July/August 2020 Vol.40 No.1
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what's new in electronics

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COVER STORY

Control Devices is the official MEC distributor for Australia. In 1998, MEC became a member of the APEM group of companies. MEC provides high-performance tactile switches and an extensive range of accessories, providing users with countless design combinations and customisation possibilities. The company's research and development team continually focuses on improving look, sound and feel to provide a good user experience with functionality and unique aesthetic design.

MEC's Mimaki flatbed printer uses anti-rust technology and ultraviolet light printing, delivering scratch and chemical resistance and reducing the use of chemical solvents in production. This allows simple high-resolution printing options in multicolour and photo-realistic legends on the user's preferred MEC caps. The print technology enables users to produce eye-catching legends where even the tiniest details are clear.

Additionally, MEC has launched a new set of cap series — 10S/10T/10U/10V. The series come in three different shapes — round, square and triangle — and can be combined into infinite versions to differentiate front panels, providing the flexibility to make a one-of-a-kind and intuitive panel design. The caps are designed with a slightly convex top surface and matte finish to give an appealing look and feel for the end user. Floating caps make the alignment of the PCB and the front panel easier and the back part of the caps has been optimised for use with the Ultramec switches, providing the end user with good tactile feel.

Contact Control Devices for MEC switches today.

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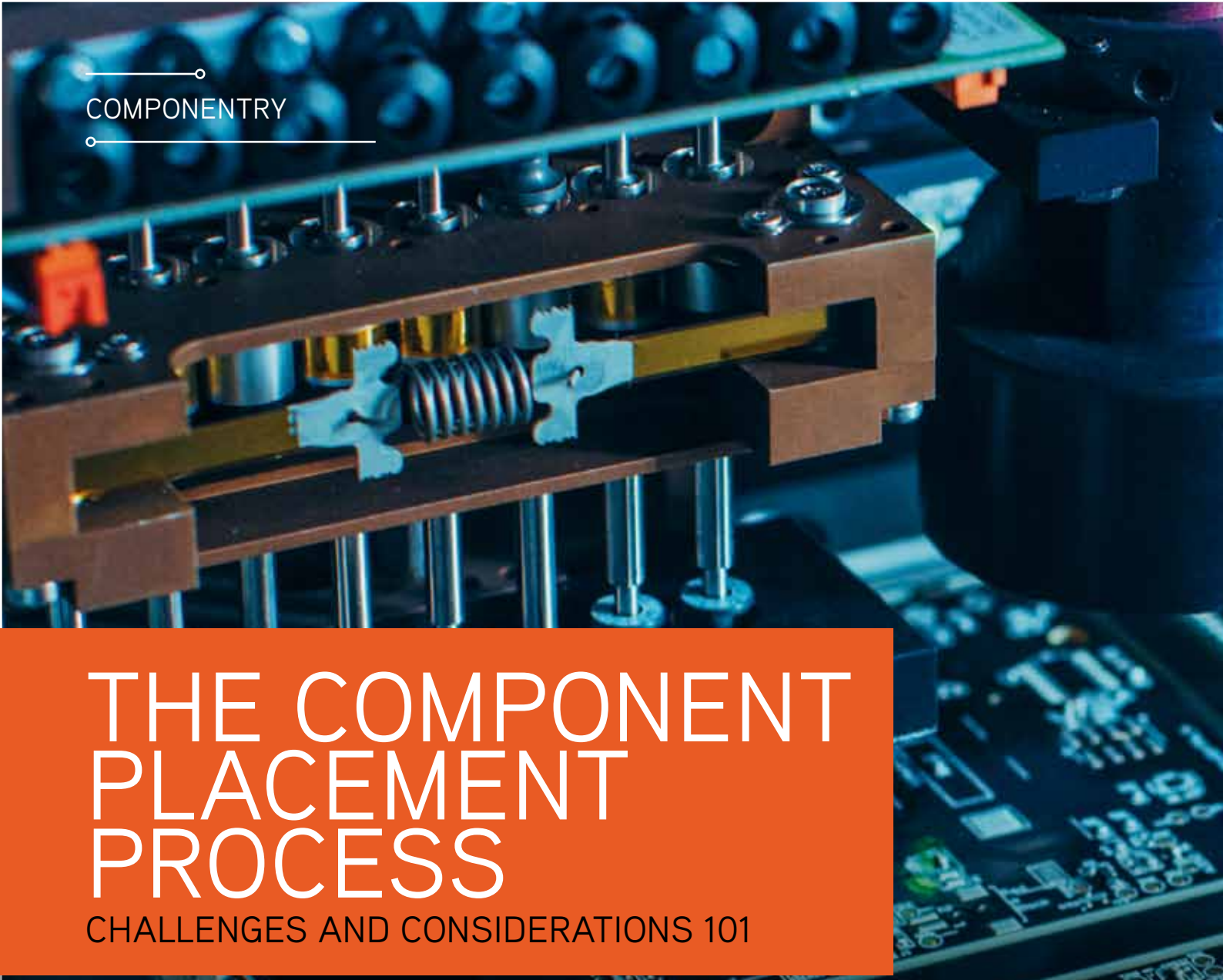


THE COMPONENT PLACEMENT PROCESS

CHALLENGES AND CONSIDERATIONS 101

The mounting process often utilises pick-and-place systems, which is still the most efficient way to mount components onto boards — but as components get smaller, this process becomes a constant battle to ensure the components are mounted accurately.

Focusing on some of the key challenges during the production of the printed circuit board, including the mounting process, we explore how to overcome some of the pain points, as well as potential difficulties that may occur in the future. Utilising this document to implement a proactive approach may help you to minimise some of these potential problems before they occur.

Miniaturisation of holes

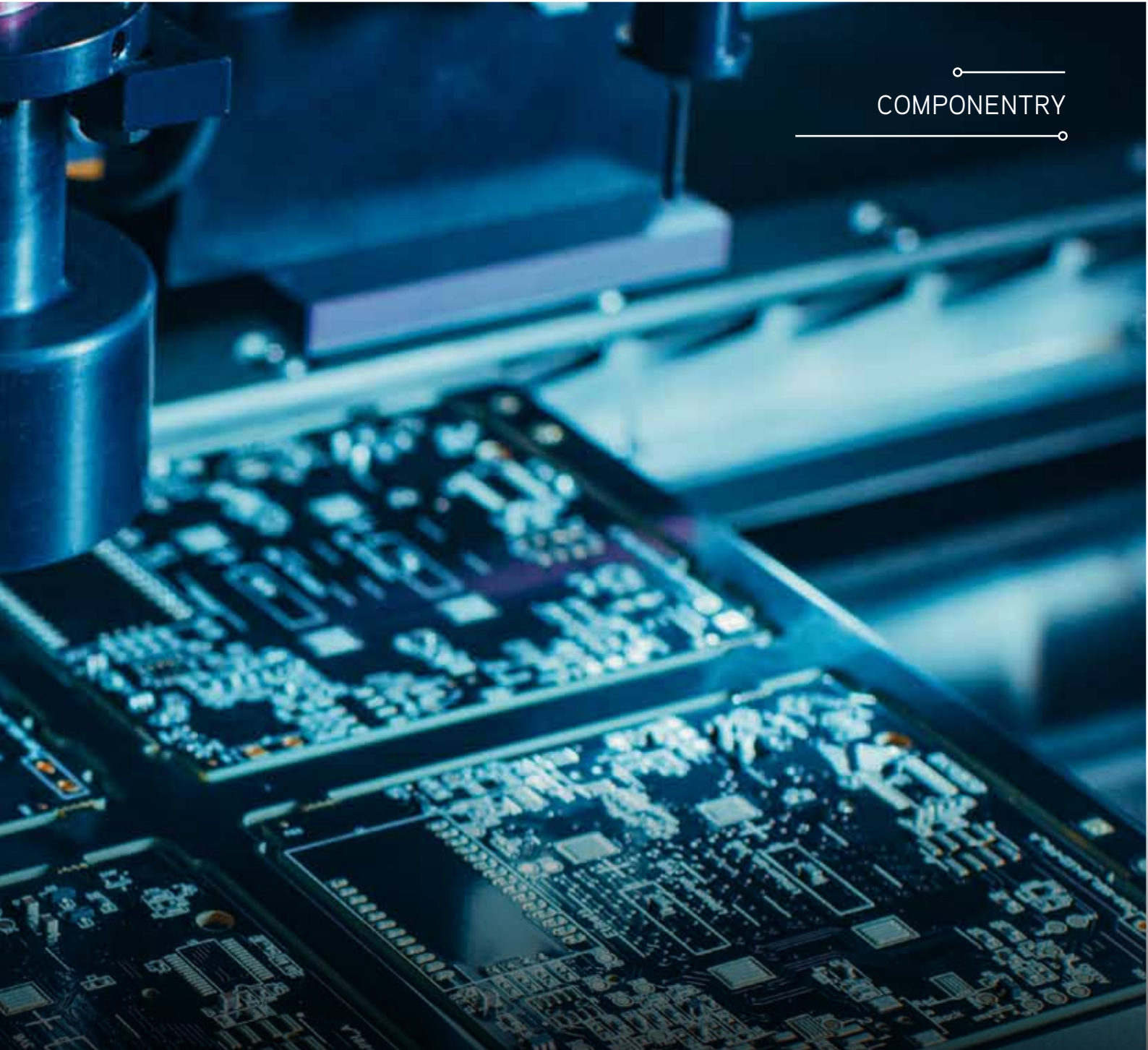
As we discussed in the article 'The screen printing process: challenges and considerations 101', components are constantly decreasing in size, sometimes requiring an aperture size of 0.1 mm. When producing boards requiring apertures of 0.1 mm to accommodate the 0201 chip, it introduces challenges that need to be addressed from the outset such as increasing routine cleaning and inspection.

Cleaning: Needless to say, additional requirement to increase these mandatory processes costs valuable time. To minimise wasted production time, some manufacturers have introduced systems that are designed to provide a quick-release nozzle, using a jig. It can then be replaced with a clean nozzle, while the current part is cleaned in an ultrasonic cleaning system. This process can help to minimise downtime, while ensuring your system is kept clean from debris.

Nozzle health check: Checking the health of the nozzle is critical and this can be categorised into two parts — a visual check and a performance check.

- Visual check — This can prevent a build-up of debris before it occurs. Any debris on the nozzle, particularly at the tip, can impact the recognition of the components and potentially lead to mounting failure. Typically, if you maintain a good clean nozzle, it will ensure you maintain a good recognition rate. A visual check will also ensure the nozzle stays aligned. Any deviation can result in a decrease in pick-up rate, but potentially an increase in mounting failures too.
- Performance check — This includes the vacuum functionality and the spring action of the nozzle. Both of these actions are critical in maintaining good pick-up rate and mounting consistency, as well as accuracy. If there are any inhibiting factors preventing the nozzle from performing its full spring action, it can also lead to component breakage.

However, nozzles that are manufactured from ceramics with bespoke ESD coatings improve the stability and durability of the nozzle. This will also help prevent deformation from premature wear, which could lead to the nozzle sticking.



The ESD coating will also ensure that the movement of the nozzle does not create a build-up of electrostatic discharge.

Performing both visual and performance checks are imperative, especially with 0201 components, which require high-precision throughout. This is especially the case during the pick-up process where the components are micro size.

Maintaining high-precision pick-up

Maintaining high-precision pick-up requires constant evaluation of several factors including pick-up position and height, as well as the vacuum level and the build-up of static charge from the tape.

- Pick-up position — Position of the pick-up needs to be accurate, but there are a few aspects that can cause pick-up to become displaced. These include elements such as the accuracy of the tape alignment, nozzle distortion and feeder plate positioning, as well as the actual alignment of the feeding by the feeder.
- Pick-up height — Clearly this has to be set up correctly at the start of the process, but there are other variables which can affect the accuracy of the pick-up height including the tolerance of the feeder head and the spring action of the nozzle itself.

Any abnormality in the spring action that inhibits a fluid motion can cause issues with the pick-up height.

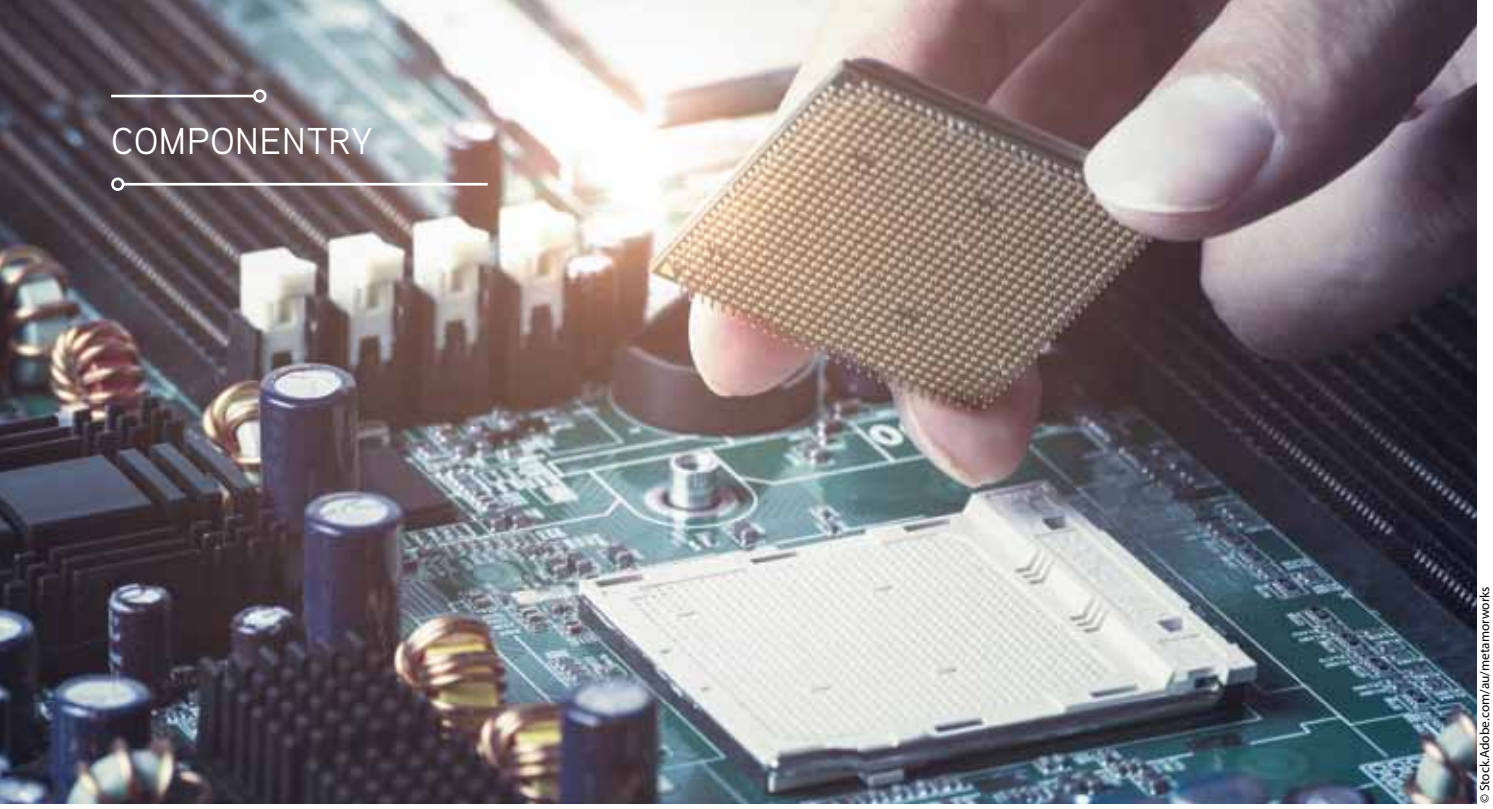
Ensuring accuracy and working out any issues with a process of elimination can become tedious and very time-consuming. Some systems have been developed with functionality that enables engineers to teach the machine to maintain both pick-up height and positioning. This is achieved by 'teaching' the system to pick up at the centre of the nozzle every time, by recognising the image of the nozzle tip. It then automatically corrects any deviation off the centre.

Pick-up height can be taught by measuring the pick-up position and the height of the tape by contact tip with the nozzle. Comparison between the current setting can provide a different value. This can be input back into the system for increased accuracy, simultaneously minimising damage to component parts.

Optimising mounting onto the board

Assuming the pick-up height and the pick-up positioning are set correctly, the focus moves onto ensuring the components are mounted correctly onto the board.

One of the main considerations is mask thickness in relation to the component part size. For example, if you are intending to



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mount 0201 or 03015 components onto the board, you need to ensure you have set the mask thickness to between 40 and 60 µm.

However, as a component's size increases it requires a thicker mask, so if the 0201 components are integrated onto the board with larger components (1005), this will require higher levels of mask thickness to account for the variation in the size of the components.

Another solution is to consider utilising solder paste in chip form. Recognising the increasing complexity of board designs, some suppliers now offer the paste in chip form so it can be placed on or next to the pads, where an increase in the amount of solder is required, ie, for the larger components on mixed boards.

Root cause failure analysis (RCFA)

Unfortunately, even if you ensure best practice has been implemented and you have done everything you can to ensure production of a good-quality PCB, you could still end up experiencing unexpected faults.

Cameras and vacuum sensors can inform you of issues such as tombstoning, or if the components aren't released onto the board, but don't provide any information as to why these issues have occurred.

Utilising a light high-resolution camera with a wide field of view, along with analysis software, could provide rapid analysis feedback, minimising downtime. The software can analyse each image to detect inaccuracies during the pick-and-place steps. However, it is essential that the system is configured accurately and synchronised to firstly capture the image and analyse it at the exact point of picking and placing.

> EVEN IF YOU ENSURE BEST PRACTICE HAS BEEN IMPLEMENTED AND YOU HAVE DONE EVERYTHING YOU CAN TO ENSURE PRODUCTION OF A GOOD-QUALITY PCB, YOU COULD STILL END UP EXPERIENCING UNEXPECTED FAULTS.

Multi-Accuracy Compensation System (MACS)

The MACS system which has been introduced onto some of the Yamaha YS series mounters provides engineers with real-time machine vision. Utilising side-view and upward-looking cameras, the system can identify the centre of the component and, by capturing its position with the centre of the nozzle, it can automatically correct any deviation that occurs in real time.

Utilising the MACS system feature on the Yamaha YS series could reduce positional error from around 30 µm to less than 10.

Checklist

Taking everything above into consideration, we have listed the main considerations below, which can be utilised as a checklist. There is no winning formula, because every aspect from the design (including the mixture of component size) to the cleanliness of the nozzle needs to be considered.

Some factors can be counterbalanced with tools and functions on your equipment, such as the 'teach' mechanism, helping you to achieve the best results.

1. Invest in an ultrasonic cleaner and a spare nozzle to maintain accuracy and efficiency.
2. Conduct both a visual check and a performance check on the nozzle regularly.
3. Invest in a quality nozzle with an ESD coating to prevent sticking and electrostatic discharge.
4. Follow the steps to ensure both the pick-up position and the pick-up height are accurately calculated and maintained.
5. Utilise 'teach' functionality to ensure accuracy and consistency.
6. Investigate solder paste in chip form. This can be utilised by your pick-and-place machine, for boards designed with a range of component sizes.
7. Minimise downtime by installing and configuring analysis software to provide feedback on why a failure has occurred.
8. Consider upgrading your system to one of the Yamaha YS series mounters and benefit from MACS system functionality, reducing positional error to less than 10 µm.

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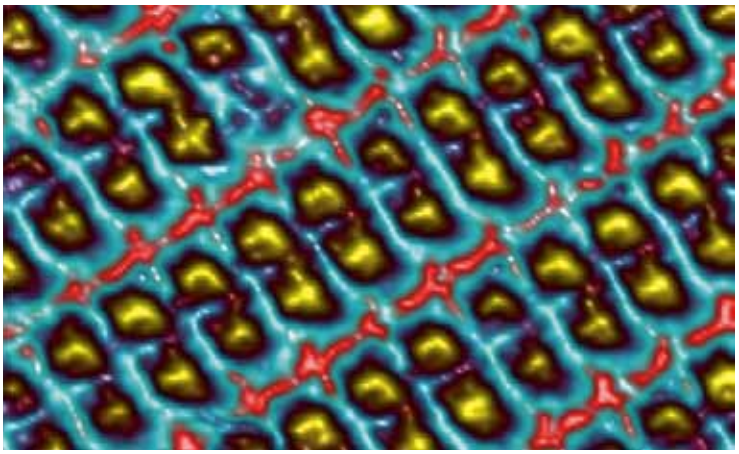
SMART MOLECULES COULD ENABLE COMPUTERS WITH BIGGER MEMORIES

An international team of researchers have discovered a single-molecule 'switch', measuring around 5 nm^2 in size, that can act like a transistor and offers the potential to store binary information — such as the 1s and 0s used in classical computing. Writing in the journal *Angewandte Chemie*, the scientists claim that molecules like this one could offer information density of around 250 terabits per square inch — around 100 times the storage density of current hard drives.



An image of the smart molecular switches as seen with a scanning tunnelling microscope. Every bright square is a single switch.

In the team's study, molecules of an organic salt were switched using a small electrical input to appear either bright or dark, providing binary information. Crucially, this information can be written, read and erased at room temperature and in normal air pressures. These are important characteristics for practical application of the molecules in computing storage devices. Most previous research into molecular electronics for similar applications has been conducted in vacuum and at very low temperatures.

"There is an entire list of properties that a molecule has to possess to be useful as a molecular memory," said lead researcher Dr Stijn Mertens, from Lancaster University. "Apart from being switchable in both directions under ambient conditions, it has to be stable for a long time in the bright and dark state, and also spontaneously form highly ordered layers that are only one molecule thick, in a process called self-assembly. Ours is the first example that combines all these features in the same molecule."

In laboratory experiments, the research team used small electric pulses in a scanning tunnelling microscope to switch individual molecules from bright to dark. They were also able to read and erase the information afterwards, at the press of a button.

During the switching, the electric pulse changes the way the cation and the anion in the organic salt are stacked together, and this stacking causes the molecule to appear either bright or dark. Apart from the switching itself, also the spontaneous ordering of the molecules is crucial: through self-assembly, they find their way into a highly ordered structure (a two-dimensional crystal), without the need for expensive manufacturing tools as is the case in currently used electronics.

Although the researchers do not expect that the particular molecules they discovered will be used in real hard drives, the study is an important proof of concept that brings us closer to the brave new world of true molecular electronics.

"Because chemistry allows us to make molecules with sophisticated functions in enormous numbers and with atomic precision, molecular electronics may have a very bright future," Dr Mertens said.

ELECTRONEX 2020 RESCHEDULED TO NOVEMBER

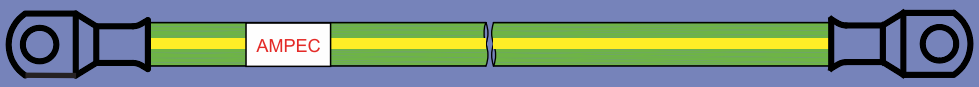
With Electronex – Electronics Design and Assembly Expo set to return to Sydney's Rosehill Hardens Event Centre later this year, organiser Australasian Exhibitions & Events (AEE) has been closely monitoring the COVID-19 situation and industry associations have been working with federal and state governments in relation to the reopening of business events and exhibitions. Indications are that exhibitions will commence again in the final quarter of this year as restrictions are progressively eased.

As a result, a decision has been made to reschedule Electronex from 9–10 September to 10–11 November 2020, to provide sufficient lead time for the event.

While COVID-19 has had a significant impact on the exhibition industry, AEE and the Surface Mount and Circuit Board Association (SMCBA), the latter of which holds the associated conference, are committed to staging Electronex this year. The event is expected to play a significant role in helping companies generate sales and new business as we come out of this crisis, with the federal government also announcing increased support and stimulus for the manufacturing sector in Australia.

Companies interested in securing a stand at this leading electronics event for the manufacturing and service sector should contact Vee Johnson on 0422 399 818 or email vee@auexhibitions.com.au.

Wiring Harness Solutions



Ampec Technologies Pty Ltd

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EMC TECHNOLOGIES NATA ACCREDITED FOR EN 55035/CISPR 35

The EMC Technologies group of laboratories, located in Melbourne and Sydney, have achieved NATA accreditation for EN 55035 and CISPR 35: Electromagnetic compatibility of multimedia equipment – Immunity requirements. This is believed to make the EMC Technologies group the only NATA accredited labs in Australia for this standard.

Although not mandatory, CISPR 35 has been adopted for use in Australia and New Zealand as AS/NZS CISPR 35 and also published as EN 55035. It is a common EMC emissions standard that is applied to a vast range of ITE and multimedia equipment (MME), including gaming machines, office equipment, modems and many Internet of Things (IoT) devices, and a companion to emission standard CISPR 32 (EN 55032): Electromagnetic compatibility of multimedia equipment – Emission requirements. Both are CE marking EMC standards in the European Union, appearing on the list of harmonised EMC standards used to demonstrate conformity with the EMC Directive 2014/30/EU.

The CISPR 35/EN 55035 test standard is intended to replace CISPR 24 and the EN 55024 and AS/NZS CISPR 24 immunity tests. The approach to monitoring the performance of the device while undertaking testing has also undertaken some changes. The older CISPR 24 test standard on which CISPR 35 is based had more personalised key parameters to monitor based on the type of device such as printers and telephone devices, while CISPR 35 focuses on the primary function or functions of the product under test.

While the CISPR 24 tests have not changed significantly in CISPR 35, there are some new additions — such as spot frequency testing for IEC 61000-4-3 radiated immunity tests — that were not previously required for CISPR 24. This means that even if a product has passed testing for CISPR 24/EN 55024 in the past, there is no guarantee that it will pass CISPR 35/EN 55035. Therefore, it would seem prudent to test the MME to EN 55035 for future products or products that have undertaken modifications.

EN 55035 is currently listed on the European Union's Official Journal (OJ) as a means of demonstrating compliance with the CE Marking EMC Directive, hence to demonstrate the conformity of MME with the immunity requirements for CE marking of electrical products. Showing compliance with this harmonised standard fulfils the first step for CE marking a product for European markets.

EMC Technologies already has a comprehensive scope for testing to a range of standards, with the company's NATA scope of accreditation also including EN 55032. The company provides Australian manufacturers with a route to compliance with the standards and regulations for several global markets.


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MAGNETOMETRY TO MEASURE THE STATE OF LITHIUM-ION BATTERIES

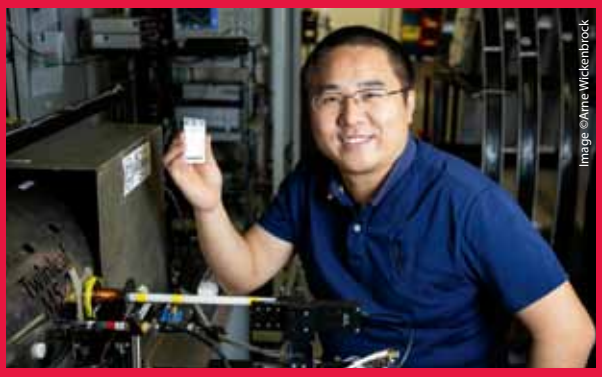
Image © Arne Wickenbrock

Scientists at Germany's Johannes Gutenberg University Mainz (JGU) and Helmholtz-Institute Mainz (HIM) have presented a non-contact method for detecting the state of charge and any defects in lithium-ion batteries, using atomic magnetometers to measure the magnetic field around battery cells. Their work has been published in *Proceedings of the National Academy of Sciences*.

The demand for high-capacity rechargeable batteries is growing, and so is the need for a form of sensitive, accurate diagnostic technology for determining the state of a battery cell. The success of many new developments will depend on whether batteries can be produced that can deliver sufficient capacity and a long, effective life span.

"Undertaking the quality assurance of rechargeable batteries is a significant challenge," said Dr Arne Wickenbrock, a member of Professor Dmitry Budker's work group at JGU and HIM. "Non-contact methods can potentially provide fresh stimulus for improvement in batteries."

Prof Budker's group has now achieved a breakthrough by using atomic magnetometers to take measurements — an idea that came about during a teleconference between Prof Budker and his colleague Professor Alexej Jerschow of New York University. They developed a concept and, with close cooperation between the two groups, carried out the related experiments in Mainz.

"Our technique works in essentially the same way as magnetic resonance imaging, but it is much simpler because we use atomic magnetometers," said Dr Wickenbrock, referring to optically pumped magnetometers that use atoms in gaseous form as probes for a magnetic field. Prof Budker's group uses atomic magnetometers for fundamental research in physics.

In the case of battery measurements, the batteries are placed in a background magnetic field. The batteries alter this background magnetic field and the change is measured using atomic magnetometers.

"The change gives us information about the state of charge of the battery, about how much charge is left in the battery, and about possible damage," said Dr Wickenbrock. "The process is fast and, in our opinion, can be easily integrated into production processes."

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new PRODUCTS

RASPBERRY Pi CAMERA

The Raspberry Pi High Quality Camera comes complete with a 12 MP ultradefinition-resolution camera and interchangeable lenses. It is suitable for professional and consumer applications that require high levels of visual fidelity and integration with specialist optics.

The camera can effectively capture still images and video footage. It is compatible with all models of Raspberry Pi boards from the Raspberry Pi 1 Model B onwards and can be used as a desktop camera. It is useful for applications including machine vision, robotics, industrial and agriculture, as well as home and professional security systems that operate in low ambient light conditions. The camera can be programmed to collect data to support facial and number plate recognition and parking space monitoring.

Professional designers will find the camera and interchangeable lens combinations simple to integrate into monitoring and quality control systems while educators, makers and consumers should enjoy the camera's capability and functionality for Raspberry Pi projects. The camera is designed to extract more information from the lens to create high-quality, content-rich images that could not be achieved by the existing Raspberry Pi Camera Module v2.

The Raspberry Pi High Quality Camera offers a high resolution of 12.3 MP and approximately 50% greater sensitivity than its predecessor for improved low-light performance. It features a circuit board with Sony IMX477 sensor, an FPC cable for connection to a Raspberry Pi computer, a milled aluminium lens mount with integrated tripod mount and focus adjustment ring, and a C- to CS- lens mount adapter. Other lens form factors can be accommodated using third-party lens adapters.

Two interchangeable lenses, a 6 mm wide-angle lens and a 16 mm telephoto lens, can be integrated with the camera's C- and CS-mount form factors. Users will no longer be limited by fixed lens autofocus cameras, as each interchangeable lens improves the camera's core functionality as a result of manual focus options including wide and narrow angles and telephoto zoom to identify objects.

element14
au.element14.com

REMOTE GPS RECEIVER MODULE

ICP DAS's GPS-721U-MRTU, a remote GPS receiver module, is designed to ensure high sensitivity and low power consumption with an ultrasmall form factor and supports the NMEA 0183 GPS protocol. The embedded GPS module is powered by a MediaTek solution and can provide high performance even in an urban environment or an environment that features dense foliage.

In addition to the ability to acquire GPS data, the module includes a single digital output channel and a single PPS (pulse per second) channel that can be used for precise timekeeping and time measurement. PPS functionality can be combined with an additional external time source in order to synchronise signal operations and provides the full date and time for accurate and precise applications.

Consequently, the product can act as a powerful remote GPS module as well as a general-purpose GPS module with an RS-232 interface. It can also be applied to applications related to automotive navigation, personal positioning and navigation, marine navigation, satellite time correction, etc.

ICP DAS now also provides an option that allows NMEA 0183 format GPS data to be converted to Google Maps format. This feature is available for both the DCON and Modbus protocols from firmware version 2.10 or later.

ICP Electronics Australia Pty Ltd
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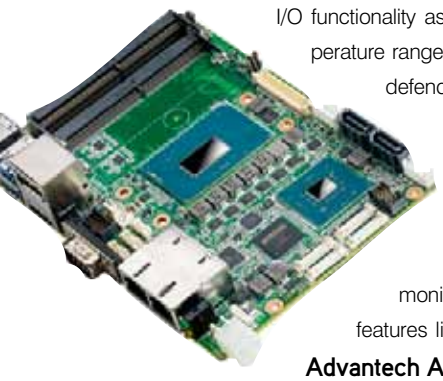
SINGLE-BOARD COMPUTER



The MIO-5393 single-board computer (SBC) is powered by a 9th Gen Intel Xeon/Core. With a compact 3.5″ design, the SBC offers good I/O functionality as well as domain-focused features like CAN bus. The small form-factor design functions in broad operating temperature ranges (-40 to +85°C), making it suitable for diverse applications that require high processing speeds, including military defence micro-servers, AOI machines, passenger information systems and outdoor kiosks.

The new-generation SBC doubles USB speed by utilising USB 3.2 Gen 2 (10 Gbps). With a built-in Gen9LP graphics engine, the MIO-5393 supports three simultaneous displays with 48-bit LVDS, HDMI (up to 4k @ 30 Hz) and DisplayPort (up to 4k @ 60 Hz). It also supports up to 32 GB/64 GB memory size dual-channel DDR4 2400 MHz and features an M.2 M-Key 2280 slot for supporting NVMe/PCIE Gen3x4 high-speed PCIe SSD storage.

The built-in iManager 3.0 integrates power sequence control to improve reliability and enable GPIO, hardware monitoring, smart fan control and watchdog timer functions. Also supported by iManager 3.0 are domain-focused features like high-speed RS-232/422/485 up to 1 Mbps, I^2C (100 kb/400 kb/1 Mb) and CANBus.

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new PRODUCTS

THREE-PHASE BUILT-IN FILTER WITH NEUTRAL LINE

SCHURTER's FMAD CP is a single-stage filter family for three-phase systems with a neutral line. Due to their compact dimensions and high performance, the filters are suited to the tight space conditions in today's machine and equipment construction. Their extended temperature range means they can also be used in critical applications.

The filter family is suitable for devices with high EMC loads at low or medium power. Typical applications include converters for photovoltaics, battery storage or charging stations for electric vehicles. The powerful compact filters are also useful for modern frequency inverters for motor control.

The standard versions can be used over a temperature range of -40 to +100°C. The filters are designed for currents from 3 to 20 A at an ambient temperature of 50°C. They have ENEC and cURus approval and are recommended for applications up to max 520 VAC. Versions with different leakage currents are available for various applications, including industry (≤3 mA), standard (≤0.5 mA) and medical technology (≤5 μA).

Although the filter family is already equipped with high-quality components, an even stronger filter effect may be required for particularly demanding applications. This is where the 'High Performance' version comes into play. Due to compact chokes with particularly high inductance and a larger X capacitor, both symmetrical and asymmetrical interference can be suppressed even more effectively.

The filter series has 6.3 x 0.8 mm plug-in connections for quick and easy wiring. Due to a metal flange, a good earth connection is ensured when screwed to the chassis. The series is a suitable replacement for the SCHURTER FMW4-65, offering the same if not higher performance at lower weight.

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AI IS ONLY AS SMART AS OUR INFLUENCE

*Joseph Zulick**

The old term 'garbage in equals garbage out' is true even in the smartest of systems.

If you incorrectly define data points or describe an outcome as being bad when it was good, then the decision tree that artificial intelligence uses starts to fall apart. It is unfair to claim that AI or sensor tracking failed because it didn't meet our outcome, especially if we supplied the data and the parameters of success.

In a recent 'Destiny of Manufacturing' podcast, Danny Schaeffler, President of Engineering Quality Solutions, discussed that many companies are not ready for artificial intelligence because they are not done mastering the systems and data they have now. He felt that many companies have not reached the potential of their current systems.

Schaeffler went on to question, "Are we prepared to compete in the global market? Technology is pulling the planet closer together and we all have to examine our competitiveness." Are you examining the total cost of ownership? We do not always take into account the price difference when we undertake a new job or task. Have we factored in transport costs — if international, duties and taxes and sometimes tariffs (yes, other countries charge tariffs)? Do we know the implementation costs? All of this information factors into our AI decisions and costs. Our current systems dictate the questions we will be asking for solutions; they are also the data points we will be using to provide those conclusions. In many plants they have stopped using their data collection systems such as tonnage monitors and die protection. This means they lack the historical trends that are used for the AI to draw a conclusion; data is critical to defining a trend and solution.

Is your company doing enough to meet the demands in the workplace? Schaeffler discussed an excellent point that as materials change and new products demand complex materials, it's not just the manufacturing or production departments that need to be educated. The engineers need to research if the equipment is adequate for the new materials. Your AI is all but starting over if you can't directly correlate the old material results and the new material expectations. The purchasing department needs to be looking at new material sources; it's possible the supplier of simple mild steel is not going to be the best source for exotic materials. On the quoting side, if you're pricing yourself too low, all departments will need to be trained on new technology and

materials. The sensors will need new calibration points as these changes occur. The resulting data will need to be compared with old data — and is it useful? Unfortunately, when you take on new materials simulation data may have a standard linear curve of data, but more likely it won't.

Along with the data that needs to be gathered to produce accurate results, we must also temper our expectations. If we think that a first run part with new tools, cutters, nozzles, etc, along with new materials mixed with limited data, will produce accurate initial data, you are setting yourself up for disappointment.

Some of this is due to an extension of the curse of knowledge — once we know how something works, we can't unknow this information. Consequently, we set too high of expectations and create unrealistic timelines. While AI and IoT can make life easier and more accurate, it cannot eliminate launch phase challenges until we can develop baseline data. Our influence over AI can be felt in the computer simulations and in closed-loop feedback where the confidence in the data can be misleading because the system has confidence in its calculation.

Let's take an off-the-floor example. We have a programmable thermostat that turns the heat on when the temperature drops 2°. The data that I monitor is the front doorbell, which trips when the button is pressed. I may assume that the visitor is the cause for the drop in temperature. I have the data which correlates this to be true when in reality it's the door opening and closing, whether there is a visitor or not. You can have a high degree of confidence because you show a correlation, but without adequate analysis of what the data means you may never reach the root cause. You may also have an inadequate number of sensors or be sensing the wrong thing to generate what is needed in order to model this situation.

The old saying is that everything that is measurable isn't important and everything that is important isn't measurable. This is often paraphrased and comes from Einstein's quote of "Not everything that counts can be counted, and not everything that can be counted counts". I'm sure this was after a grad student asked about their grades.

We are the greatest influencer in the accuracy of our results. I don't want to venture into intentionally manipulating data for personal gains, but at a very minimum it has been viewed by systems like Linknet and other data collection systems that the formulas are often edited to produce OEE (overall equipment effectiveness) scores of around 80% when in reality they are more like 60%.

If you obey the true rules of systems OEE, machine availability of 100% starts with a base of 365/24/7. If you choose not to run a third shift, many companies will say they're 85% efficient running two shifts when in reality this would be more like a maximum of 66%.

This is where data gets tricky, and AI is only as good as that we choose to provide. Many people will say efficiency is a rating of how well you do your process, so two shifts offer a maximum of 100%. The difficulty is that you may never go to fill that pipeline for the third shift if you believe you're maxed out at 90% OEE.

This is just one example of how data can get muddy if you allow it to become that way.

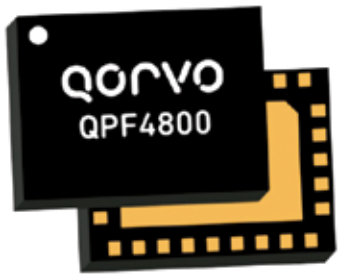
The other problem we have in AI is that when it comes to data, too often we start with the conclusion and work towards proving our point. This becomes a big problem when you are trying to sell the concept of big data to workers and operators and you have a history of using the data not to bring about improvement, but instead to assign blame.

AI can provide predictive analysis based on current data and trend examination. These trends can provide us with that look over the horizon, clear of the forest and the trees. When two roads diverge in the woods, now you can find the path that takes you to the promised land and the one that leads you off the cliff.

If you provide the right balance so people can achieve the ultimate goal of improvement and innovation, you have to set your goal for AI to provide these solutions. It's more difficult than ever to compete in this global economy, and in order to do so we need advancement and breakthroughs that will come from looking at our problems in a new way and allowing AI to provide the path.

**Joseph Zulick is a writer and manager at MRO Electric and Supply, offering Siemens and FANUC factory automation parts used by engineers worldwide.*

MRO Electric and Supply
https://www.mroelectric.com/



WI-FI 6 FRONT-END MODULE

Qorvo's QPF4800 Wi-Fi 6 front-end module (FEM) is designed for Wi-Fi 6 (802.11ax) applications, combining the high performance levels required to transfer HD and 4K video with the efficiency necessary for Internet of Things (IoT) applications. The highly integrated FEM is suitable for a range of Wi-Fi 6 applications, including wireless routers, customer premises equipment, access points, set-top boxes and residential gateways.

The dual-band FEM features 2.4 and 5 GHz power amplifiers; two single-pole, double-throw (SPDT) switches; a regulator; a diplexer; and a low-noise amplifier with bypass. It is designed to support increased users per access point, increased per-user traffic demand, higher-density deployments, increased cellular offloading, and additional power and performance in Wi-Fi 6 applications.

The high-performance FEM provides a transmit gain of over 29 dB and a receive gain of 14 dB, with a 2.6 dB noise figure when operating over a 5 V supply. Additionally, it provides the required density, capacity and thermal performance for 4x4 MIMO operation.

Mouser Electronics
au.mouser.com

SOCIAL DISTANCING REFERENCE DESIGN

STMicroelectronics has announced a compact reference design that is suitable for monitoring social distancing, assuring remote operation and provisioning, as well as warning, anti-tampering and potentially providing contact tracing to protect human health in all environments, including in response to global or local pandemic conditions.

Leveraging Bluetooth Low Energy technology through its incorporation of ST's ultralow-power BlueNRG-2 system-on-chip with tunable RF output power, the BlueNRG-Tile reference design measures the signal strength of nearby Bluetooth non-connecting beacons and, in real time, calculates proximity to these sources. The circuit can be provisioned and then operate, issuing warnings when another beacon intrudes on an adjustable perimeter or when tampered with — even when not connected to a smartphone or 5G network.

The base reference design can be supplemented with ST's S2-LP sub-GHz ultralow-power RF transceiver to add bidirectional tag-to-cloud communication through the Sigfox 0G Global Network, allowing private and anonymous tag provisioning, notifications and an advisory return-channel for emergency warnings. To assure power economy and extend battery lifetime, the ultralow power components are further enhanced with a MEMS accelerometer that power cycles the unit when it isn't moving. Optionally, internal or external memory could provide long-term storage of nearby beacons, allowing contact tracing.

The reference design has value in any environment where people need to work safely. It can be used as is or enhanced for a wide range of applications, including as bracelets and bands or as plug-ins or add-ons to eyeglasses, helmets, and masks and shields.

STMicroelectronics Pty Ltd
www.st.com

IP68 SURFACE MOUNTING ENCLOSURES

The 1555F range from Hammond Electronics is a family of rugged IP68 sealed enclosures designed for surface mounting PCB-based or DIN rail-based equipment such as security components, control equipment and radio repeaters for installation in harsh industrial environments or outdoor applications. Available in RAL 7035 light grey, and moulded in either general-purpose UL94 HB ABS for internal use or flameproof UL94 5 VA @ 3 mm polycarbonate for exterior installation, the units have a number of innovative features that provide good functionality.

In use, the lid is secured to the wall or other surface using the slots moulded into the integral flanges. The screws securing the lid to the base are then inaccessible as they are against the surface, giving security against unauthorised tampering. For maximum security, the units can be attached to the wall with tamper-resistant screws. Standoffs are moulded into both the lid and the base and, apart from in the two smallest sizes, DIN rail mounting tabs are also provided. The bottom of the base features a moulded recess for a membrane keyboard or label.

The 15 sizes range from 65 x 65 x 42 mm to 180 x 119 x 62 mm; all lids are fitted with captive M4 stainless steel fixings, allowing repetitive assembly and disassembly. Environmental sealing is achieved through a tongue and groove design and a moulded silicon rubber gasket; all fixings are outside the gasket seal. Units can be supplied factory modified with machining and silk screening to the user's specification.

Hammond Electronics Pty Ltd
www.hammondmfg.com

COMTEST LABORATORIES PTY LTD AND TÜV SÜD: A NEW PARTNERSHIP

Recently Comtest Laboratories Pty Ltd, based in South Melbourne, Australia, and TÜV SÜD China signed an agreement strengthening cooperation within the fields of testing, inspection & products certification. The TÜV SÜD & Comtest Laboratories collaboration streamlines these processes.

German giant TÜV SÜD, with its collection of more than 1000 laboratories worldwide, offers Australian, New Zealand and international clients a seamless customer experience, no matter which country or region the products are intended for.

Expanding your product sales overseas can be time-consuming and legally confusing. In each region of the world, compliance standards constantly change, certification can be a lengthy and costly process unless you know the correct path to follow.

For South Melbourne firm Comtest Laboratories, the partnership means any client can have their product tested or assessed to Australian standards or be tested by one of TÜV SÜD's laboratories for almost any standard in the world.

Services that can be accessed include, but are not limited to: testing, inspection, auditing and certification for electrical and electronics, telecommunications, hardline and soft-line products.

Comtest Laboratories is an accredited NATA laboratory. The National Association of Testing Authorities (NATA) provides accreditations to laboratories that meet high standards of testing, which allow greater confidence that products have been tested accurately.

Comtest LABORATORIES
Compliance • Testing • Calibration

Comtest Laboratories Pty Ltd
www.comtest.com.au

DIGITAL STORAGE OSCILLOSCOPE

Tektronix has released the entry-level TBS2000B digital storage oscilloscope, offering high performance and advanced debugging. Electronics designers, test engineers and educators should benefit from its easy-to-use controls, automated measurements and large display.

The TBS2000B is a complete drop-in replacement for TBS2000 series oscilloscopes, with the same form factor and programmable interface but now including cutting-edge technology, including intuitive control via the 9″ display and automated measurements to increase productivity and speed up design and test processes. It is suitable for a range of applications, including IoT, automotive, defence, power and education.

The WVGA display features a 5-million-point record length and 2 GS/s sample rate. This should enable users to capture and display more of a signal, speeding up debug and design validation. The device also features 32 automated measurements and on-waveform cursor readouts with search and mark features that enable easy identification of events that occur in the acquired waveform.

TekVPI, Tektronix's probe support interface, enables wide application coverage using the latest active differential and current probes with automatic scaling and units. The product also supports traditional passive BNC probes and has a range of connectivity options, including Wi-Fi support (via USB Wi-Fi dongle), two USB host ports and 100-BaseT Ethernet for easy sharing of measurements and collaboration.

element14
au.element14.com

SENSOR SOLUTION FOR INDOOR MONITORING

Pimoroni's PIM486 Enviro for the Raspberry Pi board provides a comprehensive sensor solution for indoor monitoring, offering measurement of pressure, temperature, humidity, noise level and light. The fully assembled board enables engineers to push collected data to an external server, allowing remote access from any location.

The product incorporates a Bosch BME280 humidity and pressure sensor. Designed for mobile applications prioritising low power consumption and small form factor, the BME280 sensor offers a high-linearity tool for measuring humidity, pressure and temperature. The sensor features rapid response times, supporting performance requirements for context awareness applications.

The product also includes a Lite-On LTR-559ALS-01 optical sensor — an integrated I²C digital light and proximity sensor with a built-in emitter — as well as a Knowles SPH0645LM4H-B MEMS microphone. Shipping with a Python library, the compact 65 x 30 x 8.5 mm module is suitable for use with the Raspberry Pi Zero and compatible with all 40-pin Raspberry Pi models.

Mouser Electronics
au.mouser.com

FANLESS DIGITAL SIGNAGE SYSTEM

iEi's IDS-310-AL series is a fanless embedded system featuring an Intel Celeron N3350E or J3455E SoC. It is preinstalled with 4 GB of DDR3L SO-DIMM and can accommodate up to 8 GB of DDR3L memory. Storage in the system is supported by the full-size PCIe Mini card slot for mSATA module or the SATA 6 Gbps connector for SATA DOM.

The ultracompact digital signage system includes three HDMI outputs supporting up to 3840 x 2160 resolution. Other slots and connectors include one RS-232/422/485, two GbE ports, three USB 3.2 Gen 1 (5 Gbps) ports, audio (line-out and mic-in) and one M.2 A-key 2230 slot for an optional Wi-Fi module.

ICP Electronics Australia Pty Ltd
www.icp-australia.com.au

TIME-OF-FLIGHT SENSOR

STMicroelectronics has extended the capabilities of its FlightSense time-of-flight (ToF) ranging sensors by introducing the VL53L3CX with patented histogram algorithms that allow measuring distances to multiple objects.

The VL53L3CX measures object ranges from 2.5 cm to 3 m, unaffected by the target colour or reflectance — unlike conventional infrared sensors. This allows designers to introduce powerful features to their products, such as enabling occupancy detectors to provide error-free sensing by ignoring unwanted background or foreground objects, or reporting the exact distances to multiple targets within the sensor's field of view.

The ST patented histogram algorithms increase cover-glass crosstalk immunity and allow real-time smudge compensation preventing external contamination from adversely affecting the ranging accuracy of, for example, vacuum cleaners or equipment that may be used in a dusty industrial environment. Ranging under ambient lighting is also improved.

In addition, the VL53L3CX has good linearity that increases short-distance measurement accuracy enhancing wall tracking, faster cliff detection and obstacle avoidance in equipment such as service robots and vacuum cleaners. It features a compact, all-in-one package design that eases integration in customer devices, as well as low power consumption that helps extend battery runtime.

ToF sensing brings high performance to a wide variety of applications, including occupancy detection in building-automation and lighting controllers, proximity sensing in IoT endpoints, auto-wakeup in portable devices and user detection in automatic sanitary equipment. With their fast response times, ToF sensors also enhance the performance of devices requiring precise movement control, typically robotics and indoor drones.

STMicroelectronics Pty Ltd
www.st.com

WORLD'S FASTEST INTERNET SPEED RECORDED,

RESEARCHERS CLAIM

Australian researchers have successfully tested and recorded what is claimed to be the world's fastest internet data speed from a single optical chip — capable of downloading 1000 high-definition movies in a split second.

The research team from Monash, Swinburne and RMIT universities were able to achieve a data speed of 44.2 Tbps from a single light source. Described in the journal *Nature Communications*, this technology has the capacity to support the high-speed internet connections of 1.8 million households in Melbourne at the same time, and billions across the world during peak periods.

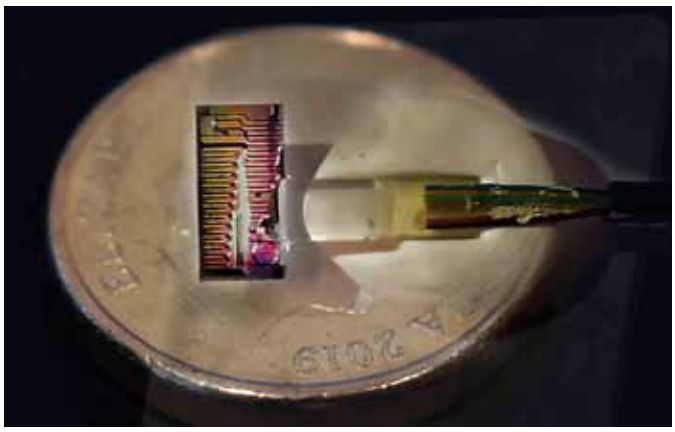
Demonstrations of this magnitude are usually confined to a laboratory. But for this study, researchers achieved these quick speeds using existing communications infrastructure where they were able to efficiently load-test the network.

They used a new device that replaces 80 lasers with one single piece of equipment known as a micro-comb, which is smaller and lighter than existing telecommunications hardware. It was planted into and load-tested using existing infrastructure, which mirrors that used by the nbn. It is said to be the first time any micro-comb has been used in a field trial and possesses the highest amount of data produced from a single optical chip.

"We're currently getting a sneak-peak of how the infrastructure for the internet will hold up in two to three years' time, due to the unprecedented number of people using the internet for remote work, socialising and streaming. It's really showing us that we need to be able to scale the capacity of our internet connections," said Dr Bill Corcoran, co-lead author of the study from Monash University.

"What our research demonstrates is the ability for fibres that we already have in the ground, thanks to the nbn project, to be the backbone of communications networks now and in the future. We've developed something that is scalable to meet future needs.

"And it's not just Netflix we're talking about here — it's the broader scale of what we use our communication networks for. This data can be used for self-driving cars and future transportation and it can help the medicine, education, finance and e-commerce



industries, as well as enable us to read with our grandchildren from kilometres away."

To illustrate the impact optical micro-combs have on optimising communication systems, researchers installed 76.6 km of 'dark' optical fibres between RMIT's Melbourne City Campus and Monash University's Clayton Campus. The optical fibres were provided by Australia's Academic Research Network (AARNet).

Within these fibres, researchers placed the micro-comb — contributed by Swinburne University, as part of a broad international collaboration — which acts like a rainbow made up of hundreds of high-quality infrared lasers from a single chip. Each 'laser' has the capacity to be used as a separate communications channel. Researchers were able to send maximum data down each channel, simulating peak internet usage, across 4 THz of bandwidth.

RMIT's Distinguished Professor Arnan Mitchell, co-leader of the research team, said reaching the optimum data speed of 44.2 Tbps showed the potential of existing Australian infrastructure. The future ambition of the project is to scale up the current transmitters from hundreds of gigabytes per second towards tens of terabytes per second without increasing size, weight or cost.

"Long term, we hope to create integrated photonic chips that could enable this sort of data rate to be achieved across existing optical fibre links with minimal cost," Distinguished Professor Mitchell said.

"Initially, these would be attractive for ultrahigh-speed communications between data centres. However, we could imagine this technology becoming sufficiently low cost and compact that it could be deployed for commercial use by the general public in cities across the world."

Research co-leader Professor David Moss, Director of the Optical Sciences Centre at Swinburne, added, "In the 10 years since I co-invented micro-comb chips, they have become an enormously important field of research.

"It is truly exciting to see their capability in ultrahigh-bandwidth fibre-optic telecommunications coming to fruition. This work represents a world record for bandwidth down a single optical fibre from a single chip source, and represents an enormous breakthrough for part of the network which does the heaviest lifting. Micro-combs offer enormous promise for us to meet the world's insatiable demand for bandwidth."

new PRODUCTS

INTEGRATED SPEED CONTROLLER FOR FLAT MOTORS

FAULHABER's BXT motor family, consisting of brushless DC servomotors with especially short design, has been expanded in all sizes with a diameter-compliant, integrated Speed Controller.

With an additional attachment length of just 6.2 mm, the motor/speed controller combinations are available with the same installation space as the products with the IEF3-4096 (L) integrated encoder. Through the use of synergy effects with the encoder variants, the speed controller is likewise fully integrated in the robust motor housing.

Based on FAULHABER's SC technology, the motors can be put into operation quickly, easily and comfortably with the familiar Motion Manager (from version 6.6). The speed controller is connected to the application with a six-pole flat cable; suitable connectors are available as an option.

The controller can be combined with the 2214…BXT H, 3216…BXT H and 4221…BXT H housed BXT motors. Even with full integration, the robust device is designed to ensure the use of nearly the entire power and speed range of the corresponding base motors. A well-designed cooling concept minimises thermal losses here.

The combination of the BXT H motors with the integrated speed controller is a suitable solution if speeds need to be controlled precisely in small spaces and high torques are also required. Typical applications are pumps, handheld devices (eg, for the tattoo industry), equipment manufacturing, and laboratory and industrial automation.

Advantages include: compact design through complete integration; high torque up to 92 mNm with continuous output up to 60 W; stable and precise mechanical speed control from 200–10,000 min^{-1}; and a second shaft end optionally available in sizes 32 and 42 mm.

ERNTEC Pty Ltd
www.erntec.net

RIBBON FUSION SPLICER

The Fitel S123M12 Ribbon Fusion Splicer is a compact, handheld device available for all METRO/ FTTX/ LAN fibres, backbone or long-haul installations. It is available to rent from TechRentals.

Its lightweight, durable metal body frame and rubber-protected corners enable usage in challenging locations, all while maintaining splicer performance. Single- to 12-ribbon fibre splicing can be achieved with this machine and it also offers a splice-on-connector (SOC) solution.

Up to 160 cycles of splicing and heating can be performed using the large-capacity dual-battery configuration, making field use faster and more consistently accessible. Its fixed V-groove allows simple operation while also being compatible with Seikoh Giken and Diamond SOCs. The tool-less electrode replacement/ mirror-free alignment system allows for easy maintenance and software upgrades via the internet.

TechRentals
www.techrentals.com.au

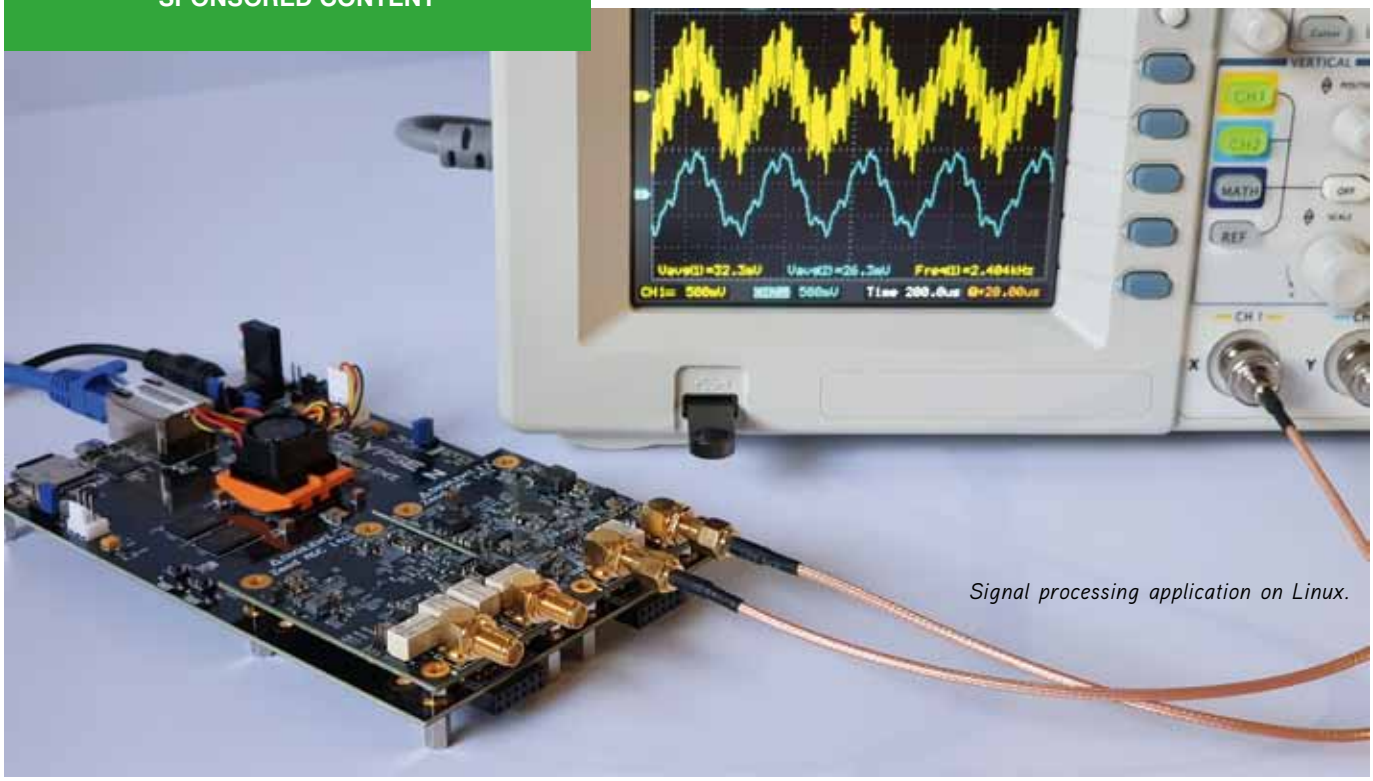
SMARC 2.1 MODULE

Advantech's ROM-5620 SMARC 2.1 module features an ultralow-power consumption design and extended operating temperature of -40 to 85°C, suitable for automation equipment and HMI devices. It is powered by NXP's i.MX 8X SoC, with a two- to four-core energy-efficient Cortex-A35 processor for mid-range automation and industrial market segments, one Cortex-M4F core for real-time processing and one Tensilica Hi-Fi 4 DSP for efficient audio and voice codec execution.

The ROM-5620 leverages high-bandwidth 2 GB LPDDR4 memory, 16 GB eMMC and dual GbE LAN controllers. It provides a flexible display solution for 1 x dual channel LVDS or 2 x 4-lane MIPI-DSI through software configuration. I/O expansion choices include USB3.0, 2 x USB2.0, PCIe3.0, SDIO and 3 x UARTs for wireless module connectivity. These expansion choices, together with 1 x 4-Lane MIPI-CSI2, 4 x I2C, 2 x SPI, 2 x CAN bus and 12 x GPIO interfaces, cover all essential requirements for automated control and ruggedised application.

The product also comes with Advantech's WISE-DeviceOn for securely automated device onboarding, remote device monitoring and software over-the-air updates.

Advantech Australia Pty Ltd
www.advantech.net.au



Signal processing application on Linux.

DIGILENT INTRODUCES FPGA-BASED SIGNAL PROCESSING SYSTEM

As more RF communications, test, software-defined radio (SDR) and other similar applications press the technology further, Digilent, an NI company, has been hard at work to not only keep up the pace but also explore ways to influence the direction of this evolution.

These trending applications employ high-speed analog inputs and/or outputs where real-time signal processing is required, driving the need for higher precision and higher speed solutions. Digilent's latest Eclypse Z7 Ecosystem is ideal for high-speed instrumentation, control and measurement systems for edge-computing, medical and communications applications.

The Eclypse Z7 ecosystem, available from Excelpoint, includes the Eclypse Z7 Xilinx Zynq SoC Platform, Zmod ADC 1410 and Zmod DAC 1411. Zmods products are SYZYGY compliant expansion modules, a high-speed I/O expansion standard for FPGA boards intended to fit between the Pmod standard and FMC. The SYZYGY standard offers a much higher speed/bandwidth digital interface than Pmod but at a much smaller and lower-cost form-factor than FMC, enabling the user to configure a FPGA development board with the right I/O for their application.

The Eclypse Z7 Ecosystem.

The Zmod ADC 1410 is equipped with Analog Devices' AD9648, the dual-channel, high-speed, low-power, 14-bit, 105 MS/s analog-to-digital converter (ADC). Driven by the SYZYGY carrier, the Zmod ADC can acquire two simultaneous signals (1 MΩ, ±25 V, single-ended, 14-bit, 100 MS/s, 70 MHz+ bandwidth). Analog inputs can be connected to a circuit using SMA cables.

The Zmod DAC 1411 is equipped with Analog Devices' AD9717, the dual-channel, high-speed, low-power, 14-bit, 125 MS/s digital-to-analog converter (DAC). Driven by the SYZYGY carrier, the Zmod DAC can generate two simultaneous signals (50Ω, ±5 V, single-ended, 14-bit, 100 MS/s, 40 MHz+ bandwidth). The analog outputs can be connected to a circuit using SMA cables.

Design the signal processing application on Linux

With the Eclypse Z7 system, engineers and developers can experiment with different signal processing techniques. Digilent provides an example project which showcases the implementation of a Zynq-based 32-order finite impulse response (FIR) filter design on Linux. The 32-order FIR filter, clock-enabled generator and a signal generator are implemented in the programmable logic of the Xilinx Zynq 7000 SoC. A Linux OS is run on the processing system. Quantification of the coefficients, a Hanning window, can be computed in C. The details are available at the Digilent Project Page.

Digilent Inc
www.digilent.com

DIGILENT
A National Instruments Company

what's next

Wireless charging enabled for robot fleets

As robotic fleets reshape logistic, delivery and inspection industries, the demand for more efficient and flexible charging solutions is increasing while the feasibility for these fleets to be managed manually and recharged ad hoc by a 24/7 rotation of personnel is decreasing. The next step is towards enhanced autonomy, whereby normal operations can be sustained without human intervention. This is where WiBotic comes in.

WiBotic provides wireless charging and power optimisation solutions that are integral to charging the rapidly growing ecosystem of aerial, mobile, marine and industrial robots. A range of solutions enable robots and unmanned vehicles (UVs) to be recharged through wireless charging stations, eliminating the need for human operators to physically connect the robots to chargers. In addition, wireless charging technology reduces wear and tear on physical connection points, trip hazards from power cords and floor-mounted charging stations, and the space requirement for dedicated charging rooms.

WiBotic wireless charging solutions are designed to facilitate many-to-many operation, whereby multiple robots (including from different manufacturers) can charge from the same transmitter at different times. Alternatively, an entire fleet of robots can move between a network of transmitters in different locations within a warehouse. In short, any robot can charge from any station, even if the robots have different battery chemistries, voltages and charging current.

Such wireless charging innovation has been made possible with the Vicor 48 V VI Chip PRM Regulator — a 400 W high-efficiency converter that operates from a 36–75 V input to generate a regulated output. The device powers the adaptive matching transmitter onboard the WiBotic TR-110 wireless charging station, which feeds power wirelessly to the robot's or UV's onboard receiver. The PRM accepts 48 V from an AC/DC power supply and the output voltage is adaptively controlled and trimmed from approximately 20–55 V.

The Vicor PRM enables consistent, high-efficiency conversion across the full range of impedances, flexibly supporting 'full charge' and 'trickle charge' modes with no significant drop-off in efficiency at lower power levels — a critical performance benchmark that competing power components failed to achieve, the company claims. This high-efficiency conversion capability yields a tightly consistent, maximum device temperature of 40–45°C, helping to neutralise thermal management constraints across the full power range.

WiBotic delivers a dynamic charging solution that is designed to enable the next generation of autonomy, freeing robotic devices from the confines of manually managed charging processes and helping them achieve new levels of functionality and productivity — with no power constraints to hold them back.

Vicor Corporation
www.vicorpower.com

FULLY RUGGED LAPTOP

Getac has revealed its B360 fully rugged laptop, engineered for 5G and featuring good computing speed and brightness. This results in a mobile solution that is designed to excel in challenging working conditions in industries such as public safety, manufacturing, utilities and defence.

The product runs on the 10th Generation Intel Core Processor, making it capable of running large numbers of applications simultaneously without any impact on performance, and the display is 1400 nits Full HD. An IP66 rating means it is completely protected from dust ingress, as well as high-pressure water jets and spillages. The device can also withstand drops of up to 1.8 m when in operation, while the latest MIL-STD 810H certification gives users confidence in its ruggedness.

At just 34.9 mm thick and weighing 2.32 kg, the B360 can be carried and operated for extensive periods of time without causing user fatigue. Despite such a compact form factor, it features an expansive 13.3″ LumiBond 2.0 display for usability in all situations and weather conditions. The latest 802.11ax Wi-Fi delivers wireless speeds up to three times faster than previous generations. Dual hot-swappable batteries ensure full-shift functionality between charges, while optional GPS makes mapping, surveying and tracking in the field quick and easy. An optional barcode reader also makes intelligence gathering at the scene of an incident fast and convenient.

The B360 Pro, optimised for the defence sector, includes all the core technology specifications of the B360 along with a number of additional features and build options that are vital for military personnel. High-capacity hot-swappable batteries deliver even more operating time between charges, while additional serial ports allow legacy and/or customised military equipment to be connected directly to the device. Users also have the option to spec a PCMCIA, ExpressCard or a discrete graphics card, as well as a DVD or Blu-ray drive as required.

Getac Technology Corp
www.getac.com/apac/

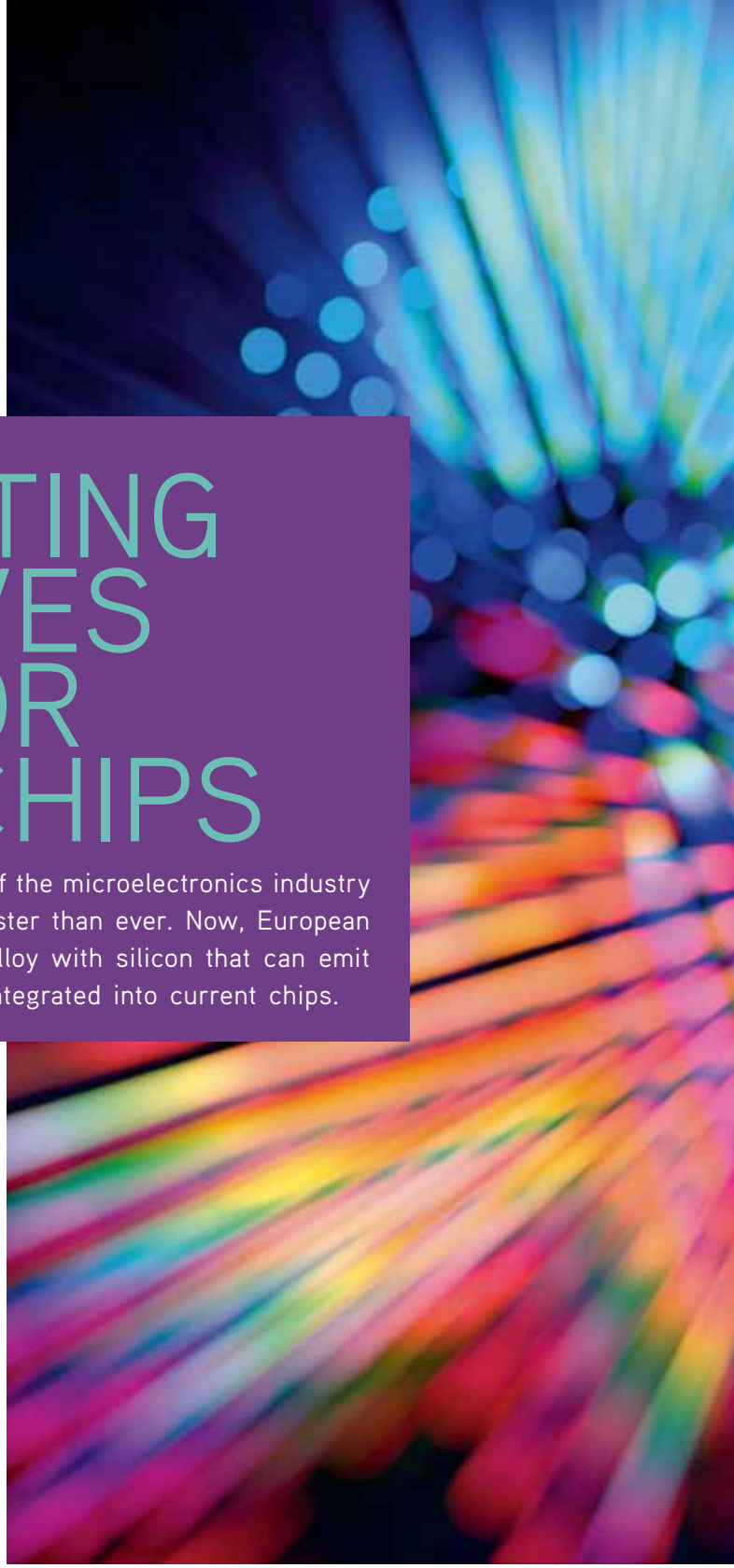
FRAME GRABBER

Matrox Imaging has announced the Matrox Rapixo CL Pro frame grabber, with support for high-performance Camera Link cameras. Each Pro board delivers onboard image processing offload to FPGA devices, high frame-rate image capture, support for extended cable lengths and good image acquisition.

The product makes use of an FPGA device from the Xilinx Kintex-7 family, directly integrating control, format and stream logic onto the frame grabber itself. Paired with the Matrox FDK, a powerful development kit, the Pro models support development of custom FPGA configurations to relieve the host system of intensive image-processing functions.

An enhanced iteration of the Matrox Radient eV series of Camera Link boards, the frame grabber capably handles image capture from an extensive range of devices, from a single low data-rate Camera Link device to multiple maximum-bandwidth Camera Link cameras. Users can interface with up to four Base or two Full/80-bit mode Camera Link cameras at up to 85 MHz on a single board. With integrated Power-over-Camera Link (PoCL) and extended cable lengths support, the Pro boards are designed to simplify cabling requirements.

Dindima Group Pty Ltd
www.dindima.com



LIGHT-EMITTING SILICON PAVES THE WAY FOR PHOTONIC CHIPS

Emitting light from silicon has been the 'Holy Grail' of the microelectronics industry for decades, as it would enable chips to become faster than ever. Now, European researchers have reported the development of an alloy with silicon that can emit light, and will begin work on a silicon laser to be integrated into current chips.

Every year we use and produce significantly more data — but current technology, based on electronic chips, is reaching its ceiling. The limiting factor is heat, resulting from the resistance that the electrons experience when travelling through the copper lines connecting the many transistors on a chip. If we want to continue transferring more and more data every year, we need a new technique that does not produce heat. Enter photonics, which uses photons (light particles) to transfer data.

In contrast to electrons, photons do not experience resistance. As they have no mass or charge, they will scatter less within the material they travel through, and therefore no heat is produced. The energy consumption will therefore be reduced. Moreover, by replacing electrical communication within a chip by optical communication, the speed of on-chip and chip-to-chip communication can be increased by a factor of 1000. Data centres would benefit most, with faster data transfer and less energy usage for their cooling system. But these photonic chips will also bring new applications within reach — think of laser-based radar for self-driving cars and chemical sensors for medical diagnosis or for measuring air and food quality.

Dropping electron emits a photon

To use light in chips, you will need a light source; an integrated laser. The main semiconductor material that computer chips are made of is silicon. But bulk silicon is extremely inefficient at emitting light, and so was long thought to play no role in photonics. Thus, scientists turned to more complex semiconductors, such as gallium arsenide and indium phosphide. These are good at emitting light but are more expensive than silicon and are hard to integrate into existing silicon microchips.

To create a silicon-compatible laser, scientists needed to produce a form of silicon that can emit light. That's exactly what researchers from Eindhoven University of Technology (TU/e) have done. Together with researchers from the Universities of Jena, Linz and Munich, they combined silicon and germanium in a hexagonal structure that is able to emit light — a breakthrough 50 years in the making, now published in the journal *Nature*.

Hexagonal structure

"The crux is in the nature of the so-called band gap of a semiconductor," said lead researcher Erik Bakkers from TU/e. "If an electron 'drops' from the conduction band to the valence band, a semiconductor emits a photon: light."

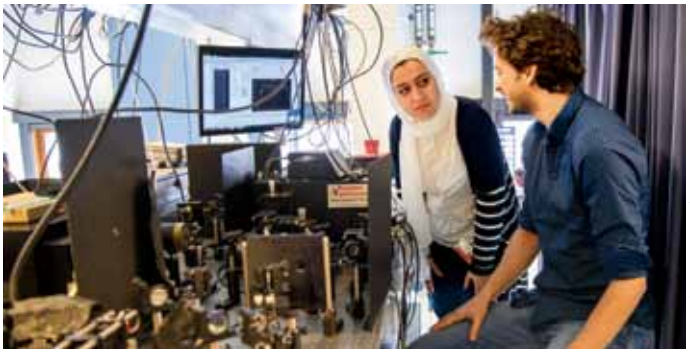


Image credit: Sicco van Grieken, SURF.

Co-first authors Elham Fadaly and Alain Dijkstra operating an optical set-up to measure the light that is emitted.

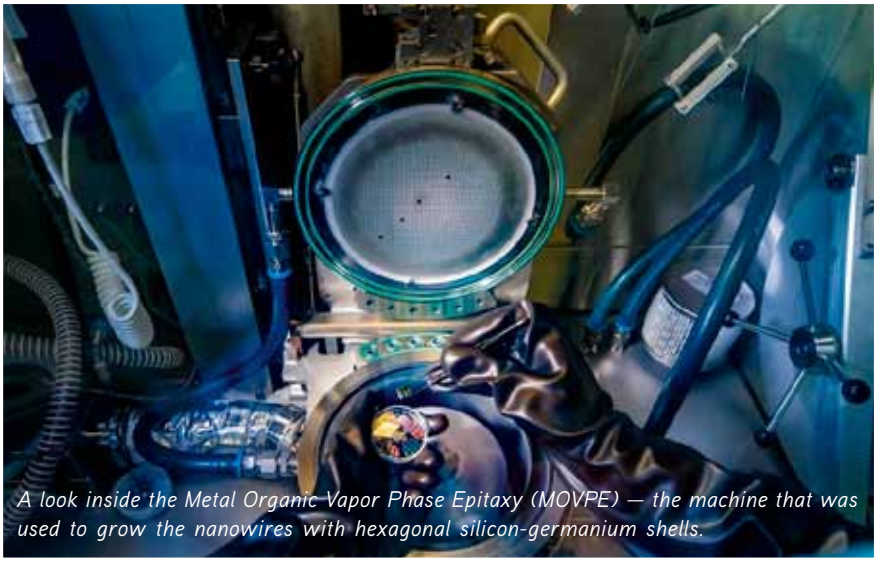


Image credit: Nando Harmsen, TU/e.

A look inside the Metal Organic Vapor Phase Epitaxy (MOVPE) — the machine that was used to grow the nanowires with hexagonal silicon-germanium shells.

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But if the conduction band and valence band are displaced with respect to each other, which is called an indirect band gap, no photons can be emitted — as is the case in silicon. "A 50-year-old theory showed however that silicon, alloyed with germanium, shaped in a hexagonal structure does have a direct band gap, and therefore potentially could emit light," Bakkers said.

Shaping silicon in a hexagonal structure, however, is not easy. As Bakkers and his team master the technique of growing nanowires, they were able to create hexagonal silicon in 2015. They realised pure hexagonal silicon by first growing nanowires made from another material, with a hexagonal crystal structure. Then they grew a silicon-germanium shell on this template. Elham Fadaly, co-first author of the study, said, "We were able to do this such that the silicon atoms are built on the hexagonal template, and by this forced the silicon atoms to grow in the hexagonal structure."

But they could not yet make these devices emit light, until now.

Silicon laser

Bakkers' team managed to increase the quality of the hexagonal silicon-germanium shells by reducing the number of impurities and crystal defects. When exciting the nanowire with a laser, they could measure the efficiency of the new material. Co-first author Alain Dijkstra, responsible for measuring the light emission, said, "Our experiments showed that the material has the right structure and that it is free of defects. It emits light very efficiently."

Creating a laser is now a matter of time, Bakkers claimed. "By now we have realised optical properties which are almost comparable to indium phosphide and gallium arsenide, and the materials quality is steeply improving. If things run smoothly, we can create a silicon-based laser in 2020. This would enable a tight integration of optical functionality in the dominant electronics platform, which would break open prospects for on-chip optical communication and affordable chemical sensors based on spectroscopy."

In the meantime, the team is also investigating how to integrate the hexagonal silicon in cubic silicon microelectronics, which is an important prerequisite for this work.

SECURITY-ENABLED SBC

Aitech's latest security-enabled SBC (single-board computer) features up to 16 lanes of PCIe to handle increased data processing requirements, while protecting the board from data attacks and cyber threats. The C878 is a 3U VPX board that provides Intel Xeon D level processing in a rugged, industry-standard form factor.

Equipped with double the Gen3 PCIe Data Plane lanes as Aitech's C877, the rugged SBC was specifically designed using a modern, high-bandwidth bus architecture and can accommodate an increased amount of backplane traffic. This makes it suitable for compute-intensive, mission-critical applications found in harsh environments.

Instead of supporting an XMC site, the SBC includes a GPU to provide an intuitive interface via a 128-bit 2D graphics engine. These HMI capabilities allow the user to interact and control the application graphically or display pertinent data/video or other info on a monitor/screen. The hardware video decoder in the GPU supports many video outputs, including MPEG-2, MPEG-4, VC-1, H.264 MVC/AVS+ and JPEG/MJPEG.

The product uses Aitech's proprietary AiSecure cybersecurity architecture to provide secure transmission of sensitive data. Intel security includes Trusted Platform and Secure Boot as well as a BIOS Guard based on TXT TPM 2.0 and BIOS security. The onboard SATA SSD, up to 1 TB, supports write protection, secure and quick erase in addition to disk data encryption using AES 256 keys. A battery-backed tamper detection signal ensures system level protection.

A variety of onboard I/O interfaces, including USB 3.0/2.0, SATA III, PCIe Gen2, serial, discrete, DVI out and Ethernet, as well as custom I/O via the FPGA, are available on the OpenVPX-based SBC. The board also offers up to 32 GB of DDR4 SDRAM with ECC at 2133 MT/s to meet storage requirements.

The product comes in conduction- and air-cooled versions and features several board resources, such as watchdog timers, a real-time clock, temperature sensors, an elapsed time recorder and VITA 46.11 Tier 1 and Tier 2 IPMI. Supported operating systems are Windows, WindRiver VxWorks and Linux.

APC Technology
www.apctechnology.com.au

MOISTURE PROTECTION FOR SPLICING CONNECTORS

When moisture meets electricity, a short circuit can happen quickly. However, casting compound has shown itself to provide good protection.

Ready for instant deployment, reaccessible and with a high storage capacity, WAGO's Gelbox can be used to protect splicing connectors from moisture and humidity, such as that found outdoors. The product clears a path to achieving IPX8 levels of moisture protection in a quick and easy way: simply open the box, insert the connector and close the box.

The polyurethane gel used is silicone-free, making the Gelbox ready to use in any branch of industry — even those where varnishes, paints and other sensitive products are used. In addition, the gel has already reacted and is therefore label-free.

The device is available in six sizes and can be used in a wide variety of low- and extra-low-voltage applications. It is compatible with WAGO's 221 Series COMPACT Splicing Connectors and 2273 Series COMPACT PUSH WIRE Connectors.

WAGO Pty Ltd
www.wago.com.au

POWER SUPPLY

Developed using Vicor high-density and high-efficiency ChiP power modules, the VITA 62 compliant power supply is designed for 6U OpenVPX conduction-cooled chassis systems.

The product operates from a nominal 28 V input with predefined output voltages ranging from 3.3 to 12 V and delivering up to 1000 W of power. Users requiring different output voltages or power levels can request a customised power supply to meet their own specifications.

The 6U supply fully meets MIL-461F, MIL-704F and MIL-1275E standards.

Vicor Corporation
www.vicorpower.com

RF SIGNAL GENERATORS

SIGLENT's SSG5000X series of signal generators can generate analog and vector signals. They have a frequency range of 9 kHz to 4/6 GHz and offer high performance in phase noise, spectral purity, bandwidth, EVM and output power.

The internal IQ modulation generator and waveform playback function make it easy to create even complex signal types. The series also covers the most important RF band for digital wireless communications and includes standard waveform files.

The signal generators are suitable for R&D, education and manufacturing.

IPD Group Limited
www.ipd.com.au

NEW GUIDELINES FOR

SOFTWARE UPDATES ON EMBEDDED SYSTEMS

Cybersecurity for embedded systems and the Internet of Things (IoT) is set to take a step forward, with the not-for-profit Trusted Computing Group (TCG) announcing its latest guidelines and best practices for software and firmware updates for embedded systems.

Firmware and software updates are of increasing importance. Attackers constantly target the firmware and software in embedded systems, such as appliances and connected door locks, searching for vulnerabilities to exploit in order to establish a permanent foothold on the device. As a result, designers of embedded systems (ordinary items with an embedded computer) must be prepared to deliver firmware and software updates that customers must promptly install to ensure that these connected devices remain secure.

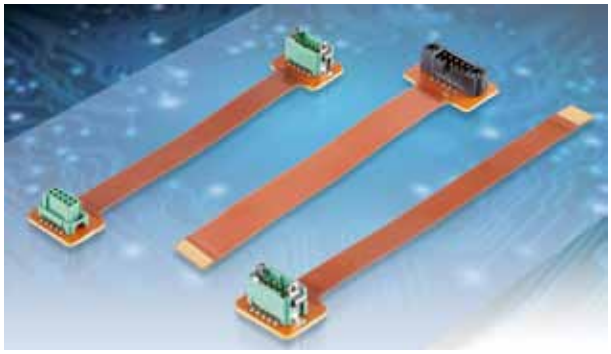
With its newly released document, TCG is sharing a set of guidelines and best practices for secure software and firmware updates. By following these guidelines, manufacturers can keep their products secure throughout the lifetime of the products, not just when they are purchased. As a result, manufacturers should be able to avoid the bad publicity, recalls and other problems caused by infected machines.

"The state of the art in information security is advancing rapidly and this is even more true for embedded systems security," said Steve Hanna, Chair of TCG's Embedded Systems Work Group. "We must constantly raise the bar in the way that we build and maintain these systems so that the defenders can stay ahead of the attackers."

Driven by functionality, convenience and profit for both the manufacturer and the user, network-enabled embedded systems (IoT) are found in an ever-widening number of smart applications and platforms, including automobiles, household appliances, industrial systems and medical equipment. Increasing network connectivity in such devices allows for advanced feature sets, increased awareness and response, and faster patching and updating of system firmware and software. However, this network connectivity also results in new threats and potential issues that never previously existed in platforms.

The Stuxnet virus in 2010 that compromised programmable logic controllers (PLCs) used in the Iranian nuclear program is a prime example of the scale of attack that can occur if embedded systems are not secure. A similar attack was also successful against the Ukrainian power grid in 2015, resulting in temporary power loss for 225,000 individuals. Both incidents illustrate the potential impact of cyber attacks against embedded systems in critical infrastructure and both took advantage of weak software update mechanisms.

"As we put greater trust in things like autonomous cars, smart homes and healthcare sensors, we need to take steps to make sure connected devices are tightly secured to protect them from data breaches and hackers," Hanna said. "Over the years TCG has developed a range of technologies to address the challenges faced by the industry, resulting in widely deployed, proven solutions. These open standards are the ideal option for delivering the security needs for embedded systems as we move towards a world where everything is connected." To view the new guidelines, visit the TCG website.



CONNECTORS WITH FLEXIBLE PRINTED CIRCUITS

Harwin now offers both its Datamate J-Tek and Gecko high-reliability (Hi-Rel) connectors with flexible printed circuits (FPCs) attached for situations where there is little space above the board surface. Suited to aerospace, motorsport, satellite and defence installations, the FPC assemblies provide engineers with low-profile interconnect solutions, meaning the PCBs within a system design can be stacked closer together. Through right-angled connections, these components can be kept at the periphery of the board, resulting in thermal management and ease of mating benefits.

The Datamate J-Tek option consists of a 2 mm-pitch connector plus a 1 A-rated 1 mm-pitch FPC, and is supplied in a single-ended design fitted with a male connector. The Gecko options have a 1.25 mm-pitch connector along with a 0.4 A-rated 0.5 mm-pitch FPC, available in single- or double-ended configurations.

The FPCs feature a copper-clad polyimide base with a bonded overlay. There is a rigid area at each end to aid connector mounting. They are able to support a tighter bend radius than conventional cables, according to the company, and are better suited to dynamic movement when bent.

Due to the 4-finger design used for the beryllium copper contacts, the assemblies exhibit strong resilience to shock (up to 100G) and vibrational forces (up to 20G), without breaks in signal. The inclusion of stainless steel jackscrews on the Datamate connectors and sturdy latches on the Gecko connectors ensures interconnect integrity is maintained.

The FPC assemblies have an operational temperature range matching the relevant connectors, as wide as -65 to +150°C. The free ends of the FPC are compatible with industry-standard FPC/FFC connectors that accept 0.3 mm-thick circuits.

Clarke & Severn Electronics
www.clarke.com.au

EMBEDDED CONTROLLER

Aplex's ACS-2310 Ultra Compact Multi-Core Embedded Controller is a high-performance, standalone, embedded ultraslim PC featuring fanless operation, extensive I/O, compact size and robust construction. The product is based on the Intel system-on-chip (SoC) chipset to provide a state-of-the-art multi-core embedded platform.

The unit is equipped with a factory-installed quad core Celeron N2930 1.83 GHz processor, one SODIMM socket supporting up to 8 GB of DDR3L system memory, two Gigabit RJ-45 Ethernet connectors, two USB 3.0 ports, four USB 2.0 ports, one RS-232/422/485 port and two RS-232 ports. It provides one 2.5″ mounting for a hard drive or SSD and one full-size Mini-PCIe slot that can be shared with mSATA. System expansion is possible via a second full-size Mini-PCIe slot. One HDMI port and one VGA port are provided for high-resolution displays.

The product's fanless design, coupled with an operating temperature range of 0 to 50°C, should ensure long-term operation in industrial and embedded environments. Measuring 207 x 130 x 35.5 mm, the compact device can be powered from a 12 VDC source. An optional 100–240 VAC power pack is also available.

Interworld Electronics and Computer Industries
www.ieci.com.au

REWIREABLE IEC APPLIANCE INLET

The IEC appliance inlet 4783 from SCHURTER combines a reconnectable C13 appliance inlet with a V-Lock cord retention system. Reconnectable appliance sockets are particularly suitable for small series builds, with the user free to choose the cable length and country-specific plugs. The product is available in black, white and grey for better differentiation, eg, in three-phase systems.

SCHURTER already offers a wide range of rewireable IEC device connectors. The 4783 features the integrated V-Lock cord retention system, which effectively prevents the cable from being pulled out unintentionally.

A cable guard with a diameter of 8.5 or 10 mm is pre-assembled at the factory. The screw terminals accept cables with cross-sections between a minimum of 3 x 0.75 mm^2/18 AWG (0.82 mm^2) and a maximum of 3 x 1.5 mm^2/14 AWG (2.08 mm^2).

The product does not use halogens in the cable guard or any other plastic components. It has all approvals for the European, Chinese and North American markets and is also certified according to the UL 60320 standard.

SCHURTER (S) PTE LTD
www.schurter.sg

SINGLE-WIRE CONNECTORS

Würth Elektronik has released the WR-FAST series of THT-configurable male connectors for accommodating single wires with blade receptacles, eg, in household appliances. The connectors are available in various blade designs, orientations and dimensions and are intended for current flows up to 16 A and working voltages up to 300 V.

Straight or angled contacts in various numbers are available for the common 6.3 mm blade receptacles as well as the 2.8 mm version. For the latter, the 2863-type WR-FAST connectors are used: the forked blades can accommodate both types of blade receptacles.

The connectors are designed for operating temperatures from -30 to +120°C. They have passed glow wire testing according to IEC 60335-1 and meet flammability class UL94 V-0. They also have cULus approval.

Wurth Electronics Australia Pty
www.we-online.com

HOW TO SAVE COSTS WHEN MAKING A CUSTOM ENCLOSURE

You have developed an electronic gadget and decided that you can take that product to the next level with a few improvements and insights in the target market. So, pumped up, you modify your electronics and add features that might require a custom or customised housing instead of that diecast box you bought online.

You decide to contact an industrial designer to help you develop a professional-looking custom enclosure. They proceed to tell you it will cost upwards of tens of thousands of dollars ($50K–$120K) to design and tool for what you thought was a relatively simple custom enclosure. Deflated, you balk at the cost and wonder if this is really a viable project.

This is a common scenario in electronic design. Making a custom enclosure can be complicated and frustrating when you consider the amount of options that are now available. From years of experience in this space, here are some considerations that we believe can help minimise time/cost and maximise value in the process of making a custom enclosure:

- Think about your enclosure design first.
- Can I customise instead of custom design?
- To tool not to tool: that is the question.

Think about your enclosure design first

This sounds obvious, right? Tooling is expensive, so it is important to get your design right. Design is expensive and charged by the hour; therefore, it is also important to specify your requirements clearly to reduce the amount of information loops and adjustments (ie, hours) required. It's an easy thing to say, but in practice it can be hard to know where to start when you have not even fleshed out your system design. Here are some tips on what to consider when embarking on enclosure design that might help you avoid pitfalls later in the process.

First, consider your realistic quantity for the lifetime of product. What will be the continuity plan for this design? Are you developing to grow to an ultimate quantity over time, or will you this be a staged process with redesign each production run?

FUNCTION	FEATURE	COMMENTS
Handheld and wall mountable	Small, clip mount	Target space profile WxHxD = 50 x 20 x 45
Must be accessible for service, battery change	Removable lid or door	
Ingress protection	IP65	Or higher
Sun-proof	UV stabilised	
Non-flammable plastic	UL94	
Enclosed wireless transmitting	Must be plastic	
External button	IP65 button gland	Reset button
Drop-proof	Thick enough plastic or bumper shock proof	

Table 1

Next, write down functional specification and relate it to desired enclosure features. Typical things to consider are:

- PCB dimension
- Material
- IP rating
- Connectors
- Sensors
- Buttons
- External indicators/displays
- Type of mounting
- What are the other unique functions special to your design?

For example, see the functions for an IoT sensor enclosure in Table 1.

Now decide how important cosmetic appearance is. Appearance is usually high on the list of reasons why to develop a custom enclosure in the first place. However, there are only so many ways to implement some features.

Now you have laid bare what is critical you can start analysing what is viable.

Customise instead of design custom

- If you consider that your ongoing quantity point is not in the hundred thousands, it may be more sensible to look at standard options that can be modified to suit, eg, under 2000 pieces it might be best to go with a rapid prototyping technology:
  - Additive manufacture
  - Custom metal enclosure
  - Modify a standard enclosure
- Consult with enclosure manufacturers to get advice on what's possible and what's not.
- Avoid I/O and connections on too many edges.
- Metal or plastics?
- Where possible, use standard options and materials.

To tool or not to tool: that is the question

Injection moulds are expensive but result in low cost in volume. Personally, I would look at low-volume injection moulding using cheaper aluminium tooling. The tooling wears much more quickly but can get you started faster/cheaper. You would design the part (sketches → 3D CAD), 3D print to verify function, pass the design to the injection moulding company (design verification and pricing), pay for the tooling, run first article(s), verify function/aesthetics, make changes/verify again, and go into production. The process is expensive and time-consuming no matter what.

At 2000 cases, go with rapid prototype tooling.

The key to tooling with these vendors is to be a very good designer of injection moulded components. If you don't follow the design guidelines dead on, your parts will suffer cosmetically.

ERNTEC has been designing and manufacturing enclosure solutions for many years. Talk to us for standard, modified or fully custom solutions.

ERNTEC Pty Ltd
www.erntec.net

COMPACT LED FAMILY

The Synios S 2222 LED family from Osram Opto Semiconductors is suitable for a wide range of applications: from customised lighting solutions for electronic devices, to ambient lighting for trains and planes, to high-quality architectural lighting. The product family is characterised in its compact dimensions, combined with good brightness values and the ability to cover the entire colour palette.

The product family provides an efficient and flexible platform for a variety of low- and mid-power applications (from 10 to 200 mA). Users can choose from six colours and combine them to create more. In addition to white versions (3000–6500 K, CRI >80), the product family includes versions in blue (445–460 nm), green (520–540 nm), yellow (583–595 nm, conversion and direct emission), red (612–626 nm) and deep red (626–636 nm). The family's uniform dimensions of 2.2 x 2.2 mm and solder pad design make it particularly easy to integrate into many different solutions. The low package height of only 0.6 mm makes flat lighting solutions possible.

The family is Osram's response to the trend of producing ever smaller discrete components with higher performance. For example, the yellow converted variant delivers a brightness value of 50 lm at 140 mA. Depending on the application, additional optics can be easily applied to the respective component due to the centric chip position in the package. The products are easy to handle via pick and place in series production.

Osram Australia Pty Ltd
www.osram.com.au

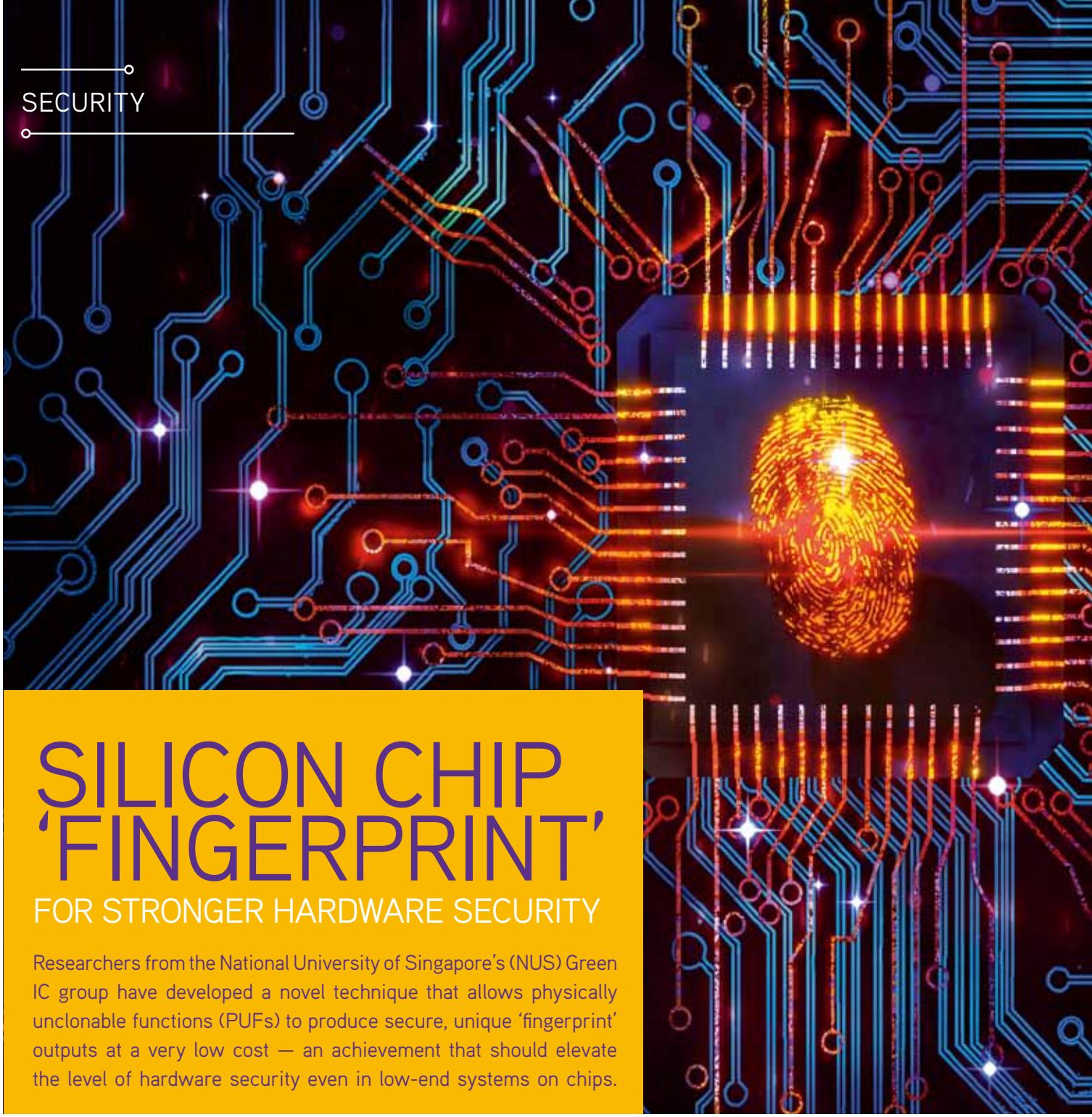
new PRODUCTS

CHIPSET

Vicor has announced the 4609 chipset for high-performance GPU, CPU and ASIC (XPU) processors powered directly from 48 V. A driver, MCD4609, and a pair of MCM4609 current multiplier modules supply up to 650 A continuous and 1200 A peak power. Owing to their small footprint and low profile (45.7 x 8.6 x 3.2 mm), current multipliers are placed close to the processor enabling reduced power distribution network (PDN) losses and higher power system efficiency.

Powering GPU and OCP Accelerator Module (OAM) artificial intelligent (AI) cards, the chipset is available on the Vicor Hydra II evaluation board. The product adds to the Vicor Power-on-Package portfolio of Lateral Power Delivery (LPD) solutions, enabling high current density and efficient current delivery for advanced processors in applications including AI accelerator cards, AI high-density clusters and high-speed networking.

Vicor Corporation
www.vicorpower.com



SILICON CHIP 'FINGERPRINT'

FOR STRONGER HARDWARE SECURITY

Researchers from the National University of Singapore's (NUS) Green IC group have developed a novel technique that allows physically unclonable functions (PUFs) to produce secure, unique 'fingerprint' outputs at a very low cost — an achievement that should elevate the level of hardware security even in low-end systems on chips.

Traditionally, PUFs are embedded in several commercial chips to uniquely distinguish one silicon chip from another by generating a secret key, similar to an individual fingerprint. Such a technology prevents hardware piracy, chip counterfeiting and physical attacks. Now, the NUS team has taken silicon chip fingerprinting to the next level with two significant improvements: enabling PUFs to be self-healing and self-concealing.

Self-healing

In spite of their remarkable evolution in the last decade, existing PUFs still suffer from limited stability and periodically incorrect fingerprint identification. Often designed as standalone circuits, they provide hackers with obvious points of physical attacks on the chip.

The instability is conventionally counteracted through overdesign, such as designing error-correcting codes margined for the very worst case, which substantially increases both chip cost and consumption. In addition, before proceeding to commercialisation, chips with unstable PUFs must first be identified and discarded through extensive testing on a very wide set of environmental conditions, further increasing cost.

To address the gaps, NUS engineers introduced a novel adaptation technique that uses on-chip sensors and machine learning algorithms to predict and detect PUF instability. This technique intelligently adjusts the tuneable level of correction to the minimum necessary, and produces a more secure, stable PUF output. In turn, the novel approach brings consumption back to the minimum possible, and is able to detect anomalous environmental conditions such as temperature, voltage or noise that are routinely exploited by hackers in physical attacks.

An added benefit is that the traditional testing burden and cost are dramatically reduced by narrowing down the test cases required. This eliminates overdesign and unnecessary design costs, as most of the testing effort can be delegated to the available on-chip sensing and intelligence throughout the device's lifetime.

NUS researchers Professor Massimo Alioto and Sachin Taneja testing the self-healing and self-concealing PUF for hardware security.

"Our approach utilises on-chip sensing and machine learning to enable accurate prediction, detection and adaptive suppression of PUF instability events," said Professor Massimo Alioto, who leads the Green IC group. "The ability to self-heal without stability degradation over the entire chip's lifetime assures reliable generation of secret keys at the highest level of security while avoiding the burden of designing and testing for the very worst case, even if the latter is actually infrequent and unlikely. This reduces the overall cost, shortens the time to market, and cuts down on system power to extend the battery lifetime."

The reduction in the cost of chip design and testing is key in enhancing hardware security even in very low-cost and low-power silicon systems, such as sensor nodes for the Internet of Things (IoT), wearable devices and implantable biomedical systems.

"On-chip sensing, as well as machine learning and adaptation, allow us to raise the bar in chip security at significantly lower cost," Prof Alioto added. "As a result, PUFs can be deployed in every silicon system on earth, democratising hardware security even under tight cost constraints."

Self-concealing

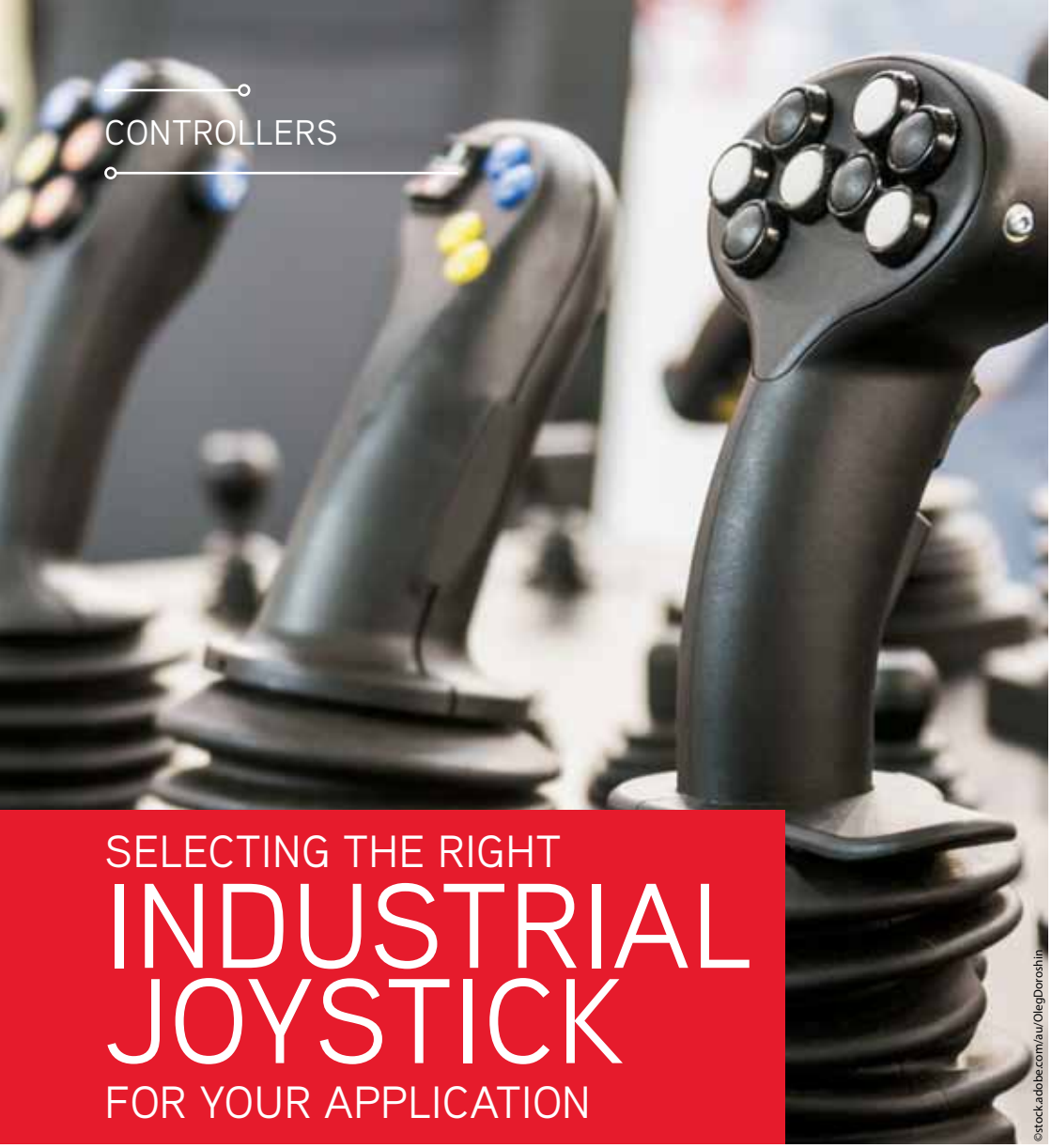
The PUFs invented by the researchers also exhibit the ability to be fully immersed and hidden within the digital logic that they actually protect, believed to be a world first. This is enabled by the mostly digital nature of the PUF architecture, which allows the placement, routing and integration of digital standard cells, similar to conventional digital circuits. This reduces the design cost as conventional digital automated design methodologies supported by commercial software design tools can be applied to design the PUF.

In addition, the PUF digital design allows the generation of secret keys to be interspersed within the very logic that uses such keys, such as cryptographic units protecting data and the microprocessors handling the data to be encrypted. The immersed-in-logic approach scatters the PUF standard cells among the cells used for the digital logic, thereby 'hiding' or concealing any explicit points of attack for hackers trying to probe specific chip signals to physically reconstruct the keys.

This self-concealing ability increases the attack effort by approximately 100 times. It also raises the cost of attacking typical chips to millions of dollars with state-of-the-art tools, as opposed to tens of thousands in conventional standalone PUFs.

Next steps

The NUS research team will continue to look into the convergence of computer architecture, physical security and machine learning to develop next-generation secure systems on chips, driven by the growing need for privacy and information security. The team is also pursuing ubiquitous and ultralow-cost enablement of hardware security through tight physical co-integration of architectures and security primitives with circuitry that is generally available in any system on a chip, ranging from logic to memory, intra-chip data communication and accelerators. Ultimately, the team's work is expected to enable hardware security at the granularity of every silicon chip, even within individual subsystems on a chip.



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SELECTING THE RIGHT INDUSTRIAL JOYSTICK FOR YOUR APPLICATION

From harsh environmental conditions to repetitive, high-duty-cycle functions of indoor control, OEM designers face a variety of challenges.

Costing aside, choosing the right industrial joystick when such requirement is called for can be a daunting task. This is particularly true as industry today gives operators more and more functionality at their fingertips. Examples include agriculture, heavy equipment, mining, security and surveillance, robotics, etc.

First and foremost, it is important to identify the functions that the joystick is intended to control. For proportional control, identify the axes that are proportional and their signal requirements would form the basis of design. A finger-operated joystick would not be suitable for an application that is subject to consistent vibration and heavy-handed manoeuvring, and vice versa.

Duty cycle is also important and the joystick should be rated to last the expected operating life of the equipment. For outdoor applications, there should be sufficient protection against ingress of rain, dust and other elements that would otherwise lead to premature failure.

For industrial applications, space is almost always at a premium and so the length of the handle, physical size and mounting of the joystick (with/without tilting) should be considered. A joystick that offers mounting options and design flexibility can be invaluable in boosting operator efficiency.

The same efficiency also ties into ergonomic factors and operator comfort in the actual physical placement, especially when the aim of the equipment is to enable an operator walking around to observe the movement of the machine and its surroundings. For fixed placement, one should avoid making the joystick easily accessible to the doorway, as the operator could be tempted to use the handle to pull himself/herself from a sitting position. In addition, one must be wary of placement that could result in inadvertent operation, such as an elbow or hip brushing against the handle or button.

Japanese manufacturer Sakae Tsushin is a supplier of joysticks, potentiometers and turn-counting dials. In addition to off-the-shelf models, the company's engineering team can work with customers to develop products meeting specific design requirements.

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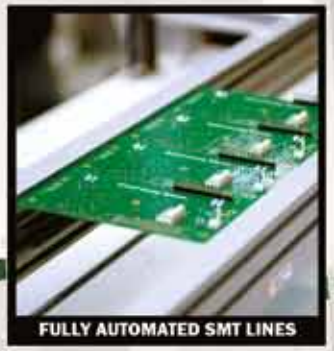

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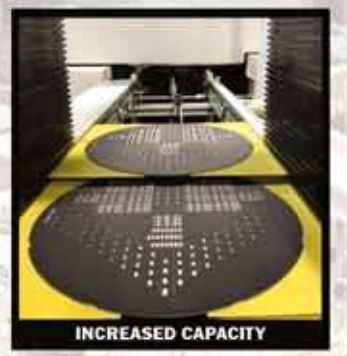

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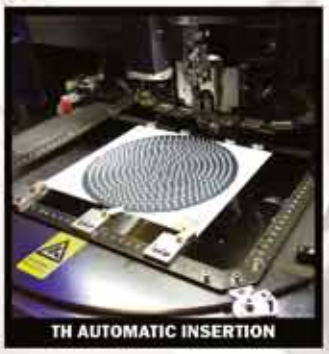

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