduces costs for system designers while also consolidating their bill of materials, as the measurement of sub 1 V to 20 V voltage rails normally requires separate components to measure each rail efficiently. The devices' ability to measure voltage rails under 1 V to as high as 32 V also relieves developers from having to reconfigure measurement resolution between low- and high-current load events.

As the industry’s only two-channel device with 16-bit power measurement, the PAC1932 can measure without host intervention for 17 minutes, relieving developers from adjusting voltage or current range to measure power and energy. The devices include two 16-bit analog-to-digital converters (ADCs) that can measure voltage and current simultaneously, enabling developers to extract a true power measurement.

The PAC1932/33 work in conjunction with Linux and Windows 10 software drivers. The ADM00805 register compatible evaluation board can be used to start development with a graphical user interface reporting Vsense, Vbus, power and accumulated power.

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

Continued from page 12

be very well shielded from electrical fields, which will be discussed further in the EMI considerations section. Although not critical, R1 should be shielded from large temperature changes. With good EMI shielding, thermal shielding is often adequate.

The LTC2063 rail-to-rail input voltage transition region of the VCM range should be avoided, as crossover may result in higher, less stable noise. For best results, use at least 1,1 V for V+ with the input at 0 common mode.

Note that R2 of 10 kΩ may seem high, but the micropower LTC2063 presents a high output impedance; even 10 kΩ does not fully decouple the LTC2063 from load capacitance at its output. For this white noise generator circuit, some output capacitance that leads to peaking can be a design feature rather than a hazard.

The output sees 10 kΩ R2 and a 50 nF Cx to ground. This capacitor CX will interact with the LTC2063 circuit, resulting in some peaking in the frequency response. This peaking can be used to extend the flat bandwidth of the generator, in much the same way that port holes in loudspeakers attempt to expand the low end. A high-Z load is assumed (>100 kΩ), as a lower-Z load would significantly reduce the output level, and may also affect peaking.

The remainder of this article can be read online at www.dataweek.co.za/papers/K4999, and covers optional tuning, measurements, EMI considerations and limitations of this design.

For more information contact Conrad Coetzee, Arrow Altech Distribution, +27 11 923 9600, ccoetzee@arrow.altech.co.za.
Robust solid state drives

Innodisk is offering innovative approaches to aerospace and defence, and heavy computational load applications. The company’s 1.8” SSD (solid state drive) has a good track record in the industry, but it is ready for a make-over to fit modern mission-critical requirements.

With solid 2D NAND SLC and MLC products already on the market, Innodisk is currently developing a new 3D NAND drive that delivers industrial-grade performance and high capacities. Coupled with advanced LDPC error correction and RAID functions, this new series offers comprehensive data safety measures. For those worried about data falling into the wrong hands, AES hardware-based encryption is easily added and offers an unbreakable barrier against data leakage.

Mission-critical applications are moving out into increasingly remote areas. These places often struggle with power supply stability, which in turn can affect storage devices. To meet this challenge, the 1.8” SSD series is available with power stability features such as iData Guard and iCell, for devices both with and without DRAM buffer.

The series offers sequential read/write speeds up to 520/450 MBps based on MLC flash, with capacity up to 1 TB. iSLC technology that drastically increases product lifespan is also available. This technology is suitable for applications where longevity is crucial.

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

DIY vector network analyser

At the recent International Microwave Symposium 2018, Mini-Circuits demonstrated a do-it-yourself vector network analyser kit. Aimed at students, the UVNA-63 was designed to bridge the gap between textbook theory and actual lab measurements.

The kit includes all the elements students need to build a fully functioning vector network analyser, develop S-parameter algorithms, and perform real-time measurements of 2-port RF devices. With a frequency range from 500 MHz to 6000 MHz, the UVNA-63 is an ideal tool for graduate students to learn more through practical experience about doing measurements. The student will be able to configure transceivers for sweep, resolution bandwidth, power and step size through a simple API (application programming interface).

With the UVNA-63 the student can build their own vector network analyser with the RF transceiver board, RF and microwave components, cables and calibration standards. They can develop real-time S-parameter measurements with Python or Matlab. The student also has access to online tutorials and sample code to ensure they understand how the system works.

Project kits are available for pre-order from Conical Technologies now and will be delivered in September.

For more information contact Conical Technologies, +27 66 231 1900, daniel@conical.co.za.
Hiconnex Industrial to make HARTING connectors for trains

Hiconnex Industrial has received a coveted stamp of approval from global connector specialist, HARTING Technology Group, to produce a selection of HARTING connectors at its premises in Centurion, Gauteng. Hiconnex Industrial specialises in supplying cable and connector solutions for the general industrial, oil and gas, renewable energy, mining and rail industries, and this latest development services the latter in particular.

Operating out of a newly developed facility in its existing premises, the connectors that Hiconnex Industrial has been authorised by HARTING to produce are destined for a new fleet of 600 modern commuter trains being built for South Africa’s metro railway network. HARTING SA has secured a supply agreement with Gibela, a consortium between majority shareholder Alstom, Ubumbano Rail and New Africa Rail which has a contract to supply the trains to the Passenger Rail Agency of South Africa (PRASA). The fact that these connectors will now be made in South Africa aids the goal of maximising local content for the Gibela project.

The new facility was unveiled at a ribbon-cutting ceremony on the 1st of August by Hiconnex Industrial’s general manager, Chris Brand, and the HARTING Technology Group’s general manager for corporate regional management, Bernd Fischer. “This is the culmination of 18 months of work putting in place the equipment and processes necessary to produce connectors to HARTING’s exacting quality standards,” stated Brand. “During that time we have obtained our ISO 9001:2015 certification, and are in the process of obtaining ISO 14000 and 18001 as well.”

Staffed by three members of the Hiconnex Industrial team, the facility receives the base parts for the connectors from an overseas HARTING production plant, and assembles and packages them ready for delivery. They are manually assembled using jigs custom designed and built by Manhattan Tools (based in Benoni on the East Rand of Gauteng) and marked using a newly purchased laser marking machine from CAB Technology. From there the connectors are visually inspected by two members of the team, before being individually sealed in air-tight plastic packaging.

“We have the capacity to produce all the HARTING connectors necessary for a train in just two days, so even once the Gibela project ramps up to full speed we will be more than capable of keeping up with the supply requirements. We can proudly say that being given the blessing of one of the world’s leading connector manufacturers to make products on its behalf acknowledges the fact that we have created a facility that is truly world class,” Brand concluded.

For more information contact HARTING South Africa, +27 11 575 0017, errol.mann@harting.com; Hiconnex Industrial, +27 12 661 6779, chris@hiconnex-industrial.co.za

Locking connectors for space applications

Radiall has expanded its range of products equipped with an SMP-LOCK interface for the space market. The connector features a robust locking mechanism, which dramatically increases the retention force of the interface and prevents accidental disconnection.

The SMP-LOCK product offering for the space market features new connector variants, cable assemblies, attenuators, loads and switches. This connector is compliant with an SMP interface and includes a unique quick locking system to simplify installation and provide a secure connection. It is an ideal alternative for SMA and SMA2.9 since it can work up to 40 GHz and avoid any risk for bad connections during integration.

The connectors are easy to connect and disconnect, with no need of a torque wrench, and produce an audible click to indicate that the plug is locked. Performance characteristics include operation from DC to 22 GHz, VSWR below 1.2, EMC above 85 dBi, mating life in excess of 100 cycles and a temperature range of -65°C to +165°C.

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

Amphenol has a broad range of high-power connectors to offer the military and industrial market. Combining the benefits of field proven MIL-DTL-38999 Series III circular connectors with hyperbolic RADSOK contacts, the 1000 A Rhino 38999 series connector is designed to meet the latest military, industrial and safety requirements. Alongside Rhino 38999, Amphenol also has a complementary range of higher-power MIL-DTL-38999 connectors.

In the single-pole Rhino 38999 connectors, the use of RADSOK contacts creates an electrical interface that exceeds typical interconnect requirements via a hyperbolic socket contact construction, which delivers very low contact resistance and performs exceptionally well under high vibration. Rhino 38999 connectors offer current ratings of 85 A up to 1000 A and operational voltage ratings of up to 1200 V d.c., with 360 degree EMC/RFI screening.

Environmental features include a temperature range of between -55°C to +150°C, IP68 sealing and 500 hours salt spray tolerance. Amphenol is also able to use the same product technology in multi-pole options, both rectangular and circular, with the additional benefit of safety inter-lock contacts to enable hot-swapping.

Alongside the higher-current Rhino 38999 connectors, Amphenol also manufactures an extended range of standard MIL-DTL-38999 series III specification multi-pole connectors with larger contact sizes to carry current up to 100 A. These connectors are available with crimp contacts and also tapped-hole contacts to suit busbar termination. Example insert arrangements include the popular 21-42 and 21-75 styles.

Both power connector series are available in a variety of shell materials including aluminium, stainless steel and aluminium bronze, and can be provided with RoHS-compliant black zinc nickel plating.

Amphenol’s broad offering of power products is suitable for high-reliability applications including harsh environments as well as hybrid and electric drive vehicles, military aircraft, naval systems, C4I base stations, power distribution modules, communication towers, satellite communications, mass transit, automation and mining.

The connectors can also be supplied as over-moulded cable harnesses providing a complete interconnect solution.

For more information contact StarTech Industrial, +27 11 823 1520, sales@startup.co.za

Mid-range relays for aircraft

TE Connectivity’s CII mid-range relays offer critical size and weight savings in aircraft applications. Their balanced force design provides the benefits of consistently high contact pressure, reduced bounce and less arcing, helping lead to extended contact life. The relays vary in size from the compact 5 A package all the way up to a 50 A version in a 2,54 cm cube enclosure.

FC-325 Series relays are hermetically sealed devices designed for harsh inductive, motor and lamp load applications in aerospace, defence and marine markets. Configured as a 3PST/NO (DM), the double make/break contact design shares the load across two contact sets, resulting in less wear and tear on the relay.

The relay’s all-welded design creates a reliable alternative to similar solder sealed relays in the market.

The Series FCA-210, FCA-410 and FCB-205 relays employ a polarised single-side stable design, where the flux from a permanent magnet provides the armature holding force in the deactivated state, and its flux path is switched and combined with the coil flux in the operated state. This results in appreciably increased contact pressure in both states over that of a spring return nonpolar design.

A variety of coil options are available which allow AC or DC control. Terminal styles include socket pins, solder pins and solder hooks. Each series comes with a variety of mounting options and all are qualified to MIL-PRF-6106 and MIL-PRF-83536.

For more information contact TRX Electronics, +27 12 997 0509, info@trxe.com.
M12 connectors for high data rates

With the Telegärtner STX M12 IP67 connector series, Jasco's Webb Industries offers solutions to the industry’s demand for consistent cabling of industrial communication networks in accordance with IEC 61918, which prescribes M12X1 circular connectors in 4- and 8-pole versions as a plug interface.

The series contains M12X1 D- and X-coded connectors which are suitable for connecting to both solid conductors and stranded wire cables.

Another important feature of the Telegärtner STX M12 IP67 connector series is its printed circuit board bulkhead sockets with housings for front or back mounting, and the series is rounded off by its pre-assembled connecting cables for connection to terminating equipment or connection of that equipment to a control cabinet.

The STX M12x1 connector series can be used for applications such as security and video surveillance (CCTV), passenger information systems (PIS), production systems or production monitoring with high-resolution cameras. Users can, for example, connect X-ray machines for baggage inspection at airports, encapsulated and safe from manipulation with the M12 circular connector. The M12 is also ideal in railway vehicles: it helps to distribute the increasing data volume reliably while transmitting the data to all connected systems and devices in the train to, inter alia, cameras or switches.

As 4-pole, D-coded compact connectors in Cat.5e, the Telegärtner M12 can transmit data rates up to 100 Mbps in the PROFINET environment. X-coded in Cat.6A, the 8-pole version can transmit data rates up to 10 Gbps according to CDV IEC 61076-2-109. The high bandwidth is ensured by separating the four-pairs transmission with a cross shield (X-coding). Additionally, a power supply to connected terminating equipment is possible.

An important part of the STX M12x1 connector series are the bulkhead sockets in Cat.6A. They are available with housings for front or back mounting, as well as versions without housings with a fourfold shield connection to the printed circuit board, and feature versatile mounting possibilities.

A standout feature of the M12 is that, thanks to an intelligent wire management and simple screw connection system, the individual components of the STX M12x1 cable plug can be assembled quickly and easily on site, completely without the use of special tools.

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

Board-to-board butt joints

Two-row pin and socket strips in a 90-degree SMT design, with a space-saving 2,0 mm grid, are the most recent members of the WR-PHD product family from Würth Elektronik eiSos.

Positioning pegs on the pin strip permit precise placement on the PCB and prevent ‘floating’ while soldering. The plug connectors, optimised for SMT, can be used in order to connect two printed circuit boards horizontally with a butt joint.

The WR PHD plugs and sockets are each available in the standard pin counts of 4, 6, 8, 10, 12, 14, 16 and 20 ex stock in roll packaging. The current carrying capacity is 2 A per pin, and the operating voltage goes to 200 V a.c. Free samples can be requested.

For more information contact Jason Page, Würth Elektronik eiSos, +27 71 259 9381, jason.page@we-online.com
4.3-10 male to N-type female adaptor

Anoison announced the release of 4.3-10 male to N-type female adaptors. The ANO 471-512-1296 was engineered for the wireless market and is ideal for applications requiring low passive intermodulation, or PIM.

With most new network radio equipment fitted with 4.3-10 connectors it is crucial that adaptors are made available to fit these connectors.

The 4.3-10 connectors offer a similar robust design as 7/16 connectors but are smaller and lighter, allowing for much more dense, lighter-weight applications and at a lower cost than the traditional DIN 7/16 connectors. The ANO 471-512-1296 is a versatile 4.3-10 male to N-type adaptor that has been designed to ease the task of the network maintenance crew by enabling them to use a test cable fitted with an N-type male connector.

The adaptor has a wide operating frequency range of up to 12 GHz and is RoHS compliant. It also has a temperature range of -55°C to 90°C. Anoison has a range of 4.3-10 adaptors and connectors for a variety of cables available.

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

Rugged high-power connectors

TE Connectivity’s high-power AMP MCP 9.5 two-position connectors are designed for harsh environment wire-to-wire and wire-to-circuit board connections, such as those required in the trucking, agricultural, mining, construction and marine industries.

The connectors are constructed of heavy-duty thermoplastic and withstand severe vibration and mechanical shock.

The connectors are IP67 and IP69K rated (with backshell) and protect connections from dust, dirt and moisture. Several mounting options are available, including inline, flange, sealed flange and PCB mount. They accept contact size 9.5 (78 Amps) and 10 mm² wire, and feature a slide lock for mating, plus an integrated secondary lock that confirms contact alignment and retention.

AMP MCP 9.5 two-position connectors are designed to avoid misorientation, as there is just one clear direction to insert the connector to achieve polarisation. They are rated for operating temperatures of -30°C to 100°C, and require no tooling for mounting thanks to their clip-in mounting feature.

For more information contact Wiltron Agencies, +27 12 940 9475, wiltron@global.co.za

Tape-on-reel pin strips

The STL(Z)950 family of pin strips from PTR are supplied in tape-on-reel format to facilitate automated assembly. They are available with either 5.00 mm or 5.08 mm pin spacing, and each copper alloy pin fits into a PCB hole of 1.4 mm diameter.

The pins are rated for 300 V and 15 A (or a higher 16 A rated variant). The strips are supplied in black (RAL 9011) with 2 to 8 poles. They are rated for operating temperatures of -30°C to 105°C, and are suitable for the high temperatures encountered during wave or reflow soldering.

For more information contact Wiltron Agencies, +27 12 940 9475, wiltron@global.co.za
Introduction to coaxial cable losses

By Peter McNeil, Pasternack.

Coaxial cable transfers radio frequency power from one point to another and, in the ideal world, the same amount of power would transfer along the cable to the remote end of the coax cable. However, real world conditions include some power loss along the length of the cable. Loss, or attenuation, is one of the most important features to look for when deciding what type of coaxial cable to use in a design.

Loss is defined by decibels per unit length and at a given frequency. Thus, the longer the coaxial cable, the greater the loss. Loss is also frequency dependent, generally increasing with frequency, but the loss is not necessarily linearly dependent upon the frequency. Power loss occurs in a variety of ways.

Resistive loss
Resistive losses within the coaxial cable occur when the resistance of the conductors and the current flowing in the conductors results in heat being dissipated. Skin effect limits the area through which the current flows, which leads to increased resistive losses as the frequency rises.

To reduce the level of resistive loss, the conductive area is increased, resulting in larger low-loss cables. Also, multi-stranded conductors are often used. Resistive losses generally increase as the square root of frequency.

Dielectric loss
Dielectric loss is signal energy dissipated as heat within the insulating dielectric of a cable, but is independent of the size of the coaxial cable. Dielectric losses increase linearly with frequency, and the resistive losses normally dominate at lower frequencies. As resistive losses increase as the square root of frequency and dielectric losses increase linearly, the dielectric losses dominate at higher frequencies.

Radiated loss
Radiated loss in a coaxial cable is usually much less than resistive or dielectric losses, however a poorly constructed outer braid on some coaxial cables may yield a relatively high radiated loss.

Radiated power, problematic in terms of interference, occurs when signal energy passing through the transmission line is radiated outside of the cable. Leakage from a cable carrying a feed from a high-power transmitter may produce interference in sensitive receivers located close to the coax cable or a cable being used for receiving can pick up interference if it passes through an electrically noisy environment.

To reduce radiated loss or interference, double- or triple-screened coaxial cables are designed to reduce the levels of leakage to very low levels.

Of these forms of loss, radiated loss is generally the less concerning as only a very small amount of power is generally radiated from the cable. Thus, most of the focus on reducing loss is placed onto the conductive and dielectric losses, except in certain applications.

Loss over time
Loss or attenuation of coaxial cables tends to increases over time as a result of flexing and moisture in the cable. Although some coax cables are flexible, the loss of level or attenuation will increase if the RF cable is bent sharply or if there is a disruption to the braid or screen.

Contamination of the braid by the plasticisers in the outer sheath or moisture penetration can affect both the braid where it causes corrosion and the dielectric where the moisture will tend to absorb power. Often, coax cables that use either bare copper braid or tinned copper braid experience more degradation than those with the more expensive silver plated braids.

Although foam polyethylene provides a lower level of loss or attenuation when new, it absorbs moisture more readily than the solid dielectric types. Cables with solid dielectric polyethylene are more suited to environments where the level of loss needs to remain constant or where moisture may be encountered. Even though RF coaxial cables are enclosed in a plastic sheath, many of the plastics used allow some moisture to enter; thus, for applications where moisture may be encountered, specialised cables should be used to avoid performance degradation.

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

The Internet of Things (IoT) industry in South Africa has matured over the past few years and as a result we have noticed new Low Power Wide Area Network (LPWAN) service providers gaining significant prominence in the telecommunications industry.

Over the past 18 months we have seen the global LPWAN provider Sigfox entering our local market through a local service provider, and they have succeeded in deploying their network to over 85% of the population in South Africa. Conversely, a competing service provider has implemented the largest open architecture LPWAN in Africa based off the LoRaWAN networking protocol. The question is, how have the traditional telco operators in South Africa catered for the new generation of IoT applications?

The two common network technologies that telco operators around the world are deploying for IoT applications are LTE CAT M1 and NB-IoT. These two network technologies offer very similar performance with regards to signal range and power consumption but the LTE CAT M1 technology supports higher network speeds in comparison to NB-IoT.

MTN has recently announced that they have conducted tests with Ericsson based on LTE CAT M1, raising speculation that they will implement such a network commercially. They have partnered with Cisco Jasper to offer a control centre for IoT which will enable advanced device management across various cellular and LPWAN technologies, as well as provide the ability for creating custom business rules and automation procedures. One can only conclude that this recent partnership should pave the way for an accelerated IoT network launch by MTN in the near future.

Vodacom has opted to deploy an NB-IoT network which will operate on the 900 MHz frequency band. Vodacom currently has select live NB-IoT cell towers enabled and offers a test facility at Vodaworld to evaluate module compatibility with their network.

Earlier this year SIMCom’s SIM7000E module’s registration and UDP client connection methods were successfully tested at Vodaworld ahead of us promoting the device to the end user market. The module has subsequently received the local regulatory approval by ICASA and is currently being evaluated for metering applications by a prominent supplier to the industry, as well as several design houses in other, unrelated applications.

The increased demand by telco operators on ICASA for spectrum availability has been one of the motivating factors for deploying NB-IoT as a means of upgrading GPRS based systems. There has been no mention of discontinuing the GPRS networks in South Africa at this stage, however one should bear in mind that the GPRS network in the US and Australian regions have been disabled and a rise in NB-IoT usage may result in a similar future for GPRS networks in South Africa.

One of the most critical features of the SIM7000E module is that not only does it support LTE CAT M1 and NB-IoT, but it also supports the traditional GPRS network services which are currently being used in a multitude of industrial communication applications. This functionality allows for traditional GPRS device and application designers to begin their transition towards the new low-power, low-speed LTE CAT M1/ NB-IoT network technologies while maintaining a ‘fall back’ ability to the tried and tested GPRS network which they are familiar with.

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

Tough GNSS antenna

The AQHA.11 GNSS quadrifilar helix antenna is a high-performance GNSS (global navigation satellite system) L1 antenna for demanding GPS / GLONASS / BelDou/ Galileo applications. Its wide bandwidth allows maximum coverage of the main global satellite constellations.

The wide axial ratio beamwidth of the quad-helix provides excellent reception and signal fidelity across the sky, reducing multipath effects while ‘seeing’ more low-elevation satellites compared to patch antenna designs. These characteristics make it well suited to timing, precision positioning, telematics and autonomous routing applications.

The AQHA.11 is provided with a dual-stage combined front-end, which provides high rejection, low noise figure and excellent gain. The amplifiers accept a wide input voltage range of 2 V to 24 V and require low current (10 mA typical). The quad-helix AQHA.11 is ready for outdoor industrial and commercial usage with full -40°C to +85°C temperature rating and IP67 ingress protection rating.

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

The Digi TransPort WR64, made by Digi International, is a high-performance cellular router with dual redundant communications for complex transit systems.

This dual module LTE-Advanced router is designed to support the connectivity needs of transit agencies and their riders with cellular and Wi-Fi connectivity today, and the ability to simply add components for future 5G functionality. Along with enterprise class routing, the device integrates security, firewall and VPN functions.

The introduction of LTE Cat. 6 with carrier aggregation is pushing theoretical download speeds to 300 Mbps, and the next generation of cellular radios are capable of aggregating three or more channels for speeds up to 600 Mbps; 5G deployments will only further increase speed demands. The WR64 is built to meet these new capabilities and the higher expectations that come with them.

Today, riders demand a seamless Wi-Fi experience, and with so many transportation options, transit agencies that are unable to provide it will struggle to grow or even retain their ridership. Agencies, meanwhile, must be able to integrate vehicle data from cameras, engines and logistics programs while maintaining the highest level of security.

The Digi TransPort WR64 meets these needs with dual 600 Mbps CAT 11 cellular radios and dual Wi-Fi radios that allow transit agencies to segment private data from public data, so Internet access for passengers is managed securely and separately from connectivity for onboard systems.

For more information contact Carl van der Merwe, Avnet South Africa, +27 11 319 8600, carl.vandermerwe@avnet.eu

High-speed broadband RF switches

MACOM Technology Solutions announced the newest entries in its high-performance RF switch portfolio. Optimised for use in satcom, 5G wireless, test and measurement, electronic warfare and microwave radio applications, the new GaAs-based SPDT (single-pole double-throw) MASW Series switches provide extended broadband frequency coverage and high-speed switching capability.

The new MASW-011105 SPDT reflective switch covers the 17.7 – 31 GHz frequency range, with low insertion loss of 1.6 dB, high isolation at 30 dB and switching speed of 12 ns, offered in a lead-free 3 mm, 14-lead QFN surface-mount plastic package.

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

Handheld spectrum analyser

The SignalHawk SH-42S-TC from Bird Technologies is a new generation of spectrum analyser that offers enhanced functionality in a small, very affordable package.

This highly portable unit fits easily in one hand and offers the user an intuitive user interface. Built upon an Android platform, users will find a high-resolution touch screen with familiar, easy to use methods for setting up and using the instrument.

Field engineers, technicians, wireless equipment manufacturers, service providers, contractors, tower erectors and military field personnel alike can rely on the efficiency and precision results of the unit. For power measurements, it includes the Bird RF Meter App that allows interoperability with a wide range of Bird field sensors. Work orders can be viewed directly on the instrument with a .pdf/.doc viewer, and a custom user-written WordPad help file can be uploaded.

For more information contact Comtest, +27 10 595 1821, sales@comtest.co.za

Sentrius Series - RG186 LoRa-Enabled Gateway

R3375 each ex vat

021 555 8400 www.rfdesign.co.za
TraX invests in RF and high-speed digital PCB capability

As technology advances annually, so do the laminates and materials used in the manufacture of printed circuit boards.

These new laminates each bring different challenges during the manufacturing process due to their chemical composition and the specialised electrical properties they are designed to achieve. Many of these laminates require special processing and special equipment, especially the PTFE low-loss materials utilised in radar and RF applications. The modern challenges involved have led TraX Interconnect to add an MEC V-Bond process to its list of capabilities.

"Working with these new laminates and materials, particularly when it comes to soldermask application and innerlayer bonding, has meant investing in the new generation of chemical adhesion promoters," explains TraX managing director, Daniel Dock. "In high-frequency printed circuit boards the surface roughness of the copper surface becomes an important factor affecting performance of the finished board. Current adhesion promoting treatments leave a surface that is too rough for high-frequency signals."

Traditionally as part of the manufacturing process of a printed circuit board, a polymer ink (soldermask), most often green in colour, is applied to the circuit board to cover the copper traces of the circuit that do not require soldering. The purpose of the soldermask is to provide an electrically non-conductive, protective layer over the copper traces that make up the electronic circuit. Failure to protect these traces will result in oxidation of the copper and cause damage to the circuit.

If the surface of the copper traces being covered by soldermask is not suitably prepared then the soldermask will peel off and not stick to the copper surface. This can be equated to traditional surface preparation of most surfaces prior to painting.

"In printed circuit board manufacturing, much like painting preparation, we used to rely on abrading of the surface to be covered by soldermask," Dock continues. "This was done by passing the printed circuit boards through conveyerised equipment containing round abrasive rollers that press down on the board surface as they pass between them. This can be compared to sanding before painting, with the resultant fine scratches in the copper surface making it possible for the soldermask to stick.

"The problem with this process is that the scratches on the copper traces are a problem in boards manufactured to operate at high frequencies, since these scratches affect the signals running at high speed across them. By implementing this new surface treatment at TraX we will be able to ensure that we provide sufficient adhesion for solder mask whilst leaving the copper surface as smooth as possible."

Dock concludes by saying he is confident this new process puts TraX in a better position to manufacture boards for radar, aerospace and military applications where controlled impedance and high frequencies are critical factors.

For more information contact TraX Interconnect, +27 21 712 5011, daniel@trax.co.za.

USB dongle for wireless development

Nordic Semiconductor has launched a low-USB dongle for its nRF Connect for Desktop PC tool that allows developers to immediately connect their PCs to a wireless device with only one end of the wireless link available. This further simplifies the application design and program development process because the developer can see exactly what the wireless device is doing from the get-go on their PC desktop and without having to invest in a full development kit.

The nRF52840 dongle supports all major wireless standards including Bluetooth Low Energy, Bluetooth mesh, Thread, ZigBee, 802.15.4, ANT and 2.4 GHz proprietary applications running on the Nordic nRF52840 multi-protocol system-on-chip (SoC). It also has a user-programmable RGB LED plus physical pushbutton, a green LED, as well as 15 GPIO accessible solder points along the edge. To give users a flying start, example applications have been made available in the Nordic nRF5 SDK under the board name ‘PCA10059’.

The dongle can also be programmed through the Nordic Semiconductor nRFutil utility — a Python package and command-line utility that supports device firmware updates and cryptographic functionality.

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

Laird’s Sentrius RG1xx Series LoRa-enabled gateway is a secure, scalable, robust solution for end-to-end control of a private LoRaWAN network.

Leveraging Laird’s field-proven and reliable 50 Series ‘Wireless Bridge’ certified module, it also offers enterprise dual-band Wi-Fi, Bluetooth v4.0 (BLE and Classic) and wired Ethernet for design freedom.

Based on the Semtech SX1301/SX1257 chipset designs, it offers a LoRa range up to 16 km and pre-loaded LoRa packet forwarder software, ideal for highly scalable, flexible IoT networks. The gateway works with Laird’s RM1xx Series LoRa+BLE certified modules for simple out-of-the-box integration, and is compatible with third-party cloud and LoRa partners, as well as any LoRaWAN certified client devices.

For OEMs looking to integrate a high-performance, certified LoRaWAN gateway interface into any Linux based platform, Laird also offers the Sentrius RG1xx-M2 concentrator card. This hardware solution expands upon Semtech drivers and reference design for improved RF performance. Comprehensive integration and design services for a custom gateway are also available via Laird’s dedicated engineering services team, as are qualified LoRa antenna solutions from Laird.

The module is designed around the Sentrius SX1301 digital baseband chip with an integrated LoRa concentrator IP, which is designed to perform high-performance gateway function in the ISM band. The RF front-end consists of two of SX1257 high-performance digital I and Q modulator/demodulator transceiver chips. The SX1257 is designed to operate over the frequency band of 862 – 960 MHz to cover the European and North American markets.

GPRS module in LGA footprint

Quectel’s M89 is a quad-band GSM/GPRS module utilising an LGA footprint, that is compatible with the BGS2 module. Based on the latest 2G chipset, it offers optimal performance in SMS and data transmission and audio service, even in harsh environments. The compact 18.8 x 27.6 x 2.3 mm size makes it an ideal platform for low-bandwidth M2M applications that need reliable network connectivity.

The M89 adopts LGA surface mounting technology which enables reliable and durable soldering processes, and provides a flexible choice for durable and rugged designs. Its minimal footprint ensures it can be easily embedded into size-constrained applications. This kind of package is ideally suited for large-scale manufacturing which has strict requirements for cost and efficiency.

The RG1xx-M2 concentrator card’s RF front-end is terminated with a standard U.FL connector. The board’s form factor and connector pinout are designed to conform to M2.COM specifications. The card requires a single 5 V supply and it generates its power supply requirements on-board. Standard SPI communication, reset and power supply to the board are provided through a 75-position host interface connector.

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

For more information contact ICORP Technologies, +27 11 781 2029, enquiries@icorptechnologies.co.za.
Internet of Agricultural Things enabled by LPWAN

Although consumer devices tend to grab the headlines, the best use of technology has always been to increase productivity, and the same is true for the IoT.

Smart home automation is perhaps the exception, and one that is growing rapidly, but for now at least the real-world applications for IoT-based technology are still in the non-consumer sectors. This creates opportunities for manufacturers eager to embrace the new.

Wireless connectivity is a crossover technology in this respect; a horizontal sector that touches and empowers every vertical, including consumer. However, there is one wireless technology that is now, and may remain, positioned for industrial applications. LPWAN, or Low-Power Wide-Area Networking, is optimised for the IoT in terms of power, range and data bandwidths.

There are relatively fewer competing solutions in the LPWAN sector, which differs from Personal-Area Networks (PANs), such as Bluetooth, ZigBee, Thread and even Wi-Fi in more than just range. The underlying physical layer isn’t intended to provide high-speed bidirectional channels between many devices; the applications for LPWAN are typically remote monitoring, where a relatively small amount of data is sent over a long distance (in the order of tens of kilometres) on a relatively infrequent basis.

The main technologies in the LPWAN arena are LTE (thanks to new technologies introduced in Release 13 of the 3GPP specification), LoRa (and LoRaWAN, which is different, as explained later) and Sigfox. Those based on LTE operate in the licensed spectrum and are largely owned by cellular network providers, while LoRa and Sigfox operate in the licence-free spectrum, so are perhaps more accessible but do not necessarily avoid the cost of using a network, as covered below.

Low bandwidth, no problem

It may be argued that a wireless technology that doesn’t offer a high bandwidth is of limited use in a world where technologies like Wi-Fi are so abundant. However, for many applications, access to a Wi-Fi access point or even power is still limited. It is these kinds of applications where LPWANs can have a real impact, and that is no more apparent than in the agricultural sector.

Asset monitoring in an agricultural environment takes on an entirely new meaning. For example, Digitanimal is a Spanish company specialising in tracking animals, including cattle, horses and sheep. Using an LPWAN-enabled tag, the animals’ locations are monitored and relayed to the customer on a regular basis and the platform can even use geotagging to send alerts if the asset moves outside a designated geographical area.

Similarly, Green Citizen, based in France, offers a range of products targeting the agricultural sector, including the Hummbox soil and weather sensor. This sensor measures humidity as well as soil moisture and temperature, and uses LPWAN (it is compatible with both LoRa and Sigfox) to communicate that information to the cloud.

The ecosystem around the ‘Internet of Agricultural Things’ is growing and includes cloud platforms to process the sensor data. An example, Master Of Things, is described as an ‘application enablement platform’ that offers a plug and play experience for users putting Sigfox devices into service.

The same, but different

While LoRa and Sigfox are both LPWAN technologies, they differ in their implementation. LPWANs in general use a star network topology, as opposed to the now dominant mesh network topology used in PANs. This means each endpoint has a direct connection to a gateway, bridge or, in cellular terminology, base-station.

Rather than leapfrogging from one endpoint...
to another until the signal reaches a gateway/bridge, as in a mesh network, the signal is received by all of the gateways within range. In order to achieve the range that this topology needs, the data rate is minimised, which effectively restricts their use to remote sensors, actuators and similar devices.

As with the cellular experience, users of LoRa and Sigfox LPWANs are not expected to build their own network; instead a growing number of providers are doing this. Getting an endpoint online using an LPWAN is, in theory, as simple as turning the device on (or, more likely, putting batteries in) and subscribing to a service. All of the network management is handled in the cloud by the platform, which again isn’t the responsibility of the user.

Of course, the option is there to build a proprietary LPWAN network, specifically using the LoRa physical layer, and there are proprietary solutions now available that make use of the LoRa physical layer running their own protocol. However, the LoRaWAN protocol, created by the same association that manages the physical layer, has been developed to meet the needs of the IoT and doesn’t rely on any proprietary technology.

For example, the LoRaWAN protocol adds Adaptive Data Rate (ADR), which allows the gateway to control the data rate of the endpoint, based on factors such as link budget. Those endpoints with a good connection can afford to transmit at a higher data rate and thereby reduce their time on the network, which helps manage the overall network capacity.

Another important feature of the protocol is the device class (see Figure 1). There are a total of three bidirectional classes available: A, B and C. Devices operating solely from battery power are likely to be Class A devices, which is the most energy efficient of the three. In this class, the device will likely be a sensor transmitting data when it needs to. Only after transmitting will it go into receive mode for a short while; it is this feature that minimises power.

Class B devices may also be battery powered but they will need a lower latency on the downlink; this may include actuators, for example. Class C supports endpoints that have access to continuous power, allowing them to listen more often and for longer.

LPWAN hardware

As most of the network management is handled by the cloud-based platform, LPWANs are arguably the simplest form of wireless connectivity to use and this is made even simpler by the availability of pre-certified modules, like the Murata Type ABZ LoRa module (part number CWMX-1ZZABZ-078). It integrates an RF frontend and baseband chipset in the form of the SX1276 from Semtech, alongside an ARM Cortex-M0+ based STM32L0 Series microcontroller from STMicroelectronics (see Figure 2).

The module is also LoRaWAN-certified, as it fully supports the protocol. The module itself meets all radio regulatory approvals for the 868 to 915 MHz part of the spectrum, which falls within the licence-free ISM band observed by most world regions. Interfacing to the module is achieved through either a UART, SPI or I²C interface and with 192 KB of Flash the microcontroller offers enough on-chip memory for customer applications. An ADC and 18 GPIOs are also included for this purpose; as such, the module can easily interface to a number of analog or digital sensors.

All of the features of the module can be easily accessed for development purposes, using the STM32 LoRaWAN Discovery Board from STMicroelectronics (part number B-L072Z-LRWAN1, see Figure 3), which is ARM mbed compatible. It also comes with ST’s I-CUBE-LRWAN software, which is Class A certified and supports Class C operation.

Conclusion

LPWANs offer a way to get more assets online over longer distances, but perhaps most importantly they can remove the complexity of using a wireless technology in the IoT.

The availability of pre-certified modules, cloud-based platforms and managed networks means getting online using LPWAN can be as simple as flicking a switch and logging into a website. It is a technology that can, and is, connecting cities, towns and rural areas across the globe.

For more information contact TRX Electronics, authorised Mouser partner in South Africa, +27 12 997 0509, info@trx.com.
Complete information offering to suit your needs

Annual subscription includes:
• 11 issues of Dataweek (February to November)
• Annual – Electronics Buyers’ Guide (EBG) www.ebg.co.za
• Electronics Manufacturing & Production Handbook (EMP)

Email News Briefs
Twice a week our News Briefs cover the latest news and views. Fast, to the point and direct to your inbox, they are the ideal way for professionals to stay in touch with what matters to them.

The Dataweek website
www.dataweek.co.za
The place where professionals search for products, services and suppliers. With access to a continually expanding repository of more than 23 500 online pages, this is the ultimate electronics and communications technology reference site.

The Digital Magazines
This is the most convenient way to stay in the know if you’re on the go. You can view the e-book version of any of the magazines online or download them as a PDF.

Free* subscription
Subscribe at www.dataweek.co.za or email nicole@technews.co.za

*Free subscription in South Africa only. The publisher has the right to refuse a free application if the respondent does not qualify in terms of our target audience.

Dataweek • South Africa’s leading electronics and communications publication
5 megapixel colour imaging module

RS Components has announced availability of the Digilent Pcam 5C fixed-focus colour imaging module, designed for use with FPGA development boards.

The Pcam 5C represents a reliable, keenly priced peripheral for electronics design engineers building devices with embedded camera applications.

The module is built around the 5-megapixel Omnivision OV5640 image sensor, which offers a number of internal processing functions to improve image quality. These include automatic white balance, automatic black level calibration, and controls to adjust saturation, hue, gamma and sharpness.

The Pcam 5C comes with a fixed-focus lens fitted to a standard M12 lens mount to allow interchanging. It is implemented on a small (40 x 25.5 mm) PCB with a 1x7 straight header to allow access to auxiliary camera signals. Output formats include RAW10, RGB565, CClR656, YUV422/420 and YCbCr422.

Data transfer between the image sensor and its host development board is via a dual-lane MIPI CSI-2 interface, providing sufficient bandwidth to support frequently used streaming video formats including 1080p (full HD) at 30 frames per second and 720p (standard HD) at 60 frames per second. The physical connection is a 15-pin flat flexible cable (FFC) that is pin compatible with the familiar Raspberry Pi camera connector; a 10 cm FFC is supplied with the Pcam 5C.

Educational design tool specialist Digilent designed the Pcam 5C for use, in particular, with its Zybo Z7 ARM/FPGA development board, and both are to be made available as an ‘embedded vision bundle’. The Zybo Z7 features a dual-core ARM Cortex-9 processor integrated with Xilinx Zynq-7000 FPGA logic on a single SoC. The Zybo Z7’s onboard Pcam connector allows direct communication between the image sensor and the FPGA, delivering much lower latency than HDMI or USB alternatives.

Because it is expensive to license, or complex and time consuming to develop a MIPI CSI-2 controller implementation for FPGA, Digilent provides its own set of Vivado IP cores that work with the Pcam 5C on Xilinx FPGA and Zynq host boards. As no dedicated CSI-2 decoding hardware is involved, users can observe how decoding is accomplished using the FPGA.

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

Moulded double choke

Würth Elektronik eiSos unveiled the WE-MCRI, a first-of-its-kind double choke taking advantage of moulding technology. With its soft saturation characteristics, it is above all suited for DC-DC converter applications.

The component consists of two identical round wire-windings compacted in a metal powder material. Designed for SMT assembly, it is compact at 10 x 11.5 x 9 mm, and is designed for a rated current up to 17 A and a saturation current up to 43.5 A. Thanks to their special winding style, the WE-MCRI series components achieve a coupling coefficient of up to 0.995 which means much lower leakage inductance than similar coupled inductors.

These double power chokes are ideal for SEPIC and Ćuk converters for which a high rated current and saturation current with a high coupling coefficient are called for. Further applications include flyback converters with a 1:1 turn ratio as well as step-up/step-down converters with isolated secondary output voltage.

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

Ingun Test Probes

Electronic Industry Supplies (PTY) Ltd
PO Box 759, Auckland Park, 2006, South Africa
Tel: +27 (0)11 726 6758, Fax: +27 (0)11 726 6357
MLCCs for Hi-Rel applications

Medical and military applications, where a high capacitance value is required, can consider the Novacap branded MLCCs (multilayer ceramic capacitors) from Knowles Precision Devices (KPD).

According to the manufacturer, comparable circuit designs can be achieved at typically a third to a fifth of the capacitance values because of the low ESR characteristics these parts exhibit.

These RoHS-compliant, high-capacitance value BME MLC chip capacitors are manufactured in stable Class II dielectrics X7R and X5R. The range is offered with a spread of capacitance values starting at 6.8 nF and topping out at 100 µF. Because of the extremely low ESR characteristics, they are ideal to replace tantalum and low-E SR electrolytic capacitors without polarity concerns.

They find application as power supply bypass capacitors, smoothing capacitors, input/output filters in DC-DC converters and in digital circuits and LCD modules. ±10% and ±20% capacitance tolerances are available, and all parts are available with high-reliability screening.

Nickel Barrier termination options include tin, tin/lead or gold flash – all suitable for reflow soldering process. The gold flash option is of particular interest to eliminate the problem of tin whiskering. This sort of failure can represent a clear and present danger, especially to Hi-Rel applications such as medical implantable devices and military equipment.

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

High-power electronic fuse

Sustaining up to 4 A continuous current over a wide operating input voltage range of 8 V to 48 V, with low insertion loss thanks to its integrated low- Rs, the STEF01 programmable electronic fuse from STMicroelectronics extends the benefits of fast-acting overload protection to applications at higher power ratings.

When connected in series to the main power rail, the device protects the load against overcurrent and over-voltage. The voltage is clamped to a user-defined maximum, preset with external resistors. Excessive current is restricted to the programmed safe limit by controlling the internal power MOSFET, and folds back to a lower limit if a strong over-current or short circuit is detected.

The STEF01 leverages ST’s BCD8 high-voltage process to integrate features including dV/dt control to prevent excessive inrush current during startup or hot-swap insertion. This slows the output voltage ramp-up time to at least 3 ms, which can be increased if desired by connecting an external capacitor. Programmable under-voltage lockout (UVLO), also set using external components, allows the user to fine-tune the desired voltage rail minimum value to suit the load requirements. Further features include thermal shutdown with latching or auto-retry, and maximum dissipated-power protection, which each prevent exceptionally high power from damaging the STEF01 when starting up into heavy capacitive loads, or during large load transients or short-circuits at high voltage. There is also a power-good indicator and an enable/fault pin that can be used as either a status monitor or to control the device. A dedicated gate-driver output for controlling an external N-channel MOSFET simplifies implementation of reverse-current protection.

The STEF01 delivers protection for a wide range of applications, including industrial hot-swap boards and control equipment, circuit breakers, power buses, security or lighting systems, telecom power modules, or distributed power systems. It is available now in a 14-pin HTSSOP14 package.

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

AC filter capacitors

TDK presents a new series of EPCOS MKP AC capacitors for filter applications. The components of the B33331V series are designed for a rated voltage of 460 Vpeak corresponding to a peak voltage of 650 V, and cover a capacitance range from 2 µF to 50 µF. Both the cans and the tops are constructed of aluminium, making the overall design particularly robust. Despite this, the dimensions – depending on the type – range from just 30 x 55 mm to 50 x 100 mm (D x H).

The reliability of the new capacitors, even under harsh conditions, has been verified by a temperature, humidity, bias (THB) test at 85°C, 85% relative humidity and an applied rated voltage for 1000 hours. In compliance with IEC 61071, the life expectancy is at least 100 000 hours. The capacitors bear the CE symbol, types with a can diameter of more than 40 mm are UL-approved, and the insulation of the connections conforms to UL 94 V0.

In the event of excessive pressure in the capacitor case due to an overload, the integrated overpressure disconnection safety device isolates both terminals from the winding. The new capacitors can be used, for example, as output filters of photovoltaic inverters, frequency converters and uninterruptible power supplies.

For more information contact Electrocomp, +27 11 458 9000, andrew@electrocomp.co.za.
DIN-rail power supplies

The fourth generation of Quint Power DIN-rail power supplies covers power ratings up to 100 W, with 24 V output voltage and 1,3 A, 2,5 A and 3,8 A nominal current ratings.

They are the first members of the Quint Power family below 100 W to feature Phoenix Contact’s dynamic boost technology, which can supply up to 200% of nominal maximum current for up to five seconds to start loads that place high short-term initial demand. In addition, the 1,3 A and 2,5 A models also support static boost that allows 25% over-current at any time for five seconds, to handle short-term peaks.

Further features include preventive function monitoring, which warns of critical operating states before errors occur, and configurable signalling of DC OK or selectable power thresholds that let users adapt output-parameter monitoring to suit the application. The wide AC input range of 85 V - 264 V, and DC range of 88 V – 350 V, gives flexibility to power the units from various sources, such as the main AC line in any geographical market, or a DC bus, battery bank or industrial power supply.

The power supplies have an ambient operating temperature range of -25°C to 70°C, allowing use in a wide variety of environments.

Power modules in SOT-227 package

Vishay Intertechnology expanded its portfolio of power modules in the SOT-227 package with seven new devices featuring ThunderFET power MOSFETs and standard, FRED Pt, and Trench MOS Barrier Schottky (TMBS) diodes. The modules are available in dual, single-phase bridge, and single-switch topologies with a variety of current and voltage ratings.

The VS-FC420SA15 and VS-FC270SA20 single-switch modules featuring ThunderFET power MOSFETs are Vishay’s first with voltages of 150 V and 200 V, respectively. Ideal for high-performance DC-DC converters, battery chargers, AC motor drives and UPSs, the devices offer current to 400 A, low on-resistance down to 1,93 mΩ at 10 V, and gate charge of 250 nC.

Vishay’s first 1200 V insulated standard recovery rectifier modules in the SOT-227 package, the VS-RA160FA120 and VS-RA220FA120, are optimised for OR-ing applications in electric vehicle chargers and single- and three-phase bridges. The dual devices feature high forward current to 220 A, low 0,26°C/W junction-to-case thermal resistance, and low forward voltage drop down to 1,22 V.

Featuring FRED Pt diodes, Vishay’s VS-UHF280FA30 insulated Hyperfast rectifier module is the company’s first to feature 300 V in a dual topology, while the VS-UHF608A65 is its first Ultrafast single-phase bridge device. Intended for low-voltage, high-frequency inverters in welding machines and UPS, and output rectification for charging stations and switch mode power supplies, the devices offer soft recovery characteristics, fast reverse recovery times down to 58 ns, and current to 280 A.

For high-frequency switch mode power supplies, DC-DC converters and plasma cutters, Vishay’s new VS-QA300FA17 insulated TMBS rectifier module is the company’s first with a 170 V rating. Offered in a dual topology, the device features current of 300 A, low forward voltage of 0,98 V at 200 A, and low junction-to-case thermal resistance of 0,26°C/W per leg (0,13°C/W per module).

While competing devices typically offer operating temperatures to +150°C, these new power MOSFET, Hyperfast and TMBS modules provide high temperature performance to +175°C. The devices are RoHS-compliant and UL-approved.

For more information contact Dirk Venter, Arrow Altech Distribution, +27 11 923 9600, dventer@arrow.altech.co.za.
**TELECOMMUNICATIONS, WIRELESS, IoT, RF & MICROWAVE**

**FEATURE**

**Hot Chips**

**Chips**

**Chips**

New portfolio of wideband double-balanced mixers available from MACOM Technology Solutions, covering the 8 – 43 GHz and 18 – 46 GHz frequency ranges. Delivering low conversion loss, high linearity and a wide intermediate frequency (IF) bandwidth, the MAMX-011036 and MAMX-011054 are ideally suited to meet the performance requirements for next-generation test and measurement, microwave radio and radar applications. The double-balanced circuit configuration of the mixers provides excellent port isolation, while internal 50 Ω matching simplifies the application. In addition, the class 1B (500 V – 1000 V) electrostatic discharge (ESD) rating ensures high levels of ruggedness and reliability.

**RFiber Solutions, +27 82 494 5466.**

From USR IOT Technologies comes the USR-GM3P, a highly integrated GSM+GPS+GPRS module with a footprint of 27,94 x 24,4 x 2,95 mm. A global positioning system as well as a location-based service positioning system are embedded on the module, and it is ideal for asset tracking or Internet of Things (IoT) applications. The device also includes a speech interface with a 1-channel mic input and a 1-channel speaker output. It supports GSM and GPRS technology and has a data rate between 14,4 Kbps and 57,6 Kbps. The USR-GM3P has a GSM launch power level of 2 W and a DCS1800 launch power level of 1 W. It supports standard network protocol and a standard GSM AT instruction set.

**Conical Technologies, +27 66 231 1900.**

Diodes Incorporated’s new AL5890 linear constant-current regulator provides simple and more cost-effective solutions for driving LED strings from an off-line or DC power supply. Available in a range of packages, the small form-factor of the AL5890 makes it ideal for any LED application where a lower bill of materials cost and sizes are important. The fully integrated design includes a power transistor and it is available in 10 mA, 15 mA, 20 mA, 30 mA and 40 mA variants. A single device or multiple devices in parallel can be used to source or sink enough current for long LED strings, with an overall accuracy of less than ±2,0 mA (typical), working over a wide ambient temperature range of -40°C to +105°C.

**Arrow Altech Distribution, +27 11 923 9600.**

The CMD283C3 from Custom MMIC is a broadband MMIC (monolithic microwave integrated circuit) low-noise amplifier housed in a leadless 3 x 3 mm surface mount package. The device is ideally suited for electronic warfare and communications systems where small size and low power consumption are needed. The device is optimised for broadband performance and delivers 27 dB of gain with a corresponding noise figure of 0,6 dB at 4 GHz. The CMD283C3 is a 50 Ω matched design which eliminates the need for external DC blocks and RF port matching.

**RF Design, +27 21 555 8400.**

Texas Instruments has added new microcontrollers (MCUs) with integrated signal-chain elements and an extended operating temperature range to its MSP430 value line portfolio. New MSP430FR2355 ferroelectric random access memory (FRAM) MCUs target applications such as smoke detectors, sensor transmitters and circuit breakers. Configurable signal-chain elements include options for multiple 12-bit digital-to-analog converters (DACs) and programmable gain amplifiers, along with a 12-bit analog-to-digital converter (ADC) and two enhanced comparators. The new devices offer memory up to 32 KB and central processing unit (CPU) speeds up to 24 MHz.

**Avnet South Africa, +27 11 319 8600.**

A new portfolio of wideband double-balanced mixers is available from MACOM Technology Solutions, covering the 8 – 43 GHz and 18 – 46 GHz frequency ranges. Delivering low conversion loss, high linearity and a wide intermediate frequency (IF) bandwidth, the MAMX-011036 and MAMX-011054 are ideally suited to meet the performance requirements for next-generation test and measurement, microwave radio and radar applications. The double-balanced circuit configuration of the mixers provides excellent port isolation, while internal 50 Ω matching simplifies the application. In addition, the class 1B (500 V – 1000 V) electrostatic discharge (ESD) rating ensures high levels of ruggedness and reliability.

**Avnet South Africa, +27 11 319 8600.**

The STMicroelectronics TSB712A precision op-amp maintains stable parameters over wide voltage and temperature ranges, bringing cost-effective high-end performance to a multitude of applications, including industrial and automotive systems. Fully specified over a wide supply voltage range of 2.7 V to 36 V, or ±1.35 V to ±18 V, the TSB712A’s low input voltage noise of 12 nV/√Hz means it can handle low signal amplitudes and ensure high resolution. In addition, input offset voltage of 300 μV simplifies circuit design for high-accuracy measurement and monitoring. The 6 MHz gain-bandwidth product (GBW) and 3 V/μs slew rate ensure faithful signal conditioning at low-to-medium frequencies.

**EBV Electrolink, +27 21 402 1940.**
<table>
<thead>
<tr>
<th>Company</th>
<th>Telephone</th>
<th>e-mail</th>
<th>Website</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>AREI</td>
<td>+27 11 462 3256</td>
<td><a href="mailto:arei@icon.co.za">arei@icon.co.za</a></td>
<td><a href="http://www.arei.co.za">www.arei.co.za</a></td>
<td>15*</td>
</tr>
<tr>
<td>Arrow Altech Distribution</td>
<td>+27 11 923 9600</td>
<td><a href="mailto:info@arrow.altech.co.za">info@arrow.altech.co.za</a></td>
<td><a href="http://www.arrow.altech.co.za">www.arrow.altech.co.za</a></td>
<td>10,12,14,30,31,32</td>
</tr>
<tr>
<td>Avnet South Africa</td>
<td>+27 11 319 8600</td>
<td><a href="mailto:sales@avnet.co.za">sales@avnet.co.za</a></td>
<td><a href="http://www.avnet.co.za">www.avnet.co.za</a></td>
<td>23,32</td>
</tr>
<tr>
<td>Battery Guys</td>
<td>+27 11 452 3914</td>
<td><a href="mailto:sales@batteryguy.co.za">sales@batteryguy.co.za</a></td>
<td><a href="http://www.batteryguy.co.za">www.batteryguy.co.za</a></td>
<td>9</td>
</tr>
<tr>
<td>Comtest</td>
<td>+27 10 595 1821</td>
<td><a href="mailto:sales@comtest.co.za">sales@comtest.co.za</a></td>
<td><a href="http://www.comtest.co.za">www.comtest.co.za</a></td>
<td>23,27*</td>
</tr>
<tr>
<td>Conical Technologies</td>
<td>+27 66 231 1900</td>
<td><a href="mailto:daniel@conical.co.za">daniel@conical.co.za</a></td>
<td><a href="http://www.conical.co.za">www.conical.co.za</a></td>
<td>15,20,32</td>
</tr>
<tr>
<td>EBV Electrolink</td>
<td>+27 21 402 1940</td>
<td><a href="mailto:capetown@ebv.com">capetown@ebv.com</a></td>
<td><a href="http://www.ebv.co.za">www.ebv.co.za</a></td>
<td>32</td>
</tr>
<tr>
<td>Electrocomp</td>
<td>+27 11 458 9000</td>
<td><a href="mailto:andrewh@electrocomp.co.za">andrewh@electrocomp.co.za</a></td>
<td><a href="http://www.electrocomp.co.za">www.electrocomp.co.za</a></td>
<td>20,30</td>
</tr>
<tr>
<td>Electronic Industry Supplies</td>
<td>+27 11 726 6758</td>
<td><a href="mailto:hreisn@iafrica.com">hreisn@iafrica.com</a></td>
<td><a href="http://www.eisn.co.za">www.eisn.co.za</a></td>
<td>29*</td>
</tr>
<tr>
<td>Forbatt SA</td>
<td>+27 11 469 3598</td>
<td><a href="mailto:sales@forbatt.co">sales@forbatt.co</a></td>
<td><a href="http://www.forbatt.co">www.forbatt.co</a></td>
<td>OBC*</td>
</tr>
<tr>
<td>Gemcon South Africa 2018</td>
<td></td>
<td></td>
<td><a href="http://www.gemcon2018.emcss.org">www.gemcon2018.emcss.org</a></td>
<td>3*</td>
</tr>
<tr>
<td>Harting South Africa</td>
<td>+27 11 575 0017</td>
<td><a href="mailto:za@harting.com">za@harting.com</a></td>
<td><a href="http://www.harting.co.za">www.harting.co.za</a></td>
<td>16,17*</td>
</tr>
<tr>
<td>Helukabel</td>
<td>+27 11 462 8752</td>
<td><a href="mailto:sales@helukabel.co.za">sales@helukabel.co.za</a></td>
<td><a href="http://www.helukabel.co.za">www.helukabel.co.za</a></td>
<td>21*</td>
</tr>
<tr>
<td>Hiconnex</td>
<td>+27 12 661 6779</td>
<td><a href="mailto:info@hiconnex.co.za">info@hiconnex.co.za</a></td>
<td><a href="http://www.hiconnex.co.za">www.hiconnex.co.za</a></td>
<td>16,19*</td>
</tr>
<tr>
<td>Hiconnex Industrial</td>
<td>+27 12 661 6779</td>
<td><a href="mailto:chris@hiconnex-industrial.co.za">chris@hiconnex-industrial.co.za</a></td>
<td><a href="http://www.hiconnex-industrial.co.za">www.hiconnex-industrial.co.za</a></td>
<td>16</td>
</tr>
<tr>
<td>ICORP Technologies</td>
<td>+27 11 781 2029</td>
<td><a href="mailto:enquiries@icorptech.co.za">enquiries@icorptech.co.za</a></td>
<td><a href="http://www.icorptech.co.za">www.icorptech.co.za</a></td>
<td>25</td>
</tr>
<tr>
<td>Microchip</td>
<td></td>
<td></td>
<td><a href="http://www.micropwr.com">www.micropwr.com</a></td>
<td>9*</td>
</tr>
<tr>
<td>Microtronix Manufacturing</td>
<td>+27 11 792 5322</td>
<td><a href="mailto:info@microtronix.co.za">info@microtronix.co.za</a></td>
<td><a href="http://www.microtronix.co.za">www.microtronix.co.za</a></td>
<td>9*</td>
</tr>
<tr>
<td>Otto Wireless Solutions</td>
<td>+27 11 791 0333</td>
<td><a href="mailto:wireless@otto.co.za">wireless@otto.co.za</a></td>
<td><a href="http://www.otto.co.za">www.otto.co.za</a></td>
<td>OFC*,22</td>
</tr>
<tr>
<td>Radio Accessories &amp; Data Modems</td>
<td>+27 11 802 2976</td>
<td><a href="mailto:radioacc@telkom.co.za">radioacc@telkom.co.za</a></td>
<td><a href="http://www.radioacc.co.za">www.radioacc.co.za</a></td>
<td>25*</td>
</tr>
<tr>
<td>RF Design</td>
<td>+27 21 555 8400</td>
<td><a href="mailto:andrew@rfdesign.co.za">andrew@rfdesign.co.za</a></td>
<td><a href="http://www.rfdesign.co.za">www.rfdesign.co.za</a></td>
<td>21,22,23*,24,25,30,32</td>
</tr>
<tr>
<td>RFiber Solutions</td>
<td>+27 82 494 5466</td>
<td><a href="mailto:sales@rfdesign.com">sales@rfdesign.com</a></td>
<td><a href="http://www.rfdesign.co.za">www.rfdesign.co.za</a></td>
<td>23,32</td>
</tr>
<tr>
<td>RS Components</td>
<td>+27 11 691 9300</td>
<td><a href="mailto:sales.za@rs-components.co.za">sales.za@rs-components.co.za</a></td>
<td><a href="http://www.rsonline.co.za">www.rsonline.co.za</a></td>
<td>9,29,31</td>
</tr>
<tr>
<td>Rugged Interconnect Technologies</td>
<td>+27 21 975 8894</td>
<td><a href="mailto:sales@ri-tech.co.za">sales@ri-tech.co.za</a></td>
<td><a href="http://www.ri-tech.co.za">www.ri-tech.co.za</a></td>
<td>5*,7*,14,15</td>
</tr>
<tr>
<td>SAICE-PDP</td>
<td>+27 11 476 4100</td>
<td><a href="mailto:allyson@ally.co.za">allyson@ally.co.za</a></td>
<td><a href="http://www.ally.co.za">www.ally.co.za</a></td>
<td>7</td>
</tr>
<tr>
<td>Sivan Electronic Supplies (SES)</td>
<td>+27 11 887 7879</td>
<td><a href="mailto:elecsupp@global.co.za">elecsupp@global.co.za</a></td>
<td><a href="http://www.elecsupp.co.za">www.elecsupp.co.za</a></td>
<td>18*,31*</td>
</tr>
<tr>
<td>StarTech Industrial</td>
<td>+27 11 823 1520</td>
<td><a href="mailto:sales@startech.co.za">sales@startech.co.za</a></td>
<td><a href="http://www.startech.co.za">www.startech.co.za</a></td>
<td>17</td>
</tr>
<tr>
<td>Technews Publishing</td>
<td>+27 11 543 5800</td>
<td><a href="mailto:nicole@technews.co.za">nicole@technews.co.za</a></td>
<td><a href="http://www.ebg.co.za">www.ebg.co.za</a></td>
<td>28*</td>
</tr>
<tr>
<td>TraX Interconnect</td>
<td>+27 21 712 5011</td>
<td><a href="mailto:daniel@trx.co.za">daniel@trx.co.za</a></td>
<td><a href="http://www.trx.co.za">www.trx.co.za</a></td>
<td>24</td>
</tr>
<tr>
<td>TRX Electronics</td>
<td>+27 12 997 0509</td>
<td><a href="mailto:info@trx.co.za">info@trx.co.za</a></td>
<td><a href="http://www.trx.co.za">www.trx.co.za</a></td>
<td>IFC*,17,26,27</td>
</tr>
<tr>
<td>University of the Witwatersand</td>
<td>+27 11 717 1017</td>
<td><a href="mailto:schalk.mouton@wits.ac.za">schalk.mouton@wits.ac.za</a></td>
<td><a href="http://www.wits.ac.za">www.wits.ac.za</a></td>
<td>6</td>
</tr>
<tr>
<td>Webb Industries</td>
<td>+27 84 034 7777</td>
<td><a href="mailto:cor.bredenhann@jasco.co.za">cor.bredenhann@jasco.co.za</a></td>
<td><a href="http://www.webb.co.za">www.webb.co.za</a></td>
<td>18</td>
</tr>
<tr>
<td>Webb Industries</td>
<td>+27 11 719 0000</td>
<td><a href="mailto:webb@webb.co.za">webb@webb.co.za</a></td>
<td><a href="http://www.webb.co.za">www.webb.co.za</a></td>
<td>20*</td>
</tr>
<tr>
<td>Wiltron Agencies</td>
<td>+27 12 940 9475</td>
<td><a href="mailto:wiltron@global.co.za">wiltron@global.co.za</a></td>
<td><a href="http://www.wiltron-agencies.co.za">www.wiltron-agencies.co.za</a></td>
<td>20</td>
</tr>
<tr>
<td>Würth Elektronik eiSos</td>
<td>+27 71 259 9381</td>
<td><a href="mailto:jason.page@we-online.com">jason.page@we-online.com</a></td>
<td><a href="http://www.we-online.com">www.we-online.com</a></td>
<td>13*,18,29</td>
</tr>
</tbody>
</table>

* denotes advertisement
When it comes to batteries there is one group of guys.

Battery Guys

Battery pack design and manufacture
Custom battery packs
Full battery analysing and testing

Full range of rechargeable and primary cells
Specialists in lithium ion battery packs
Battery repacking

FORBATT™
Sealed lead acid batteries

Maintenance-free Batteries

Battery Guys JHB
Head Office
011 452 3914
sales@batteryguys.co.za

Durban Sales Office
durban@batteryguys.co.za
083 261 5936

Cape Town Sales Office
cape@batteryguys.co.za
082 881 1721

batteryguys.co.za