BLUETOOTH TURNS 20

Two decades after its introduction, new market opportunities continue to fuel Bluetooth’s growth
Top Rated Distributor for Customer Service

Source: Distributor Evaluation Survey, Electronic Specifier, March 17, 2017

24/7 customer service, technical support, web chat

0800 587 0991
DIGIKEY.CO.UK

750+ INDUSTRY-LEADING SUPPLIERS | 100% FRANCHISED DISTRIBUTOR

*A shipping charge of €12.00 will be added on all orders of less than €33.00. A shipping charge of $18.00 USD will be added on all orders of less than $50.00 USD. All orders are shipped via UPS, Federal Express, or DHL for delivery within 1-3 days (dependent on final destination). No handling fees. All prices are in British pound sterling or United States dollar. Digi-Key is a franchised distributor for all supplier partners. New products added daily. Digi-Key and Digi-Key Electronics are registered trademarks of Digi-Key Electronics in the U.S. and other countries. © 2018 Digi-Key Electronics, 701 Brooks Ave. South, Thief River Falls, MN 56701, USA.
COMMENT 5
Could robotics and AI help the farming sector to overcome the forthcoming financial hit when EU subsidies end?

NEWS
Start up launches IoT apps processor with eight RISC-V cores, claims x20 power efficiency benefit 7

Flat field transistor for leading edge bulk CMOS processes aimed at ‘fit and forget’ IoT applications 8

AMD believes that its two latest processor families will open up new market opportunities 9

Qualcomm demonstrates some of the technologies helping to drive 5G and its evolving mobile ecosystem 10

COVER STORY
Bluetooth turns 20
Two decades after its introduction, new market opportunities continue to fuel Bluetooth’s growth and industry specialists suggest there could soon be 1 trillion devices with the technology

ROBOTICS
Learning on the job
A growing number of research projects are investigating how collaborative robots can work alongside humans and, potentially, offer assistance proactively

SENSORS
A sense of purpose
Sensors developed for consumer applications are being picked up by industrial users – and robotics systems are one of the main beneficiaries

MEDICAL ELECTRONICS
Bringing on bioelectronics
As the population ages, long term health care issues are becoming more challenging, which requires innovative solutions. We look at two leading research projects

DIRECTIVES & STANDARDS
Look before you leap
Designing medical devices needs careful planning and, above all, patience. Failure to follow the required procedures could see you having to go back to square one

BOARD LEVEL TECHNOLOGY
White noise
With more devices being developed for the IoT, more PCB designers are having to embrace EMC for the first time. We review the basics and offer practical design tips

DESIGN PLUS
Third party solder recycling
A German service provider is offering electronics manufacturers an environmentally friendly method of disposing of tin waste – and there’s more to it than meets the eye

MISSION STATEMENT
‘New Electronics keeps designers and managers abreast of the latest developments in the world’s fastest moving industry’
10 MAY 2018
NATIONAL MOTORCYCLE MUSEUM, BIRMINGHAM

PCB DESIGN & MANUFACTURING LIVE

UK’s dedicated exhibition for sourcing the electronic components & services needed to develop your PCB design

WHY VISIT?

INNOVATIVE NEW SOLUTIONS
Solve your PCB design problems by connecting with market leading UK suppliers

NETWORK WITH PCB EXPERTS
Speak to PCB Design Consultancies & Electronic Manufacturers and save time and money on your designs

ATTEND TECHNICAL SEMINARS
Learn new techniques and discover technologies to improve your PCB design skills

Take a tour of the world’s largest collection of British motorcycles

Register for FREE to attend at www.pcbdmlive.co.uk
The continuing Brexit negotiations have yet to bring certainty to any industries. While New Electronics has already highlighted the concerns of the scientific research community, another group is waiting anxiously for progress. That group is British farmers. Currently, the UK’s agriculture sector receives some £3 billion a year in EU subsidies. That money will stop when the UK leaves the EU. While the Government has said it will match that funding, it will only do so until 2022. What happens after that is open to conjecture, but the suggestion is that just as industry has been urged to boost its productivity, so too should farmers.

There’s little chance that farmers will be left to their own devices, though. The sector contributes more than £14 billion a year to the UK’s economy and supports some 500,000 jobs, so the political consequences would be fairly unpleasant.

Is it more than a coincidence that at last week’s conference of the National Farmers Union, industry secretary Greg Clark announced a £90 million investment in robotics, AI and earth observation technologies for farming?

Clark said the £90 million will make the Government’s Transforming Food Production Challenge a reality and enable the creation of ‘Translation Hubs’, helping to apply the latest research to farming practice.

Is it also a coincidence that the announcement should centre on robotics and AI – currently the two ‘go to’ phrases for politicians who want to look on the ball?

The potential for both technologies is huge, but each carries with it a significant downside. In the case of robotics, the downside is the perception that the technology is taking people’s jobs away from them. The downside of AI is that it might actually be too clever for its – and our – good.

Robotics will have a place in the industry of tomorrow – whatever the sector – but it shouldn’t be to the exclusion of humans. While some captains of industry will seize the opportunity to replace workers with automation, others will see collaborative robots – or cobots – as having the potential to augment our abilities.

Farmers are already using technology to a greater or lesser extent; will robotics help them to reap a better harvest?

Graham Pitcher, Group Editor (graham.pitcher@markallengroup.com)
EVERYTHING YOU NEED FOR YOUR BENCH

With a complete line-up of supplies including oscilloscopes, bench power supplies, test leads and probes, soldering stations, tools and static protection from leading brands at unbeatable prices.

Electronics Components, Solutions & Support
uk.farnell.com
RISC-V powers IoT apps processor

IOT APPS PROCESSOR BOASTS EIGHT RISC-V CORES, POWER EFFICIENCY. GRAHAM PITCHER REPORTS.

Fabless startup Greenwaves Technologies has announced the availability of its GAP8 IoT application processor. Martin Croome, vp of business development, said of the device: “It’s aimed at battery powered devices performing content understanding and control applications. Examples include keyboard spotting, beam forming and speech analysis. It could also be used for vibration analysis and face detection.”

Explaining why designers should consider using the part, Croome noted: “Users want to keep their comms costs as low as possible, so it includes algorithms which transform Mbit/s inputs into kbyte/day outputs.”

The part features eight RISC-V cores combined with a convolution hardware accelerator. It also has a separate core with an independent frequency and voltage domain. According to Greenwaves, this configuration will enable the integration of AI and advanced classification into new classes of wireless sensing devices for IoT applications. Croome said: “One side of the chip looks like an MCU; the other side is the RISC-V cluster, which shares instruction caches.”

Amongst the open source technology integrated into GAP8, is the Parallel Ultra Low Power computing platform developed at the University of Bologna and ETH Zurich. Measuring 7 x 7mm and manufactured on TSMC’s 55nm LP process, the chip is said to consume 20 times less power than comparable devices. Croome said: “It offers several GOPs of processing power while consuming mW.”

A GAP8 hardware development kit, scheduled for release in April, will include GAPDUINO, an Arduino compatible board, and a software development kit.

Graphene on toast?

Scientists at Rice University have enhanced their laser-induced graphene (LIG) technique and are now investigating ways to write graphene based patterns onto food and other materials.

The approach uses cross-linked flakes of graphene which can be written into target materials and used for applications such as supercapacitors, RFID antennas and biological sensors.

In the latest development, LIG is said to have been burned into paper, cardboard, cloth, coal and certain foods. “Very often, we don’t see the advantage of something until we make it available,” said Professor James Tour. “Perhaps all food will have a tiny RFID tag that gives you information about where it’s been, how long it’s been stored, its country and city of origin and the path it took to get to your table.”

He added that an LIG tag could feature sensors that detect E. coli or other microorganisms on food. “They could light up and give you a signal that you don’t want to eat this. All that could be placed not on a separate tag, but on the food itself.”

Prof Tour said flexible, wearable electronics may also be an early market for the technique.

SIM identity SoC to secure IoT devices

ARM has developed a way to integrate an MCU, a cellular modem and SIM identity into an IoT SoC, adding this will reduce device costs significantly for operators, silicon providers and module vendors looking to develop IoT applications.

Compliant with GSMA Embedded SIM Specifications, ARM’s Kigen operating system will provide a scalable, low footprint and GSMA compliant software stack to enable integration of SIM functionality into IoT SoC designs, while a remote provisioning server solution will provide integration with MNO and IoT platforms.

According to ARM, the evolution of embedded SIM and, more recently, integrated SIM form factors is essential for providing secure identity to cellular IoT devices.
Synergy Platform website upgraded

Renesas has updated its Synergy Platform website and Solutions Gallery in order to make it easier for users to take advantage of the Synergy ecosystem.

The redesign is said to provide intuitive navigation and flow, as well as easy ordering. Users can explore the Synergy ecosystem and access IoT development building blocks, while the Solutions Gallery offers reference designs and application projects.

Meanwhile, Renesas has expanded strategic partnerships with several RF hardware providers to offer reliable wireless connectivity.

Chip generates single photons, steers them

Researchers from the University of Maryland have created a photonic chip that not only generates single photons, but can also steer them.

The chip features a photonic crystal, made by punching holes through a sheet of semiconductor. According to the team, the pattern appears to a photon to be much like a real crystal. Light is generated by stimulating quantum emitters embedded into the photonic crystal with lasers.

The design, which is said to be flexible, could allow researchers to systematically assemble pathways for single photons.

Eurofins makes more acquisitions

The Consumer Products Testing division of Eurofins Scientific has acquired Electronic Test and Calibration (ETC) and Hursley EMC Services.

“The acquisition of ETC and Hursley further demonstrates the ambition of Eurofins to be the market leader in calibration, testing and certification, following the 2017 acquisition of York EMC Services,” explained Nick Wainwright, chief executive of Eurofins York. “The acquisitions support our shared plans to meet increasing demand, as well as offering the most comprehensive range of calibration, testing, certification and compliance solutions.”

Transistor meets IoT power needs

START UP CREATES FLAT FIELD TRANSISTOR FOR BULK CMOS PROCESSES BEYOND THE 40NM NODE. GRAHAM PITCHER REPORTS.

In a move intended to meet the low power requirements of IoT and on chip AI applications, startup Semiwise has developed a flat field transistor (FFT) technology that is said to be applicable to bulk CMOS technologies beyond the 40nm node.

According to Semiwise, the IoT has stringent requirements for ultra low static and dynamic power in order to enable ‘fit and forget’ installation. The company also says that low chip costs will be a key factor for broad range of IoT applications and will focus attention on lower cost technologies, such as 40nm and 28nm bulk CMOS. But, says Semiwise’s founder Asen Asenov, there are no viable conventional (bulk) CMOS solutions that meet the IoT’s low power and high reliability requirements.

He says Semiwise has developed a bulk CMOS transistor technology that meets IoT requirements ‘in full’. The FFT can be scaled beyond 20nm bulk CMOS and, when applied to 20nm bulk CMOS, is 30% faster and has a leakage current two orders of magnitude lower than its bulk counterpart at the equivalent drive current.

Importantly, Asenov asserts, the transistor has an extremely low local (purely statistical) variability, suitable it to near threshold and subthreshold logic and SRAM design.

According to Asenov: “While the concept of variability resistant transistors has been around for a few years, despite significant VC investments, many companies have failed to commercialise the technology due to a lack of understanding of statistical variability and adequate simulations capabilities.”

Computers learn to learn

Three neuromorphic chips said to be capable of mimicking important aspects of human brains will be presented at the forthcoming NICE conference, taking place at an Intel facility in Oregon.

The neuromorphic BrainScaleS, being developed at the University of Heidelberg, is said to feature a mixed analogue and digital design and operate at up to 10,000 times faster than real time.

The second generation of SpiNNaker, pictured, has been updated to feature 144 Cortex-M4F cores. According to the team from TU Dresden, this chip features innovative power management for efficient energy usage.

Intel, meanwhile, will say that its Loihi research chip is designed to support a range of on-chip learning models.

Stretchable sensor is ‘game changer’

A stretchable wearable sensor could be a ‘game-changer’ in the field of stroke rehabilitation, claim researchers from Northwestern University.

The device, designed to be worn on the throat and to move with the body, is intended to provide detailed health metrics, including heart function, muscle activity and quality of sleep. “Stretchable electronics allow us to see what is going on inside patients’ bodies at a level traditional wearables simply cannot achieve,” said Professor John Rogers of Northwestern University. “The key is to make them as integrated as possible with the human body.

“We have developed novel materials for this sensor that bend and stretch with the body, minimising discomfort to patients.”

According to the researchers, analysis of data from the sensors could allow alerts to be sent when patients are ‘underperforming’ on a certain metric.
**AMD targets the core to the edge**

NEW MARKETS FOR LATEST PROCESSOR FAMILIES. NEIL TYLER REPORTS.

AMD has introduced the EPYC Embedded 3000 and Ryzen Embedded V1000 processor families. The EPYC Embedded 3000 looks to address new markets, including networking, storage and edge computing devices, while the Ryzen Embedded V1000 will target medical imaging, industrial systems, digital gaming and thin clients.

“We are extending the high-performance x86 Zen architecture from PCs, laptops and the datacentre to networking, storage and industrial solutions,” said Scott Aylor, general manager of AMD’s Datacenter and Embedded Solutions Business Group.

The EPYC Embedded 3000 family is scalable, with designs ranging from four to 16 cores available in single and multi-threaded configurations.

The Ryzen Embedded V1000 range is said to bring together the Zen architecture with Vega graphics to deliver an Accelerated Processing Unit that provides improved graphics capabilities on a single die. With up to four CPU cores and eight threads and up to 11 GPU compute units, the parts can support processing loads of up to 3.6TFLOPS.

Both processors protect data at the hardware level with an on-chip secure processor and use Secure Memory Encryption. Meanwhile, Secure Encrypted Virtualisation offers further deterrence by encrypting virtual machine memory.

**Memristor based approach enables logic in memory**

An energy efficient, nonvolatile logic in memory circuit is said to have been successfully developed using a memristor.

The research team from the Korean Advanced Institute of Science and Technology (KAIST) said the circuit could be used as an energy efficient computing architecture in battery-powered flexible electronic systems, such as mobile and wearable devices.

The memristive nonvolatile logic-in-memory circuit is designed to simultaneously enable data storage and logic operation. The KAIST team explained that its device can minimise energy consumption and time delay because it does not require data transfer between memory and processor.

Non volatile, polymer-based memristors and flexible back-to-back Schottky diode selector devices on plastic substrates were all explored. Unlike the conventional architecture, the team claimed the memristive nonvolatile logic-in-memory will consume a minimal amount of standby power. The team also said that this one-selector-one memristor circuit will solve the issue of sneak currents.
With many leading operators expected to begin decommissioning their 2G/GSM networks – and, in some cases, 3G/UMTS networks – as they move towards 4G/LTE networks, Qualcomm said it expects to see the first 5G smartphones appearing next year.

“While we are working with a growing number of OEMs that have smartphone launches scheduled for the first half of next year,” said company president Cristiano Amon, “we expect 5G to become a significant contributor of volume, [but] it is unlikely to have an impact on revenues until fiscal 2020.”

With the first 5G networks expected later this year, Amon said the company was working closely with AT&T, China Mobile, SKT, Verizon and Vodafone, among others.

At CES, Qualcomm’s CEO Steve Mollenkopf referred to 5G as ‘the new electricity’ and, earlier this month, at a ‘5G Day’ held at its San Diego campus, Qualcomm set out its vision for 5G and took the opportunity to demonstrate a number of 5G technological innovations.

Serge Willenegger, general manager for 4G/5G, said the company’s vision behind 5G was one of expanding cell phone capacity from billions of people to trillions of devices and that it saw 5G as a significant long-term opportunity.

The first technical foundations for 5G were laid last year, when the 3GPP industry group approved standards that will govern the way devices will connect to the new networks. It is expected that 5G will bring significantly more capacity to mobile networks and support the development of new applications associated with the IoT.

“In the same way that our early R&D work on 5G led to the accelerated completion of the first 5G NR standard for enhanced mobile broadband, [these] demonstrations highlight our continued commitment to inventing technologies that help drive the mobile ecosystem forward,” said Durga Malladi, Qualcomm Technologies’ senior vice president of engineering.

The 5G NR – or New Radio – specification has been fast-tracked by 3GPP at the request of operators and vendors as a way to speed the deployment of 5G.

Among the demonstrations was 5G NR spectrum sharing, expected to bring better mobile broadband performance to unlicensed and shared spectrum, as well as playing an important role in extending 5G into new types of deployments, such as private networks for industrial IoT.

Private 5G networks for Industrial IoT are seen as being an important area of focus for the next phase of 3GPP 5G NR and the ability to run Industrial Ethernet over a wireless network will help to support reconfigurable factories – a crucial element of the smart factory. In an industry-first, Qualcomm also showed off a wireless Profinet Industrial Ethernet running on 5G NR.

Advanced spatial domain spectrum sharing technology relies on Spatial Domain Multiplexing and Coordinated Multi-Point concepts to deliver higher network capacity and user throughput through tighter coordination among users of unlicensed and shared spectrum bands.

The role of 5G NR-based Cellular Vehicle-to-Everything (C-V2X) technology in autonomous driving was also showcased. Qualcomm said the technology had been designed to help the vehicle communicate its intentions, supporting the level of predictability needed for advanced path planning.

5G NR based C-V2X is engineered to augment existing C-V2X technology with complementary capabilities, bringing high throughput and so called ultra reliable low latency communication, while maintaining backwards compatibility.

“We’re excited to showcase how our 5G technologies are helping to expand the reach of 5G NR to new industries, new deployment and business models, and new ecosystem participants,” said Malladi.
ELECTRONICS DESIGN SHOW

SAVE THE DATE

RICOH ARENA | COVENTRY
17-18 OCTOBER 2018

www.engineeringdesignshow.co.uk
In January 2018, the Bluetooth Special Interest Group (SIG) celebrated its 20th anniversary. Formed in 1998, the group was started with just a handful of companies who were looking to replace wire for mobile voice and data. Today, membership stands at more than 33,000 companies.

Speaking in January, Mark Powell, executive director for Bluetooth SIG said: “Since its inception, Bluetooth has evolved continuously, expanding the universe of innovative ways for things to connect.”

Part of that continuing evolution is Bluetooth Mesh, a major enhancement to the Bluetooth standard introduced in July 2017. “Its purpose is to enable large-scale Bluetooth networks and many-to-many communications for applications such as connected lighting and home automation,” explains Mikko Savolainen, senior marketing manager at Silicon Labs.

“The Bluetooth Mesh standard will enable higher throughput mesh networking and new applications for indoor positioning and asset tracking where mesh networks are used to track assets or provide position to connected devices like smartphones,” Savolainen suggests.

It’s true to say that Bluetooth technology has played a pivotal role in underpinning the consumer wireless revolution, whether that’s: making phones, tablets or PCs accessible to the Internet; changing the way people consume media; connecting cars and drivers to the cities around them or helping to pave the way for the next industrial revolution and the growing convergence between industry and information.

In 2018 alone, more than 4 billion Bluetooth devices are expected to be shipped.

Bluetooth is synonymous with wireless technology and, today, is very much taken for granted in terms of the way it impacts on our lives. The name ‘Bluetooth’ is said to have originated with Jim Kardach of Intel and was the nickname given to King Harald Blåtand, a Dane who was known for having brought warring tribal groups in Denmark, Norway, and Sweden together to create a single kingdom more than 1000 years ago.

Rather than bringing warring tribes together, Bluetooth was intended to ‘unite the PC and cellular industries with a short-range wireless link’, according to Kardach.

King Harald, who reigned from 958 to 986, is believed to have got his nickname from his penchant for eating blueberries; for others, that name came from the fact that his teeth were dyed blue as a result of chewing on the remains of his frozen enemies!

Whatever the history of the name,
the technology’s development which can be traced back almost 80 years to the frequency hopping spread spectrum (FHSS) technique upon which the wireless technology’s protocol is based.

FHSS is accredited to a patent issued in 1942 entitled ‘Secret Communication System’.

At the height of the Second World War, FHSS was intended for use in a radio-controlled torpedo. It worked by enabling radio signals to hop across the radio spectrum and, as a result, signals couldn’t be jammed.

The patent was taken out in the name of Hedwig Eva Maria Kiesler – better known at the time as the actress Hedy Lamarr.

The Bluetooth wireless technology used today, however, originated in 1994, when Ericsson started work on developing an RF-based wireless alternative to the RS232 cables that were commonly used to link devices.

“Ericsson wasn’t alone in this research,” explains Nick Hunn, a consultant and “wireless evangelist” who has worked in the wireless industry for more than 30 years and been closely involved with standards organisations and industry bodies.

“Both Nokia and Ericsson were working on developing wireless links from the mobile phone to the PC. Intel saw added connectivity as a valuable way of boosting sales of its PCs and favoured Ericsson’s technology.”

While all three companies had hit on the idea of wirelessly linking mobile phones and computers, they all realised that to have any chance of universal interoperability – allowing products from different companies to connect using a common RF protocol – the technology would need to be standardised.

After initial discussions in 1996, a meeting of the three pioneers agreed to standardise this short-range radio technology and to set up an SIG.

“IBM and Toshiba were invited to be part of the SIG with a view to creating a specification within 18 months,” Hunn explains.

At the time, Bluetooth was a temporary name. Alternatives were RadioWire and PAN (Personal Area Networking), PAN, the front runner, was dropped because the Internet was already generating thousands of hits for it and the failure to complete a full trademark search on RadioWire before the intended launch saw the Bluetooth name retained.

Despite doubts, the name caught on quickly.

**SIG formed in 1998**

The Bluetooth SIG was officially formed by Ericsson, Nokia, Intel, Toshiba, and IBM in 1998, with Version 1 of the technology launched a year later.

“It takes a number of years from a specification being adopted to applications reaching the market,” explains Hunn. “It takes time for people to work out how to do it all.”

“Looking back, Bluetooth was a remarkable combination of technology and world class technical marketing,” says Glen Collinson, a non-executive director of Blu Wireless Technology and co-founder of Bluetooth pioneer Cambridge Silicon Radio (CSR). “It was possibly one of the most rapid developments of a global creation standard – from idea to commercial deployment – there has ever been.”

Collinson points to several factors; in particular, the technology and the marketing support.

“The work carried out by Ericsson in the early 1990s was critical. At the time, Ericsson was among the top three mobile phone manufacturers and was determined to improve the utility of the mobile handset.”

Tasked with developing what would become Bluetooth, engineers Jaap Haartsen and Sven Mattisson turned to FHSS technology and developed the technological foundation blocks.

The second big technological breakthrough came from CSR, set up in 1998 by Phil O’Donovan, James Collier and Collinson.

“Some people might say ‘well he would say that wouldn’t he?’.

But, in fairness, CSR did establish a dominant position in the market for Bluetooth,” says Collinson, “and I don’t think many would disagree with the importance of the work we carried out at the time. We were the first company to integrate all the electronics of a modern wireless system on to a single chip.

“Before then, everything was separated out on the board. Silicon and wireless were not seen as compatible and it was thought that the radio would interfere with the silicon.

“We decided we could throw out the existing design rule book and put everything onto one chip. Not only that, but we could do it by using ‘vanilla’ CMOS.”

“CSR played a crucial role in the development of Bluetooth,” agrees Hunn, “But we shouldn’t forget the radio design Ericsson came up with; that was beautifully done.”

CSR’s resulting Bluecore chip cost just $5 at a time when wireless chips were costing more than $30.

“We delivered significant size and power savings and, within a few years, CSR had taken a 60% share of
the global market, demonstrating just how advanced this chip was.”

While the technology was transformative, the other key plank in the success of Bluetooth was the “utterly brilliant marketing of the technology by Intel”, says Collinson. “That success can be attributed to two people: Simon Ellis and James Kardach.

“They went back to basic marketing principles and decided to turn Bluetooth into something that everyone would want and understand. They wanted to create demand through the supply chain; not just from semiconductor companies, but also from consumers.

“They focused on interoperability, cost and short range communications and the technology took off.

“I would describe those first years as maniacal. People were buying chips and putting them into everything. We could track design wins using information published by the SIG and see the places where Bluetooth was being used.”

‘Brilliant marketing’

“The marketing campaign was brilliant, it paid dividends,” agrees Hunn. “But I would suggest that Bluetooth didn’t really take off in the way that it had been envisaged on the PC. Wi-Fi came along and Intel focused on pushing Wi-Fi into its laptops in preference to Bluetooth. My guess would be the PC industry, in general, preferred a Wi-Fi Ethernet based standard, while Bluetooth was closer to a GSM standard.

“What we saw was a clash between PC centric and cellular views of the world.”

Despite that, within just a few years, the industry was seeing the volumes it needed to enable the chip industry to invest and innovate. “We saw a shakeout in the industry and it became increasingly difficult for companies to compete,” says Collinson. “CSR, Broadcom and TI emerged as the ‘big three’, driving further investment and innovation.”

“One of the big drivers,” according to Hunn, “was pushing Bluetooth into mobile phones. This was the result of research which suggested that, in 2000, US mobile operators were seeing a third of their revenues coming from people phoning while in their cars. The threat of a phone ban, on safety grounds, saw the industry latch onto Bluetooth as a hands-free solution.

“It proved a real boost to Bluetooth and rather a good ‘get out of jail free’ card for the operators.”

According to Martin Woolley, technical programme manager EMEA for the Bluetooth SIG: “It’s remarkable the technology is still here after 20 years.

“In 2000, when the technology was really being commercialised for the first time, around 800,000 Bluetooth enabled devices were shipping per year. Today, we’re seeing 10million devices shipped each day.”

According to Woolley, there have been a number of significant milestones in Bluetooth’s history. “When we were first learning about the technology, it was being positioned as a cable replacement technology. As it became increasingly successful, we saw demand for Bluetooth DR/EDR (enhanced data rate) take off and volumes started to increase significantly in 2004.

“The next significant development was the introduction of Bluetooth Low Energy (BLE) in 2010, with the formal adoption of Bluetooth v4.0. Being very power efficient means it can perform a private product function while communicating wirelessly.

“Finally, last year’s introduction of Bluetooth Mesh paves the way for future developments.”

Hunn agrees that introduction of BLE should be seen as a significant milestone. “It moved the focus away from the mobile phone, adding Bluetooth functionality to stuff that had nothing to do with cellular.” But he also points to the Bluetooth v2.1 specification.

“This was important; not for what was in the specification, but because it was the point at which the SIG got serious about interoperability and ensured that products could work together. I think that’s one of the SIG’s greatest successes.”

Where next?

Today, thousands of businesses are developing products using Bluetooth.

“I’m certainly intrigued as to where we go next,” says Hunn. “Bluetooth Mesh will make it easier to deploy the technology, which will now reach into homes and could push the levels of deployment into the trillions.”

According to Woolley, the next version of the Bluetooth standard is set to focus on reinventing how Bluetooth audio will sound, as well as providing indoor positioning and navigation services with the use of Bluetooth beacons or using Bluetooth based tags.

After nearly two decades of development and with cumulative Bluetooth product shipments in the billions, Bluetooth still appears to have a very bright future.
Your Innovative New Products Deserve Our Innovative New Crystals

Small - 2.0mm x 1.6mm
20.000MHz to 54.000MHz

Small - 1.6mm x 1.2mm
24.000MHz to 54.000MHz

Smallest - 1.2mm x 1.0mm
36.000MHz to 54.000MHz

- Ultra-Miniature components crucial for IoT applications.
- Maximise PCB Real Estate
- Smaller crystals need lower power requirements
- Off-The-Shelf products developed with leading chip manufacturers for Bluetooth, Zigbee and WiFi applications.
- Proven Reliability
- Highly competitive global pricing from AEL Crystals Ltd

Talk to our highly experienced field sales engineers, and let’s see how we may assist you in the development of your next innovative product.

Unit 28, The IoCentre - Salbrook Road - Salfords - Surrey - RH1 5GJ - UK
email: sales@aelcrystals.co.uk - Web: www.aelcrystals.co.uk
Tel: +44 (0)1293 789200

UMT-H

SMD fuse with high breaking capacity

- High breaking capacity up to 1500 A
- High rated voltages up to 277 VAC / 250 VDC
- 24 rated currents from 160 mA to 30 A
- Compact, square design: 5.3 x 16 mm

www.newelectronics.co.uk  27 February 2018
With automation accelerating around the world, according to the International Federation of Robotics, one of the fastest growing segments of the industrial robotics market is that associated with collaborative robots.

Growth is being driven by a combination of stronger-than-expected growth in the global economy, faster business cycles, greater variety in customer demand and the scaling up of Industry 4.0 concepts.

One of the leading UK developers of ‘collaborative robotics’ is Ocado Technology, which develops the software and systems that power the online grocery retail platforms of ocado.com and Morrisons, the UK’s fourth largest supermarket chain.

Ocado is involved with a growing number of high-profile research projects, including the SoMa soft manipulation system and the SecondHands technician collaborative robot.

**Humanoid robots**

While the SoMa project is looking to develop smart and generalised solutions and systems capable of picking out thousands of different grocery items safely and reliably, the SecondHands humanoid robotic project is being developed to help engineers fix mechanical faults and even learn on the job.

“The SecondHands project is intended to assist Ocado’s maintenance technicians and crucially, and most excitingly, anticipate the needs of human operatives,” explains Graham Deacon, who heads Ocado’s robotics research team.

“The robot is intended to be completely autonomous and to be able to perform a variety of tasks from fetching tools to holding objects as well as assisting with cleaning and engineering tasks.”

The robot – described as a ‘second pair’ of hands – will be able to assist technicians and, through observation, augment human capabilities.

“It is intended to complete tasks that require levels of precision and physical strength that are not available to humans,” Deacon says.

“The SecondHands project is a European collaboration between Ocado and four EU universities and it would be fair to say that it is one of the most advanced assistive robot projects in the world,” according to Deacon.

The SecondHands robot, which uses 3D vision to see depth and colour, will look to use artificial intelligence so it can learn by example and respond to changing surroundings.

“Once it has been trained in a series of basic tasks, the robot should be able to increase its intelligence and act independently,” explains Deacon. “We are also working to enable it to understand natural speech, so that it can respond to voice commands.

“Technicians will need to be able to rely on these robots and there will certainly be challenges when it comes to voice, especially when you consider they could be operating in very noisy environments. To address this, we are looking to use a headset with a microphone close to their mouth,” says Deacon.

“Because we want the robot...
to be able to work alongside our technicians, the prototype uses omni-directional wheels for maximum mobility, but in the future, it could use tracks or even legs.”

The robot has to be able to work alongside humans, so it will deploy torque controlled arms, anthropomorphic hands and a flexible torso.

**European project**

Ocado is co-ordinating this European-wide project, funded by the EU to the tune of €7 million. The investment forms part of its Horizon2020 initiative to encourage researchers to work more closely with industrial partners.

“While we are co-ordinating and contributing to the research, Ocado will ultimately be the end user and the robots have been designed specifically for our warehouses, or Customer Fulfilment Centres (CFCs),” explains Deacon.

A SecondHands robot prototype was delivered to Ocado’s robotics research lab in late 2017 and, earlier this year, a prototype robot was put through its paces in front of EU officials.

“While there is still plenty of work to do,” concedes Deacon, “the past few months have provided us with the opportunity to evaluate and then integrate the various research components from the various project partners.”

Those research partners have combined to develop what is described as a real-world solution which has required them to not only take into account the design of a new robotic assistant, but also one that facilitates proactive help, supports a degree of human-robot interaction and the development of advanced perception skills to function in dynamic industrial environments.

Ocado’s research partners include: École Polytechnique Fédérale de Lausanne (EPFL); Karlsruhe Institute of Technology’s (KIT) Interactive Systems Lab (ISL) and its High Performance Humanoid Technologies Lab (H²T); the Sapienza Università di Roma; and University College London (UCL). Various research groups have been focused on computer vision and cognition, human-robot interaction, mechatronics, and perception.

“We want to demonstrate the versatility and productivity that human-robot collaboration can deliver in practice,” explains Deacon.

The research contributions for each of the project partners include:

- **EPFL**: human-robot physical interaction with bi-manipulation, including action skills learning;
- **KIT (H²T)**: Development of the ARMAR-6 robot, including its entire mechatronics, software operating system and control as well as robot grasping and manipulation skills;
- **KIT (ISL)**: the spoken dialogue management system;
- **Sapienza University of Rome**: visual scene perception with human action recognition, cognitive decision making, task planning and execution with continuous monitoring; and
- **UCL**: computer vision techniques for 3D human pose estimation and semantic 3D reconstruction of dynamic scenes.

“Ocado is responsible for the integration of these different functionalities and for the evaluation of the platform,” says Deacon.

While Deacon concedes that while more work needs to be done following the presentation to the EU representatives, it was important that the platform was pulled together.

The SecondHands robot is based on KIT’s next-generation ARMAR robot.

Below: The SecondHands robot is intended to help technicians in a proactive manner

“**When something goes wrong … we want the SecondHands robot to step in and help engineers carry out repairs quickly and safely.**”

Graham Deacon

“The fact the SecondHands robot has been developed across various sites using different laboratories, tools and facilities, means the project has been complex. But, despite that, everything was ready for January this year.”

As robots evolve from industrial machines performing repetitive tasks in isolated areas of large-scale factories to more complex systems powered by deep neural networks, the SecondHands project has been set the challenging goal of developing, collaborative robots that can interact safely and intelligently with their human counterparts in real-world environments.

“When it comes to maintenance tasks in Ocado’s network of warehouses,” says Deacon, “when something goes wrong with a mechanical component, we want the SecondHands robot to step in and help engineers carry out repairs quickly and safely.

“It should be able to operate in areas deemed too dangerous for humans – examining high-speed conveyors at close quarters, for example, or handling toxic material.”

More importantly, the team expect the robots to track what an engineer is doing, understand the task the engineer is trying to perform and then synthetically understand its own capabilities as a robot to offer assistance proactively.

“SecondHands’ potential for high-level reasoning,” Deacon explains, “is a work of artificial intelligence.”

He explains that software will help the robot construct a vast knowledge base around the tasks it carries out to better understand how they can be applied to problems. “In this sense, the robot will learn on the job,” he concludes.
Sensors have always been an important part of the industrial environment, measuring such variables as temperature, pressure and load. But the operative word was ‘industrial’, implying devices that were relatively large and relatively unsophisticated.

The appearance in the 1980s of MEMS technology changed all that. All of a sudden, sensors became much smaller and capable of being integrated into a range of new applications. And, when combined with electronics, such sensors became intelligent.

The miniaturisation of sensors has continued to the point where smartphones now integrate devices with the ability to measure such things as angular rotation and gravity – even air quality.

One of the pioneers of the MEMS sensor industry is Bosch Sensortec, which emerged from Bosch’s automotive activity and is now an independent company. “But we have a deep connection to Bosch,” said Wolfgang Schmitt-Hahn, director of strategic marketing, “and share its processes.”

He admitted that a large proportion of Bosch Sensortec’s output was supplied to the smartphone sector. “We’re supplying accelerometers for use in low end handsets,” he remarked, “but also sensors for wearables such as fitness trackers. Now, we’re developing a strong position in VR.”

So far, Bosch Sensortec has made more than 9 billion sensors, with 75% of that output – such as gyroscopes and magnetic sensors – supplied to the consumer electronics sector.

“Today,” Schmitt-Hahn continued, “developing sensors is also about packaging, adding intelligence and writing software and algorithms.”

While many of the sensors developed for use in smartphones may not be appropriate for industrial use, some are and system developers are taking advantage.

“While the consumer electronics sector is driven by the cost cycle, industrial users want these products to be available for more than five years,” Schmitt-Hahn pointed out, “and cost is not as important to them.” But Bosch Sensortec isn’t developing devices for use in hard industrial environments; instead, it’s addressing low impact industrial applications where sensors developed for consumer products can be used. “In that way,” he continued, “industrial customers can benefit.”

One of the issues is that, while smartphones, for example, have well defined sensor requirements, industry has a wide range of potential use cases. “Even so, we can look at how an accelerometer developed for a smartphone could be used to measure vibration on a machine,” he said.

Ralf Schellin, director of product management, said this could bring problems, particularly when sensors were being retrofitted. “We have seen our sensors added to air conditioning systems, but they need to be connected properly. If you have a pressure sensor, that needs to be connected to a pressure tube in the air conditioning system and that can mean connecting two different materials. Besides the electronics, there are mechanical elements, which can make things more difficult.”

At the 2018 Consumer Electronics Show, Bosch Sensortec unveiled BMI088, pictured left, an inertial measurement unit (IMU) designed for drone and robotics applications. The device integrates an extremely stable gyroscope, with a low noise, low drift output.

“Challenging applications, such as drones and robotics, demand extremely stable and high performance IMUs,” said Dr Stefan Finkbeiner, Bosch Sensortec’s CEO.

The BMI088 consists of a triaxial 16bit acceleration sensor and a triaxial 16bit gyroscope integrated into a package measuring 3 x 4.5 x 0.95mm. With a bias stability said to be less than 2°/hr and a temperature offset coefficient of 0.2mg/K, the accelerometer can measure ±24g.

Schellin said that, while the BMI088 had been demonstrated on a...
drone at CES, the device was robust enough for industrial use. “The sensor was on a PCB in a robust housing, designed to resist EMI and capable of operating in temperatures ranging from -40 to 85°C. If we have better domain knowledge, then we can better tailor sensors to customer requirements.”

Industrial users can also take advantage of the power consumption benefits provided by sensors developed for consumer applications. Schmitt-Hahn pointed to the Internet of Things and Industry 4.0 applications. “If you think about retrofitting sensors in these applications, then it’s likely you would use a wireless device. You can certainly think about applications where you not only need sensors with low power consumption, but also a low power solution.”

While it may be beneficial to integrate a small sensor into an industrial application, such as robotics, it’s still important to be able to use the data generated in a sensible way. And that means software has become as important as the sensor itself.

“We can do this in a number of ways,” said Schmitt-Hahn. “There are some sensors where all we need to do is to supply the device with a library of drivers. But there are also more complex parts. For example, a motion sensor might feature an accelerometer, a gyroscope and a magnetometer; each with three axes. “That creates nine axes and, to make that raw data useful, it requires us to develop the software because we know our sensors best.”

Data rate is also an important factor, particularly in the rapidly developing field of VR. “Software allows data to be aggregated from a number of inputs,” he added.

Making sense of data coming from a large number of inputs is pushing companies such as Bosch Sensortec to add intelligence within the package. “We do this either by integrating MCUs inside the package or including an MCU core,” Schmitt-Hahn noted. “This local intelligence is provided by MCU structures optimised for the process. It’s important to point out that this doesn’t waste space nor power.”

But there is a limit to how much software the company can develop for its sensors. “Whenever we can support an application, we do. But while we help customers solve application problems, we don’t have specific solutions for particular applications.

“When it comes to connecting sensor data into other algorithms – vibration measurement, for example – the expertise has to be provided by the customer. What we have to do is to build the bridge between the sensor and the customer’s system,” said Schmitt-Hahn.

Schellin reinforced this point. “The customer has the domain knowledge and creates the application layer. Our job is to create the bridges by adding an intermediate layer. Then, it depends on the application.

“In a step counting application, the output is the number of steps and the customer’s task is to represent that data. In more complex applications, the output could be Euler angles and that means the customer has to do more than simply develop an HMI.”

Process technology is playing an important role in creating smaller sensors which consume less power. “We’re using state of the art CMOS,” Schmitt-Hahn noted, “and we’re always trying to shrink devices as much as possible and to move to different process nodes. But we have to strike a balance between cost and power consumption. For example, there may be more power leakage on a smaller node.”

Most Bosch Sensortec products are provided as systems in package, with the MEMS and CMOS elements as separate dice. “The challenge is to decide how many dice should be put into one package,” Schmitt-Hahn concluded, “and how we put these things into a package without having problems with stress and bending.”

Nine axis sensor features Cortex-M0+ MCU

The BMF055 is a compact nine axis motion sensor that can be programmed for particular applications. With sophisticated motion sensing capabilities, the part is said to replace multiple discrete components.

The sensor, from Bosch Sensortec’s Application Specific Sensor Node family, integrates an accelerometer, a gyroscope, a magnetometer and a Cortex M0+ processor from Atmel’s SAMD20 family into a package measuring 5.2 x 3.8 x 1.1mm.

The device is said to be suited to the needs of customers developing advanced application specific sensor fusion algorithms, including robotics.
As the population ages, long term health care issues are becoming more challenging, which requires innovative solutions. By Bethan Grylls.

As part of the UK’s Healthcare Technologies strategy, the Engineering and Physical Sciences Research Council launched a competition in 2016 to identify promising research projects addressing challenging issues. Among the eight winners, announced in 2017, were Dr Rylie Green of Imperial College London and Dr Frankie Rawson of the University of Nottingham.

Dr Green’s efforts centre on implantable polymer bioelectronics for devices such as bionic eyes and cochlear implants. Her aim is to create a soft and flexible conducting polymer.

“Cochlear implants currently have 22 channels of stimulation – a limitation caused by the fact they are made from metals,” Dr Green said. “Metal conducts electricity using electrons, while the body uses ions. The material we’re using can conduct electricity using both.

“Metal limits size,” she continued. “You can’t make the device smaller without compromising safety and you can’t push more current through the metal as it could cause unwanted chemical reactions, such as changing the pH in the tissue.”

The polymeric material allows current to be pushed into the body at a ‘faster rate, more efficiently and at a lower voltage’, lowering the risk of electrical changes or degradation significantly.

“This provides better perception of sound for a cochlear implant patient, or allows someone with a bionic eye to see not just with 40 or 60 points of light – which is the current limitation of metal electrodes – but with hundreds and thousands of points of light.”

Dr Green’s other challenge was to develop a polymer which could be accepted by the body. This involved modifying the properties of conductive polymers to create a soft interface that interacts more readily and reduces the foreign body response. According to Dr Green, this has been accomplished by hybridising a conductive polymer with hydrogels and elastomers.

The bionic eye developed by Dr Green comprises a camera, fitted to sunglasses, connected to a processor that converts the analogue signal into a digital format that is then delivered into the body. The electronic package sits behind the ear under the skin. An electrode lead is inserted into the eyeball, where it can stimulate cells to create a perception of vision. A chip interprets the information received.

The implants are powered via inductive coils; one remains outside the body, with a matching coil inside. When clipped together magnetically, it can be used for data transmission. “A wireless inductive link powers the implant, sends processed information to it and gets reverse telemetry data on how the device is working inside the body,” Professor Nigel Lovell of the University of New South Wales, explained Prof Lovell, who has been leading an R&D programme to develop a retinal neuroprosthesis and collaborates with Dr Green. He continued: “The chip encodes image information from the camera into electrical pulses. The brighter the image spot, the larger the amplitude of the electric pulses. There are 99 electrodes in our array; more electrodes means better visual acuity.”

Dr Green’s polymeric material will

Above: Gold coated substrate is used to 3D-print structures in the development of artificial conductive cell scaffolds

“Metal limits size; you can’t make the device smaller without compromising safety.”
Dr Rylie Green

www.newelectronics.co.uk  27 February 2018
coat the electrodes to make them work more effectively and, potentially, enable devices with more electrodes, something which is not possible with metal electrodes.

“The electronics package (where data transmission and signal generation occurs) is implanted at a distance from the sensory organ (eye or ear), but the interfacing electrode array must be implanted in contact with the cells that require activation and connected to the electronics package via a cable or tracks,” Dr Green said.

“The more tracks and channels, the better the patient experience. Once you reach the tissue, you need to be able to stimulate and separate those channels.”

According to Dr Green, making sure that polymer-based tracks can carry electricity across these lengths is a challenge, hence the development of new polymer chemistries and fabrication techniques.

“Hydrogels are best for interacting with tissue when looking to stimulate them, but the elastomers are needed to create long tracks. The biggest challenge is creating a continuous electrical path that doesn’t break with movement. We’ve achieved that, but need to make it commercially competitive.”

Bioelectronics appears to have a role to play in future medicine and, while Dr Green is working on improved audio and visual perception for diseased cells, Dr Rawson is looking to use bioelectronics to communicate with cells wirelessly.

Instead of implanting an electronic device near the nerve tissue and applying a current to modulate cell proteins and stimulate communication, Dr Rawson has other plans.

“By inputting electric fields, we plan on modulating electron transfer, which can then be used to sense and actuate chemical reactions. We’ve demonstrated that cancer cells efflux electrons and metabolise more quickly and grow faster than normal tissues. If you can modulate that external electron flux electrically, we may be able to treat cancer.”

There are three methods for treatment that Dr Rawson is looking to address.

“First, we plan to develop nanotechnology and use conducting nano/micro particles that are functionalised with a bioactive molecule. The cells take up these nanoparticles and when an external electric field is applied, the redox state on the surface of that nanoparticle is changed. When the state of the bioactive molecule changes, it causes a modification in the cell’s metabolism, telling it to kill itself.

“Secondly, we think that, by using wireless electrochemistry to self-assemble conductive wires around brain tumours, you can inhibit cell proliferation, which should theoretically extend the patient’s life.”

Left: An experimental setup for the induction of electrochemical wireless microwire growth

“Thirdly, we plan on using artificial conductive porins.”

Porins – a type of protein – create channels through cellular membranes large enough to allow ions to pass.

“The basis of a lot of electrical talk between cells is from porins opening or closing, depending on the electrical fields,” he continued. “By putting in artificial conductive channels and applying external electric fields, we believe we can modulate the potential that cells see and, therefore, the way they communicate.”

These conductive wires are created by printing electrode systems on a glass substrate. When printing with conductive inks, Dr Rawson found an electrochemical reaction caused atoms to diffuse into the solution and self-assemble into nanoparticles. These then aligned at the conductive bipolar electrode, which has no physical connection to the circuit, creating conductive wires.

Current bioelectronics therapeutics require standard electronic materials, which need invasive surgery. Dr Rawson proposes to ‘grow electronic devices potentially in situ and avoid the need for that surgery.’

He said there are ‘no current commercial examples of treating cancer in the way we propose’, but it is likely this technology could be developed and applied in the next 10 years.

Dr Rawson’s vision is a wearable device, such as a skin patch, that modulates the electric field and targets the area of disease. To do this, the next step is to develop a device to modulate that electrical behaviour and, therefore, control cell proliferation and communication.

Although bioelectronics appears to have numerous benefits, there isn’t a mass market for the technology as yet. This, Dr Green concludes, is due to a combination of ‘high cost and regulation’. But she remains optimistic, believing that demand and growth for this technology will soon see commercial applications.
RFI / EMI shielding gaskets & components

Fast...

Kemtron
Proven EMC Shielding Performance

www.kemtron.co.uk
+44 (0) 1376 348115
info@kemtron.co.uk

Fast lane

- M12 X-Coded 10 GB
- 8 Contacts
- Shielded metal housing
- IDT Connection
- Ethernet cable
Designing medical devices needs careful planning and, above all, patience. By Graham Pitcher.

By 2045, according to the Office for National Statistics, the UK’s population will have risen to some 76 million and almost 25% will be 65 or older. The health and social care implications will be significant – and that will create an opportunity for innovative healthcare devices.

It might be that your company has an idea for such a device, but if you have no experience of developing products for the medical sector, what process should you follow and, importantly, how long will it take?

Helen Simons, a quality specialist with technology and product design company Cambridge Design Partnership (CDP), said the first thing to determine is which market you’re going to address. “For medical devices, the two main markets are Europe and the US. Other health authorities tend to follow these requirements, although some – such as Australia and Canada – are beginning to develop their own regulations.

“If you’re targeting Europe, your product will have to comply with the Medical Devices Regulation or the In Vitro Diagnostic Medical Devices Regulation, both of which have been updated recently and replace previous Directives. These Regulations are mandated by law.”

The fact the UK is leaving the EU in March 2019 is already muddying the waters, Simons noted. “It’s causing confusion, but it’s likely the Medical Devices Regulation will come into UK law, but it’s not clear how.”

The good news is that the EU and US regulations are published on the web and can be downloaded free of charge. The bad news, if that’s the appropriate term, is the sheer volume of information.

James Baker, a CDP partner, explained: “Take safety as an example. The top level standard for safety is 424 pages long, with 455 clauses. And there are another 92 standards. You can understand why people feel daunted.”

Simons said one of the main standards for medical device development is IEC13485. “This is a quality management standard and is the medical equivalent of ISO9001. A lot of companies choose to follow this because it provides a framework that helps them to meet most regulations, including how to control the design process.

“There’s also IEC14971, which is about risk management. While neither standard is mandated, if you are seen to follow them, it’s likely things will be OK.”

Three other important standards need to be consulted along with way. “IEC60601 includes a whole suite of standards,” Simons pointed out, “and which part you use depends on the kind of product being developed. IEC61010 covers test equipment, while medical device software is covered by IEC62304. All three feature risk based approaches and levels of control While these are the key standards, others will need to be consulted.”

Baker said CDP has a long history in designing products within regulatory frameworks. “We’re also doing more awareness training. That’s becoming more and more relevant, particularly when it comes to 60601-1 – electronics in medical. Traditional mechanical products are now integrating electronics and sensors, so companies coming at medical from the mechanical side need to plan more when integrating electronics.”

Patience is a virtue when designing for the medical sector. “Mind set is
important,” Baker asserted. “When a market opportunity appears, some companies will see the regulations as burdensome and try to move ahead quickly. My advice is to take your time because, if you move too quickly, you could design yourself into a corner and, potentially, need to do a complete redesign. The best approach is defensive design; really analyse your product and make a decision about how the design will comply.”

So where do you start? Simons said: “It’s really important to think your design through at the earliest stage because authorities need documentation; evidence that you know how you’re going to produce it. Take the approach that if it isn’t written down, it hasn’t happened.

“Write an intended use statement – Who will use it? What for? Where will it be made? That helps to generate the design inputs and which parts of the regulations you have to comply with.”

Baker focused on the software development process. “Taking this approach forces you to show that you have considered the process from end to end. You will be expected to show that you have analysed the project, how you will deliver the functionality and how you will test the software against requirements. Generally, this will be accomplished using the V model.”

Simons added: “Software needs to be thought about early in the project because you can’t always prove that software will do what it should.”

Risk management is another important element. “Getting this wrong could lead to a hardware redesign,” Simons cautioned. “Thinking about this at an early stage can save a lot of time and money.”

Baker explained that CDP’s approach to medical design is to consider how every element of compliance will be dealt with. “It depends on how you architect the product. For example, you may decide to eliminate software from the safety critical aspects and handle that element using hardware. It’s all about understanding the design and producing the documentation you need to prove compliance.”

Don’t be concerned about generating too much documentation. Simons said: “The amount of paperwork you will need to provide is an order of magnitude or two greater than for a consumer product. One design I was associated with required 20 lever arch folders for the paperwork – even before manufacturing.”

Safety is another element of risk management. “60601 has two elements – basic safety and essential performance,” Baker noted. “With basic safety, it’s never acceptable to electrocute someone, for example. Essential performance is something the device needs to do, even if it’s gone wrong, because it could put people at risk.

“When you’re analysing the design, ask what happens if a component is open circuit or short circuits or is the wrong value? That’s the level at which you need to demonstrate safety. Ask what happens in the event of a single point of failure, because your device must continue to be safe.”

Simons added: “While consumer electronics just fail, a medical device just stopping could be risky, so there is a need for graceful shutdown. Also think about design safety; if you are designing an implantable device, what are you going to do if it goes wrong?”

The regulations and the associated assessment periods are a challenge and this can see extended time to market – something which can, potentially, stifle innovation as companies fall back on proven designs. “However enthusiastic you might be,” Simons observed, “it’s going to take at least two years to get a medical product on the market.”

Baker added: “It could be four years for more complex devices.”

Both emphasised that standards are there to help, so you should take time to read them and go through the detail. “Remember,” Simons concluded, “if you haven’t taken Directives and Standards into account, you don’t have a product – you only have a concept.”
White noise

With more products joining the Internet of Things, a growing number of PCB designers are having to embrace EMC for the first time. **Ralf Brüning** discusses some EMC basics and offers some practical design tips.

Though often used as synonyms, Electromagnetic Compatibility (EMC) is really the controlling of radiated and conducted Electromagnetic Interference (EMI); and poor EMC is one of the main reasons for PCB redesigns. Indeed, an estimated 50% of first-run boards fail because they either emit unwanted EM and/or are susceptible to it.

That failure rate, however, is not across all sectors. This is most likely because of stringent regulations in some sectors, such as medical and aerospace, or because the products being developed are to join a product line that has historically been designed with EMC in mind. For instance, mobile phone developers live and breathe wireless connectivity and are well versed in minimising the risk of unwanted radiations.

Those most falling foul of EMC issues are the designers of PCBs intended for white goods - such as toasters, fridges and washing machines – which are joining the plethora of internet-enabled devices connected wirelessly to the IoT. Also, because of the potentially high volumes involved, re-spinning PCBs can introduce product launch delays. Worse still, product recalls could be very damaging to the company’s reputation and finances.

**Where’s noise coming from?**

There is no shortage of guidance on designing with EMC in mind, and many companies have their own in-house PCB design and EMC rules. Guidance can also come from external sources, such as legislative bodies, IC vendors and customers. However, accepting all guidelines at face value can lead to an over-defensive EMC strategy, and introduce project delays. Rules should be evaluated individually to determine if they apply to the current design.

That said, your basic, common sense rules will always apply. For instance, to supress noise sources on a PCB you should:

- Keep clock frequencies as low as possible and rising edges as slow as possible (within the scope of the requirements spec’);
- Place the clock circuit at the centre of the board unless the clock must also leave the board (in which case place it close to the relevant connector);
- Mount clock crystals flush with the board and ground them;
- Keep clock loop areas as small as possible;
- Locate I/O drivers near to the point at which the signals enter/leave the board; and
- Filter all signals entering the board.

While the above measures will help mitigate against some of the most common EMI issues, every powered PCB will still radiate EM energy. This is because every current produces a magnetic field and every charge causes an electric field. The total radiation will be the sum of signal loop differential-mode radiation, common-mode radiation (both voltage- and current-driven) and radiation produced by the power distribution system (PDS).

**Looking at these in more detail.**

- **Differential mode radiation** is caused by transmission line loops, and the signals creating differential currents (see Figure 1). Countermeasures include using shielded layers (Vcc or ground), placing critical signals on inner layers (also known as striplining), avoiding long parallel runs for signals and, as mentioned above, minimising the loop area and keeping signal rise and fall times as slow as possible.

- **Common mode radiation** is often the more critical EMC design aspect as the EMI is more ‘visible’ in the far field. It is created from parasitic currents (for example, switching currents or inducted currents by flux couplings) or parasitic voltages (such as crosstalk voltages to active I/O signals). The countermeasures include removing the sources of those parasitic currents and voltages - hence avoiding crosstalk between fast-switching signals – and smarter component placement and routing to avoid flux coupling and wrapping effects.

- As for PDS, it can radiate because the PCB is essentially an LCR resonator, comprising inductive...
elements (the tracks), capacitance (ground and voltage planes are like the plates of a capacitor) and resistance. Countermeasures for PDS EMI include lowering the board impedance, avoiding inductance and ensuring sufficient decoupling.

In addition, ICs are also a source of EMI and will contribute to the PCB’s EM profile. This must be factored in during IC selection, and chip vendors should be able to provide you with information on the EMI behaviour of the circuits.

**Rule checkers and simulations**

Many PCB design tools include EMC rule checkers. Checks include looking at the design data geometry for instances where signal crosstalk may occur (because of parallel-routed traces), instances of little or no shielding, and where decoupling may be required.

The rules will incorporate the ‘know-how’ of many EMC engineers. However, it is important to know their origin and how they were implemented by the CAD tool vendor – and you are within your rights to ask to see the vendor’s rule books.

The tools should also allow you to highlight PCB areas where EMI suppression and EMC integrity are key – you tell the tool what your priorities are.

But let’s not forget, these are post-layout checks. It is always best to design with EMI and EMC in mind rather than embark on a trial-and-error exercise. Also, you will receive little if any steer on what the EM radiation levels are likely to be.

For a more advanced analysis, simulation is required. As with EMC design rule checkers, the meaningfulness and therefore value of the results will depend on how well the digital representations of the board and its behaviour have been rendered, plus of course how well the variety of EM equations have been implemented as software algorithms. Again, the tool vendors should be able to supply information. You should also take some representative measurements to validate the simulation methodology, and compile metrics to act as the basis for interpreting future results.

There are many numerical 3D EM simulation tools on the market, some of which are dedicated to specific activities such as antenna design. They are well-suited to what-if studies and the optimisation of structures. They can model all EMI effects for a given structure, but they do require considerable computation power (memory and CPU time) and tend to cost a lot. In addition, an in-depth understanding of EMI is needed to understand the results, as it can sometimes be difficult to explain using 3D EM results alone the reason for a particular radiation peak, for example.

However, for the types of PCBs used in white goods, we are not seeking to optimise antenna structures or produce a particular RF profile; we simply wish to verify that the board design exhibits good EMC – and a PCB design CAD tool with good EMC rule checkers will suffice.

**Designing out EMI**

While there is no silver bullet to EMI, good design work should include the identification of parasitic EMI antennas, such as electric and magnetic dipoles. Also, identify the current paths, as current flows in loops and will always look for the path of least resistance. Accordingly, plan for a proper return path (noting that ‘ground’ is not an accepted technical term in EMC engineering) and avoid crossing splits/gaps (even for differential pairs) and return path discontinuities (see Figure 3).

In summary, it’s always best to design with EMI in mind, rather than risk board re-spins, but you must have a clear understanding of which EMC rules will apply to your project. Also, having an EMC analysis capability embedded within the PCB design CAD tool can greatly reduce the risk of EMC compliance failure once the board is manufactured; but make sure the tool’s rule checker is based on well-documented and verified EMC principles and explanations. And never simulate unless a) you trust the simulator and b) you have a feel for what the results will be.

**Author profile:**

Ralf Brüning is product manager and senior consultant with Zuken.
EMBEDDED DESIGN SHOW

SAVE THE DATE

RICOH ARENA | COVENTRY
17-18 OCTOBER 2018

www.engineeringdesignshow.co.uk
Assemblers of electronic components in Europe generate many different forms of waste and are liable, under recycling regulations, for their soldering waste including solder dross, paste and solder-contaminated wastes.

It remains common for companies to send their old solder back to new solder suppliers rather than commissioning third parties to handle it because of the legal uncertainty and risks associated with processing it. If the waste isn’t handled properly by the recipient, then the electronics manufacturer could face litigation.

MTM NE-Metalle is currently the only trader in Germany that is certified for the handling of old solder according to ISO 9001: 2015. It provides free and advice and solutions for the safe disposal of solder. Thanks to its ISO 9001:2015 certification, the company is seen as a first port of call for component assemblers when it comes to third party solder recycling managing their solder waste.

MTM NE-Metalle also offers training in how best to handle these harmful materials.

“We work with around 300 tonnes of solder waste per year and, as such, are the largest service provider in Europe for the recycling of used solder material,” explains Dan Mutschler, managing director of MTM NE-Metalle. “Using our expertise, we are able to support any component manufacturer that needs to safely manage its waste.”

Crucially, the company guarantees legal certainty when it comes to disposing of solder waste, keeping detailed documentation in which the recycling process is recorded for auditing purposes.

Efficient handling and a short supply chain saves money and time, suggests Mutschler.

“When dealing with used solder material, it is important to sort it accurately to ensure high recovery rates and effective utilisation,” he explains. “Although you can just mix all the solder waste, this makes neither economic or ecological sense, since it makes reprocessing much more difficult and is inconsistent with the concept of sustainable recycling and material utilisation.”

The various additives found in solder waste, including nickel, germanium, silver, bismuth and phosphorus, requires metallurgical expertise to effectively sort them. MTM NE-Metalle addresses this by carrying out material analysis using various spectrometers and RFA devices. This is the only way to correctly classify the waste solder so that a qualified recycling process can be selected.

“It is not uncommon that, through our material analysis of the solder waste, component assemblers gain information about the impurities in their production process which might otherwise go unnoticed,” Mutschler suggests. This optimises the recovery of valuable materials.

Guaranteeing legal certainty when it comes to disposing of solder waste is crucial as is keeping a precise record of the recycling process.
rate for old solder, ensuring the best possible utilisation of the final waste.

**Transporting rules**

Transport routes are another consideration and can be more efficiently planned when experts for new and old solder become involved.

“When commissioning a third party, the waste producer – i.e. the component assembler – should seek advice about regional and national statutes,” Mutschler states. “This represents a huge jungle of logistical and legal problems which is beyond the abilities of the uninitiated.”

In addition, much of the solder waste cannot be processed by the solder manufacturers themselves, so this waste needs to be sold on to specialised metallurgical plants equipped with special smelting plants, pyrolysis and vacuum distillation ovens as well as electrolysis systems.

MTM NE-Metalle has a well-established network in the industry and has made it its mission to select the shortest and most efficient supply chains so that complete processing and recycling can be achieved. As such, the recyclable waste is delivered in an environmentally and cost-effective manner to those sites where it can be used. This means that there is only one interim storage facility in which the material is sorted by experts before it is prepared for the recycling pathway.

Since solder waste can sometimes be dangerous, it is crucial that transport safety is maintained.

“When there is a risk of transport damage, the waste can often leak out of poorly chosen packaging, such as cardboard cartons, which can then lead to environmental pollution.” Mutschler adds: “Even when using disposal companies, contaminants can still gain access by seeping into the material. For legitimate and safe transport from the production site to its final processing location, it’s essential that a company needs to use its own containers.”

While MTM NE-Metalle can supply material-specialised drums for storage and transport, including buckets, hobbocks and drums with capacities ranging from 9 litres to 216 litres, it tends to adapt the containers to the needs of its customers’ specific production sites.

During handling and transport, however, occupational safety must also be considered and the employer will be obliged to pay attention to the safety needs of its employees.

For example, excessively large loads should not be moved around.

“It may of course be beneficial from an economical perspective if a container with a capacity of 60 litres is used, but filling to a weight of as much as 100kg can pose an unacceptably high risk of having an accident,” warns Mutschler. “That is why we offer suitable handling aids, such as small cranes, so that the material can be loaded correctly. In addition, we also advise companies on how to deal with their waste”.

**Training sessions**

Training sessions are used to sensitise and qualify employees.

“Many companies are specialised in the production of component assemblies and are familiar with the corresponding electronics and DIN standards,” explains Mutschler. “However, the issue of waste management often only plays a subordinate role. We are the only service provider in Germany to be certified according to ISO 9001 (2015) for the handling of used solder materials.”

MTM NE-Metalle also offers training courses on dealing with old solder. In this way, it hopes to make every waste producer aware of waste legislation and packaging regulations.

Under national regulations, each material is categorised according to a waste code number and must be handled differently wherever necessary.

Above all, knowledge about a company’s own duties in the choice of the waste disposer is important because not every company has the professional competence and the required reliability standard.

“Many self-proclaimed waste disposal companies often do not have sufficient knowledge of waste disposal law, nor do they have environmental liabilities, let alone sufficient liability to cover any insurance claims. Since the waste producer – the component assembler – can also be held liable after the commissioning of third parties, we strongly advise against using these types of companies,” Mutschler suggests. “In our training courses, we draw attention to the usual pitfalls, so that companies can then recognise with whom they can actually work.”

There are also different obligations regarding documentation, which are dealt with comprehensively in the training courses. In addition, employees are made aware of the background of what happens during the recycling of the materials, and what must be ensured during storage and transport.

“Complex logistical and physical processes are involved, which at first glance may not even be suspected,” says Mutschler.

“With the proper training, employees will be thoroughly informed about how to deal with old soldered waste and become aware of what to look for, as well as the mode of disposal which is ecologically and economically the most appropriate.”
Fujitsu Chooses Wireless Connector Technology

Fujitsu chooses Lattice’s SIBEAM Snap Wireless Connector Technology to Simplify USB Connections in Next-Generation Tablet PC

Lattice’s S8B32 and S8B23 USB3 Devices Improve Ease of Use and Reliability of Connecting the Tablet to the Docking Cradle

- SIBEAM Snap technology provides a short range 60 GHz wireless link that delivers up to 12 Gb/s of data transfer
- Proven technology improves system robustness and industrial design by eliminating physical connections

Lattice Semiconductor Corporation (NASDAQ: LSCC), the leading provider of customizable smart connectivity solutions, today announced that its SIBEAM™ Snap™ technology will be integrated in Fujitsu’s next-generation Tablet PC, model Q581. The USB3 will be the first tablet supporting USB 3.1 data transfers at 5 Gbps wirelessly and will be displayed during CES 2018. The product will be available in Japan starting in January 2018.

☎: bruce.fienberg@latticesemi.com
☎: 408 826 6023

Full colour TFTs

A range of bar type full colour TFTs

The mainstream aspect ratio of the TFT LCD panel in the market is 4:3 or 16:9. But for some applications, bar type shapes of display panel would be much better to display the required information. Bar type TFT-LCD displays are perfect for industrial equipment, automotive application, server systems, POS system, dynamic information displays and advertising displays.

Sizes available are 3.9”, 4.6”, 5.2”, 8” & 12.3 inch. Resilient or capacitive touch options plus high brightness versions.

☎: nw@mansky.co.uk
☎: 01344 307733

LYTSwitch-6 LED Drivers

LYTSwitch-6 LED Drivers from Power Integrations Feature High Efficiency and Very Low Standby Power

High-accuracy CV/CC operation; ideal for smart lighting and ballast applications

Power Integrations (Nasdaq: POWI), the leader in high-efficiency, high-reliability LED-driver ICs, today announced the LYTSwitch-6 family of safety-isolated LED-driver ICs for smart lighting applications. The new ICs deliver flicker-free output up to 65 W, and feature up to 94% efficiency and as little as 15 mW standby power, with configuration options for two-stage or single-stage PFC support. Targeting smart residential and commercial fixtures and low-profile ceiling trofflers, LYTSwitch-6 ICs also exhibit fast transient response, which facilitates excellent cross regulation performance of parallel LED strings without additional regulator hardware, and allows easy implementation of a pulse-width-modulation (PWM) dimming interface.

☎: peter.rogeron@power.com
☎: (408) 414-8573

Mouser Now Offering Transceivers

Mouser Now Offering Maxim Integrated’s MAX2250E Transceivers for High-Performance Motion Control

Mouser Electronics, Inc., the industry’s leading New Product Introduction (NPI) distributor with the widest selection of semiconductors and electronic components, is now stocking the MAX2250E and MAX2250E RS-485/RS-422 transceivers from Maxim Integrated. Offering up to twice the data rates over longer distances compared to similar devices, the MAX2250E and MAX2250E transceivers deliver increased accuracy for demanding motion control systems, encoder interfaces, and other industrial controls.

The MAX2250E and MAX2250E half-duplex transceivers, available from Mouser Electronics, provide flexible performance with ±15 V HBM electrostatic discharge (ESD) protection to suit a variety of applications. The devices offer a large receiver hysteresis of 250 mV, which provides excellent electrical fast transient (EFT) robustness.

☎: kevin.hess@mouser.com
☎: (817) 804-3833

Nexperia introduces new network

Nexperia introduces new generation of high performance In-Vehicle Network protection diodes

Drop-in replacements have higher surge current, greater ESD robustness and much better ESD clamping

Nexperia, the former Standard Products division of NXP, today announced a new generation of in-vehicle network (VIN) protection diodes that offer a higher surge current, greater ESD robustness and a significant improvement in ESD clamping performance. The new REZ-US11 qualified PESD24N series of surface mount devices is optimized for the latest generation of CAN, LIN, and FlexRay transceivers.

The new parts are drop-in replacement for legacy devices, available in familiar SOT23, SOD323 and SOT23 packages. However the new parts deliver higher performance. For example, PESD24N241 parts deliver a 30 kV ESD robustness (up from 23 kV on the legacy PESD24N), an improved surge current of 3.5 A and much better clamping of 42 V at 3 A (was 70 V at 3 A).

☎: petra.beekmans@nexperia.com
☎: +31 6 137 111 41

New Keyed SMA fibre optic system

New Keyed SMA fibre optic system from OMC ensures consistent mated performance

Combines best features of multiple connector styles; eliminates rotational variation

OMC, the pioneer in optoelectronics design & manufacture, has launched a new, Keyed SMA (KSM) connector and diode-receptacle system for its wide range of fibre optic transmitters and receivers which offers the rotational consistency of a keyed connector alongside the security and reliability for which the SMA connector is renowned.

The KSM fibre optic connector system combines a new connector and diode housing design, which OMC describes as delivering the best of all worlds. Unlike the standard SMA connector, which can be inserted at any rotation about the ferrule axis, OMC’s KSM system incorporates a mechanical keyway mechanism, thus eliminating rotational variation when a cable is mated to the transmitter or receiver. The connector continues to feature the secure hexagonal locknut fixing of OMC’s standard SMA connector, ensuring maximum long-term integrity of the connection.

☎: Heathw@omc-uk.com
☎: +44-1209-215424

Red Pitaya adds Vector Network Analyser

Red Pitaya adds Vector Network Analyser capabilities to low cost credit-card-sized, reconfigurable STEMIab instrument

Multi-function, open-source, reconfigurable test & measurement platform can now measure electrical performance of RF components

Red Pitaya, the company that is pioneering the move to low cost, open-source, reconfigurable instrumentation with its credit-card-sized STEMIab™ platform, today launched a VN4 new bridge module and application that enables STEMIab to function as an affordable vector network analyser (VNA), a precision measuring tool that tests the electrical performance of high frequency components in the radio frequency.

STEMIab is a test and measurement environment that includes a board, an application marketplace and a source code library. It is designed as a low-cost alternative to many expensive measurement and control instruments. STEMIab can function as an Oscilloscope, Logic Analyzer, Signal Generator, Spectrum Analyser and more, also performing other tasks, now including vector network analysis.

☎: rok.mesar@redpitaya.com

TTL, Inc. adds ALPs TACT Switches™ and industrial components to Europe-wide franchise portfolio

TTL, Inc., adds ALPs TACT Switches™ and industrial components to Europe-wide franchise portfolio

TACT Switches™, sensors, encoders, spring contacts stocked in depth in Europe

TTL, Inc., a world leading specialist distributor of electronic components, has signed a pan-European franchise agreement with Alps Electric, a leading global manufacturer of high-quality electronic components for mobile devices, home electronics, vehicles and industrial equipment.

Alps developed the first TACT Switches™ and are leaders in this field with a range of TACT Switch™ varieties that offer a specific ‘feel’ for different applications, as well as reliable contacts with a three-dimple dome design to give better dust resistance. In particular, SK1A series devices have been developed to address industry trends for low profile, compact switches with IP67 ratings.

☎: sales@de.ttlinc.com
☎: +49 8142 6680 – 0
WE’VE REACHED A NEW LOW

LT6018
30nVp-p: 0.1Hz to 10Hz Noise

- Ultralow Voltage Noise
- 30nVp-p: 0.1Hz to 10Hz
- 1.2nV/√Hz (Typ): 1kHz

- 50μV Offset Voltage (Max)

- 0.5μV/°C Offset Voltage Drift (Max)

- 124dB CMRR (Min)

- 15MHz Gain-Bandwidth Product

LOW NOISE PARTS

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LTC6655</td>
<td>0.25ppm Noise Voltage Reference</td>
</tr>
<tr>
<td>LT1028</td>
<td>0.85nV/√Hz Op Amp</td>
</tr>
<tr>
<td>LTC2500-32</td>
<td>32-bit 1Msps SAR ADC with Filter</td>
</tr>
<tr>
<td>AD7177-2</td>
<td>32-bit 10ksps ADC, 157dB DR</td>
</tr>
<tr>
<td>AD5791</td>
<td>1ppm, 20-bit, ±1LSB INL, VOUT DAC</td>
</tr>
<tr>
<td>LTC2758</td>
<td>16-bit Dual I/O, SoftSpan DAC</td>
</tr>
</tbody>
</table>

FEATURED DESIGN NOTE
Low Noise Precision Op Amp Drives High Resolution SAR ADCs
www.linear.com/DN1039

DATA SHEET
www.linear.com/product/LT6018