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Shrinking electronics

Making devices smaller trumps AI, 5G and the IoT as the top design trend for 2019

New research from Future Facilities has revealed the top electronics design trends for 2019 and making devices smaller and more compact is seen as being the number one design priority for electronics engineers next year.

The research, conducted at this year’s Engineering Design Show, held last month in Coventry, surveyed over 100 electronics professionals and engineers and found that a third believe that shrinking device sizes will have more of an impact on the electronics industry than new technology developments such as 5G, artificial intelligence (AI) and the internet of things (IoT).

The top five trends that are expected to define electronic design in 2019 include:
1. Making devices smaller / more compact;
2. The internet of things;
3. The need to add AI capabilities;
4. Extending battery life; and
5. Incorporating edge computing into designs.

Surprisingly, or perhaps not, the addition of 5G capabilities and making devices more computationally powerful didn’t rank highly on the survey. Disappointingly, making devices greener and more sustainable ranked lowest in the poll. According to the research a mere 2% agreed that it would be their top priority for 2019.

According to Future Facilities, this trend will have some profound implications for issues such as thermal management.

It’s true to say that as devices get smaller so a host of new thermal challenges for design engineers will certainly appear.

Commenting Tom Gregory, Product Manager at 6SigmaET said: “Across all five of the top trends shaping electronic design in 2019, thermal management represents a major challenge. As devices become smaller, so the potential for thermal complications and the requirement for innovative solutions grows significantly. At the same time, new technologies such as AI and the IoT are bringing their own unique challenges and a host of new hardware requirements.”

So, are designers taking thermal considerations seriously enough? Apparently not. According to Gregory few are running simulations or identifying thermal complications until after a design is complete.

That’s going to have to change if engineers want to successfully develop the complex designs needed and fully capitalise on new technology trends.
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The automotive sector is in the early stage of a radical transformation of personal mobility, as new vehicles gain a wider range of driver assistance features, a trend which will eventually see partially- and fully-autonomous vehicles reach the new car market. This has created a need in automotive electronics systems for high-performance systems-on-chip (SoCs) that can handle in real time the vast amounts of sensor data generated by cameras, radar, positioning systems and other input devices. These processors are typically fabricated at, or near, the leading edge of the semiconductor technology wave, often at 16nm nodes or below. This has an unintended consequence for automotive electronics engineers: these advanced process nodes lack a non-volatile storage solution that can be embedded inside the SoC.

System designers who previously relied on the internal Flash resources embedded in an SoC are now having to learn to specify external NOR Flash ICs for storing code, system settings and application data. And for many automotive design engineers, development work is governed by the need for compliance with the ISO 26262 functional safety standard, meaning the safety and reliability of automotive NOR Flash memory ICs are coming under further scrutiny.

Under the terms of ISO 26262, electronics system manufacturers must analyse the ways in which a system can fail, estimate the probability of each kind of failure occurring, assess the potential harm in the event of failure, and put in place appropriate response or recovery mechanisms which guarantee safe operation should any foreseeable machine failure occur.

NOR Flash IC manufacturers that supply the automotive industry are now adding processes and product features which support their customers’ ISO 26262 compliance efforts.

NOR Flash technology is generally regarded by electronics systems designers as highly reliable, offering a combination of long data retention and high endurance. However, this alone does not satisfy the requirements for ISO 26262 compliance, which imposes rigorous requirements for safety analysis and safety operation on electronics systems and components.

The starting point for a system containing a NOR Flash IC is a comprehensive Failure Modes and Effects Analysis (FMEA). Reliable as NOR Flash technology is, it does have failure modes. These can be classified in...
three broad categories:

- System-level failures
- Storage operation errors
- Interface errors

In properly designed and fabricated NOR Flash ICs, the risk of any of these failures occurring is low. Indeed, consumer device OEMs happily embed NOR Flash without implementing functional safety measures, since experience shows that Flash ICs are almost never the cause of premature system failure.

The automotive design environment however, calls for more rigor, both because of the high cost of failure, and because of the long expected lifetime of a vehicle. The design process of an automotive system that is required to comply with ISO 26262 will:

- Quantify the risk of system failure. The ISO 26262 standard applies risk metrics such as the FIT (Failure In Time) rate. For each of four Automotive Safety Integrity Level (ASIL) grades from A to D, there is a maximum FIT rate at the system level, which requires a lower FIT rate at the component level.
- Implement robust protection and counter-measures to maintain system safety in the event of a failure.
- Provide for traceability of the internal development process.

Fortunately for automotive system OEMs, the pressure to support compliance with ISO 26262 has given rise to a new wave of innovation in the Flash memory market. These new NOR Flash IC offerings also need to reflect the demands of the automotive operating environment, such as a wide operating temperature range from -40°C to 125°C, high levels of EMI, and the risk of sudden, unexpected power outages caused by battery failure. Cypress Semiconductor has responded to this demand with the introduction of new technologies and features in its Semper family of automotive NOR Flash devices for functional safety applications. These provide diagnostics, protection and recovery capabilities in each failure mode identified above: system failure, storage operation error and interface error. The Semper family includes a CPU core (Arm Cortex-M0) for managing the complex operation of the memory device and the communication of status and flags to the host SoC.

**System failure protection**

On start-up, Semper devices implement a Safe Boot process. This uses a status register polling sequence to detect if there is a power-on failure or to determine if the register has been corrupted. On detection of an error, the system performs a reset cycle to re-initialise the Flash device or to erase and reprogram the register. Should the device fail to reboot correctly, a back-up recovery mechanism is available: a hard reset using a back-up register stored in the host SoC and implemented with standard JEDEC SPI commands.

**Safeguarding storage operation**

The EnduraFlex architecture aids the designer by enabling a Semper Flash device to be divided into multiple partitions, independently configured for either high endurance or long retention. For sectors of memory allocated to frequent data Write operations, the partitions can be configured to provide up to 1.28 million P/E cycles in 512Mbit parts, or 2.56 million cycles in 1Gbit parts. For storage of code and settings, a partition can be configured to retain data for 25 years. This endurance and retention performance is far superior to that of any standard NOR Flash IC.

Separately, protection against Read and Write errors is afforded by the application of Error Correcting Code (ECC) to all Read and Write operations. Semper NOR Flash devices support Single Error Correction and Double Error Detection (SECDED) by generating an embedded ECC during memory array programming. This ECC is then used for error detection and correction during Read operations. Detection of any faults in the memory array prior to execution can be performed by computing a data integrity CRC check for a specified address range, and verifying it against a previously calculated CRC value.

**Detecting interface errors**

Semper devices are high-frequency memories operating as fast as 200MHz.
When data is transferred over the interface between the NOR Flash IC and another device, such as the host SoC’s DRAM main memory, it might be corrupted due to a noisy channel or errors introduced by the transmitter, receiver or both. To keep the system running safely, Semper parts feature an Interface Cyclic Redundancy Check (CRC), an error-detecting code which detects faults during data transmission. The Interface CRC calculates the checksum of all command, address and data bits. The host SoC independently calculates the CRC checksum and compares its result to the value read from the NOR Flash to verify the integrity of the transferred data.

**Diagnostic outputs to monitor system health**

The safety features described above serve to minimise error rates and to provide for safe recovery from error or failure states. System designers can also incorporate information about NOR Flash IC operation into their system safety architecture by drawing on the comprehensive diagnostic data provided by Semper parts. This data includes flags indicating programming errors, suspension of a program operation, Erase errors, and suspension of Erase operation.

**Supply chain quality**

Important as the functional safety features of Semper ICs are, they are not sufficient to support the compliance efforts of automotive system OEMs. This is why Cypress also backs its Semper product range with a set of reliability and safety reports supplied to customers. These provide documentary underpinning to the OEM’s FIT rate analyses. The production test data provided by Cypress validates the lifetime and operating specifications detailed in the device datasheet. Cypress also provides automotive customers with an assurance of product longevity.

In addition, Cypress architected and designed the Semper parts in accordance with the specifications of the ISO 26262 safety standard, and is certified to the IATF 16949 (International Automotive Task Force) quality management standard. Semper parts are automotive-qualified to AEC-Q100 grade 1 for operation over a temperature range from -40°C to 125°C.

Taken together, these product features and development and production processes ensure that users of automotive Semper NOR Flash ICs can have the greatest possible confidence that they will perform in the field as specified and achieve the reliability levels required by the application.
The increased complexity of today’s designs, combined with new product delivery schedules, strain engineering resources to the limit, often to the point of breaking. As a result, 17% of all projects are canceled, and another 28% miss their target release date (Source: Lifecycle Insights – September, 2018). A more efficient design flow is needed to better utilize engineering resources, while keeping complex projects moving forward on schedule.

**The Conventional Design Flow**
The traditional project design flow is inefficient and fraught with pitfalls, relying far too heavily on manual reviews and costly prototypes. Valuable engineering resources are spent debugging errors in the lab that should have been caught during schematic entry and layout. Verification of each design phase occurs too late in the process. Errors uncovered this late in the process result in costly re-spins.

**A Shift-Left Approach to an Integrated Multi-Dimensional Verification Platform**
To eliminate conventional design flow inefficiencies, a “shift-left” approach that integrates analysis and verification as early as possible in the design flow is ideal. The ultimate goal is all-inclusive, multi-dimensional verification process that reduces manual reviews and manual debugging of physical prototypes.

**The Tools to Implement a Shift-Left Automated Verification Design Flow**
The Mentor Xpedition platform includes all of the shift-left enhancements shown above. Xpedition provides powerful verification tools integrated within the authoring environment for easier, faster validation which reduces costly design re-spins, improves time-to-market and results in higher quality products with fewer defects. The Xpedition integrated verification platform is an optimum solution for today’s complex design challenges.

For more information, visit the website: [www.mentor.com/pcb/xpedition](http://www.mentor.com/pcb/xpedition).

See the YouTube video for this new solution: [https://youtu.be/sKd6fro1hs](https://youtu.be/sKd6fro1hs), or download the technology white paper from the Mentor website: [www.mentor.com/xpedition-verification-paper](http://www.mentor.com/xpedition-verification-paper)

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Power up

How do you choose the right power supply for your design? Start with accurate DC/DC converter measurements, according to Florian Haas
One subject that designers in the electronics industry have long been familiar with is why does data collected in the laboratory differ from data collected from actual usage?

How does that happen? Are readings actually incorrect, or are there considerations that need to be taken into account the moment an AC/DC power supply or a DC/DC converter is integrated into a circuit?

The first thing we should do is define what the respective power supply is required for, and this throws up some simple preliminary questions. The key objective is to bring input voltage for the application to a new potential.

• Should potential be divided or not?
• What are the input and output voltage ranges and what is required at which output current?
• What design do I have space for?
• What is the end product that the circuit is required for?
• Which regulations need to be followed? (Industrial, railway or medical)
• In which environmental conditions will the application be used?
• How reliable should or must the whole circuit and application be?

Selecting the appropriate power supply isn’t simple. Once the standard basic questions have been cleared up, we come to the ones that this article intends to investigate more fully:

• How can I measure correctly and avoid errors?
• How do I deal with Ripple & Noise?
• What happens in the event of inrush current?
• What do I need to be aware of with respect to electromagnetic compatibility? (EMC)

Traco Power’s product portfolio includes more than 25 3 Watt DC/DC Converter ranges, such as the TVN Series with ultra-low Ripple & Noise or the THM series, which is certified for medical applications, open-frame variants or the TMR-WIR series approved for railway applications with 3000VDC isolation voltage - a whole host of possibilities.

So what do we need to establish to find a solution? The first step is to determine which measurement values we need – a simple measurement allows us to easily make a rough assessment: input and output voltage and current on the converter, on the load and possible changes in efficiency.

Measurement errors
A basic point to take into account is that every measurement changes the actual state of the circuit and any impact needs to be kept as minimal as possible. This means that doing a 4-wire measurement even for a “simple measurement” is advisable.

Measuring current and voltage with independent test leads means that the leads’ inherent resistance will have less impact on values. It’s also important to think about end usage.

For example, in an operating theatre, there can be 30m wires between the power supply and the actual load. If the load required is 24V the source needs a higher output voltage to offset voltage loss in the wire. That means that both load and source need to be measured. See above for an example of a classic 4-wire voltage measurement at source.

Ripple & Noise
Why is Ripple & Noise measured? Regardless of application the ripple and noise of a DC/DC converter could lie in its actual area of operation, for example in a measuring bridge, so as a result, this needs to be considered and evaluated separately.

What are they and how can they be measured cleanly? We talk about Ripple in AC/DC and DC/DC circuit when irregular disturbances are caused by internal circuits.
whereas Noise denotes the peaks that return periodically, produced by the transforming pulsing at switching frequency.

To determine actual values the probe head must be in direct contact with the pins, the ground ring and also the measurement tip making contact with them.

In order to be able to compare results with manufacturer’s data, bandwidth on the oscilloscope is limited to 20MHz, a common value for laboratory work.

Usually, noise and ripple can simply be reduced with two parallel-switched capacitors, for example, a 100nF metal film capacitor and a 10µF electrolytic capacitor, always bearing in mind that values presented on datasheets can be influenced by other factors during end usage.

**Dealing with Inrush Current**

This information is important for ensuring that components upstream are the correct dimensions.

- Current depends essentially on switching speed, so ideally mercury switches should be used in the laboratory
- Source should have lowest internal resistance possible
- Current is measured with a demagnetised tip

Ambient temperature also has a big impact on inrush current. For example, the use of electrolytic capacitors is highly dependent on temperature. If you are having issues with inrush voltage affecting a circuit, using a thermistor (NTC) can help.

**Electromagnetic Compatibility**

It’s also important to establish the EMC compatibility (electromagnetic compatibility) for the general application. Using a DC/DC converter with an internal filter doesn’t automatically mean that you’ll adhere to the values specified for the application because EMC compatibility can often be affected by several components. In many cases, the output voltage must be connected with protective earth for safety reasons, and this can have a significant impact on EMC. Usually, the power supply manufacturer can offer advice regarding how to adhere to EMC values.

Most power supply manufacturers provide help in the form of suggestions for suitable filters on their websites, and at Traco, for example, these can be downloaded directly from the relevant device’s page. If you can’t find the circuit diagrams for the product you have selected, don’t hesitate to contact the manufacturer directly.

**Summary**

In conclusion, you don’t need to put in a huge effort to establish the power supply components you need for a design if you make use of help from manufacturers and simple resources available. Before any assessment and selection, it is important to define your requirements clearly, and there is a big difference between deciding on what you really need, and what you would like.

It is important to think about how measurements can be taken correctly, and how every measurement impacts values gathered. Testing strips and laboratory conditions are defined when a circuit is built, but what are the conditions that circuit will actually be used in?

If there is no suitable device available in the marketplace, maybe series - or parallel-switching, or using a filter might produce the desired results? Meeting EMC requirements depends heavily on the field of application and its prerequisite conditions, just as with ripple and noise and inrush current.

It is well-known that there are many manufacturers out there, so the quality, as well as price of a specific product, can vary greatly.

Is it enough to choose a “simple” unbranded, mass-produced device or will trying to save come back to bite you further down the line? Do you always need to go for the high-end variant?

The final decision is down to the customer, regardless of any recommendations.
Human Machine Interfaces (HMI)

The new AURORA solution

SCHURTER Electronics are a worldwide provider of customised human machine interface (HMI) solutions, for the most demanding customer requirements.

SCHURTER has just released its latest innovative demonstration unit, the AURORA. This unit attests to the added value that SCHURTER can provide to its customers. The AURORA combines backlit capacitive keys, a capacitive touch screen, connectors, circuit protection and EMC protection. This is all built by their own electronic manufacturing service and all in a visually attractive form. Combining these competences into one product demonstrates how SCHURTER can provide the expertise to deliver one single solution that satisfies business needs and requirements.

SCHURTER works closely with its customers to produce the perfect interface to increase the productivity and sales of its customers products. A properly designed HMI unit that encompasses all the data entry and feedback requirements while maintaining a safe and comfortable user operation will produce a machine that will elevate itself above its competition.

SCHURTER’s fully customisable capacitive touch solutions can be used in a wide range of industries including: Industrial, Medical, Energy, Communication, Aviation and Automotive to name a few. The knowledge and expertise allow the team to work with their customers from the initial design stages through to the prototyping and manufacturing stage. SCHURTER can also provide the technical knowledge to meet the applicable industry standards including EMC certification and ATEX qualification.

SCHURTER endeavour to support their customers by delivering the value and understanding to make them successful in their areas of expertise. As a result, they produce products that repeatedly differentiate themselves from the competition, are seen as the leaders in their field of operation and the product of choice for their market.

To complement the release of the new AURORA product, a short two-minute video has been commissioned. The video portrays the expertise of SCHURTER in delivering a product that will satisfy the customer needs in one single solution.

Please see our video at:
• https://youtu.be/PhTKTka11SM

For a demonstration of the AURORA unit please email: uksales@schurter.co.uk

For further information on our range of products visit: www.schurter.co.uk

SCHURTER Electronics are a worldwide provider of customised human machine interface (HMI) solutions, for the most demanding customer requirements.
Digital technology has had a huge impact on modern life, revolutionising how we perform simple tasks like taking a photo or watching TV, but perhaps the most significant impact has been its transformation of medical care. Like the transition from film-based to digital cameras, X-rays have advanced from a film imaging process to one based on digital technologies. Digital radiography greatly benefits the healthcare industry, but it also places high demands on medical equipment manufacturers.

Diagnostic imaging remains an important tool for the detection and treatment of many disorders. In various clinical settings, an X-ray is often the starting point for diagnosis. During the process, a beam of X-rays is transmitted through the part of the patient’s body which needs further investigation. The X-rays are absorbed by the body in differing amounts, resulting in the familiar contrast seen in X-ray images.

**Film versus digital**

Thanks to digital radiography (DR), medical imaging is being transformed by better detectors, more powerful computers, sharper displays, faster processing and more efficient archiving. The benefits are great and wide ranging; an image can be acquired in seconds and viewed on any computer monitor; it can be accepted or deleted at the click of a button; it can be easily shared with other medical professionals and archived in an online database.

It also allows for greater precision, and the balance between image quality and radiation dose can be controlled more accurately, making it a safer process for the patient.

Traditionally, the images were exposed onto photographic film, but with the advent of digital radiography an electronic detector is used instead. The image is then processed by a computer, rather than being chemically developed.

The initial cost of a DR system,
compared to the conventional film-based system, is high. However, hospitals save money by eliminating film costs and reducing the storage space required to archive the images. Because it is a faster and more efficient process, perhaps the biggest saving is time. Fewer operators are required to man the service and patients can be seen more quickly.

The basic principle is very similar to that of a digital camera. Both the conventional camera and its digital counterpart work by using a series of lenses that focus light to create an image. In the digital camera, instead of focusing the light onto a piece of film, it focuses it onto a semiconductor device that records light electronically. A computer then breaks this electronic information down into digital data.

In digital radiology, amorphous silicon detectors are combined with a caesium iodine or gadolinium oxysulfide scintillator to convert X-rays into light. The light is channelled through the amorphous silicon photodiode layer where it is converted to a digital output signal. The signal is then read by thin film transistors or fibre coupled CCDs before being sent to a computer for processing and display.

Introduced in the mid-1980s, DR has steadily gained in popularity. Like the digital camera, it rapidly began to compete with the more conventional film-based process and today is moving towards replacing it altogether.

The portable detector
In digital radiography, the X-ray source will often be built into a medical trolley. The battery allows the detector to be completely portable, so that if the patient is in a hospital bed, the trolley can be wheeled to them and the detector can be slipped underneath the patient to take the X-ray. Portable X-ray detectors need to be light weight and slim but extremely robust.

The comparison with the digital camera ends when it comes to the size of the detector required for each device. For example, the detector on your smart phone camera is about 3mm across, whereas a DR detector can be the size of a briefcase.

Furthermore, the batteries within smart phones usually consist of a single Lithium ion cell whereas the large portable detector panels require a far more complicated multi-cell battery pack.

Although the batteries for detectors need to be larger, they must still maintain a slender profile if they are to fit into the rear of the detector – the need for thinness in such a large footprint creates a number of challenges for the battery designer.

The lithium ion cells used within such batteries are more commonly of the ‘pouch’ type which cannot tolerate bending or twisting. The battery case must provide enough torsional rigidity to prevent damage to the cells which may cause internal short circuit leading to overheating or fire. The use of modern plastics technology can aid in the design of such cases but clever mechanical design can also ensure that rigidity is built into the structure and still maintain the thinness that the market requires.

Removable and rechargeable
Some digital radiography detectors contain an embedded battery similar to that used in handheld tablet devices, but the consequence is that, once the battery reaches its end of life, the hospital has to send the detector back to the manufacturer for the power source to be replaced. This is a costly exercise which puts a vital piece of medical equipment out of service. The solution is a removable, rechargeable battery, enabling the hospital to achieve continuous use.

However, batteries used in critical environments in this way must provide genuinely accurate fuel gauging to ensure that the remaining battery life indicators are reliable. This provides the user with predictive run time of the device, giving them the ability to know how many images they can take.

For clinical environments, Accutronics has developed multi-bay smart charger technology which means that multiple batteries can be charged at a time, resulting in a quick changeover and a device that can remain in continuous use.

Smart features
These innovative power products contain the latest smart battery technology, including active and passive protection circuits that prevent over-temperature, over and under-voltage, overload and short circuit. They are capable of accurate fuel gauging and are built to international regulatory standards, all features especially useful in the increasingly dynamic nature of modern hospital care.

Digital radiography’s future
Because of the initial cost of a DR system, it mostly being adopted in countries with a tier-one health system, however, digital technology is evolving at a rapid rate and becoming more flexible and affordable. More than two billion people in the world now have access to the internet and five billion of have mobile phones. Like the transition from film-based to digital cameras, it’s conceivable that digital radiography will also, one day soon, have a global appeal.