THE **PUBLICATION** FOR **DESIGN ENGINEERS**

DENA

DESIGNING ELECTRONICS NORTH AMERICA

SEPTEMBER/OCTOBER 2022

AN MMG PUBLISHING TITLE

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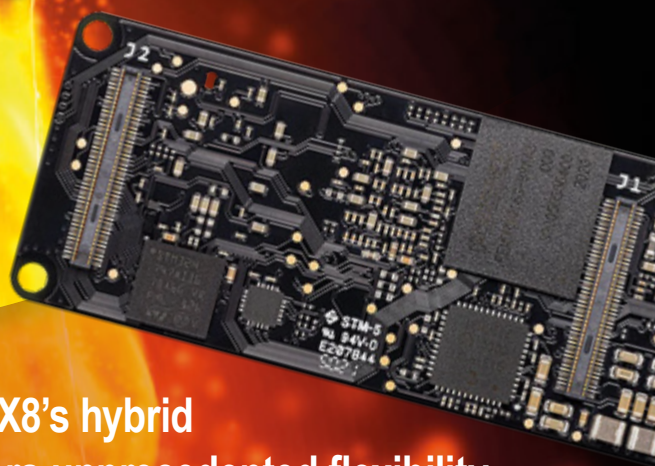

+

ALSO FEATURED ON PAGE 30 - **The Portenta X8's hybrid combination of MPU and MCU offers developers unprecedented flexibility**

CONTENTS

EDITORS WORD

The excitement mounts!

September is going to be an exciting month for me this year, not the least that it sees the publication of this issue of DENA. Another reason for my excitement is that on Wednesday 7th September I will be giving the keynote presentation at the FPGA Forum in Norway. It's been 10 years since I last spoke at this event, which is the premier conference for anyone who has anything to do with FPGAs in Norway and nearby countries, including designers, managers, and vendors.

Whilst there, I've also been invited to give a guest lecture to the students on the MSc course in embedded engineering at the Norwegian University of Science and Technology (NTNU). I always feel its important to have an overall theme for this sort of thing, otherwise the audience might think I was making it up as I went along, so my theme for this talk is going to be "change." For example, we will consider how much has changed with respect to technologies and design tools since I started out in my career, after which we will contemplate some of the changes that are to come, such as software development tools and electronic design automation (EDA) tools that are augmented with artificial intelligence (AI).

These tools are already starting to appear, but there's no need to worry because you can be assured that we will be covering anything you need to know about such topics in future issues of DENA.

Max Maxfield

CLIVE 'MAX' MAXFIELD
Editor, DENA

Contact

EDITORIAL
Managing Editor: Clive 'Max' Maxfield
max@designing-electronics.com

ADVERTISING
Sales Executive: Will Leary
william.leary@designing-electronics.com

DESIGN
Production & Design Manager: Josh Hilton
josh.hilton@designing-electronics.com
Junior Creative Artworker: Tom Claydon-Smith
tom.claydon-smith@designing-electronics.com

CIRCULATION
Circulation Manager: Vicky Leary
vicky.leary@designing-electronics.com
Circulation Account Manager: Liz Poole
liz.poole@designing-electronics.com

PUBLISHER
Mark Leary
mark.leary@designing-electronics.com
Director of Operations: Denise Pattenden
denise.pattenden@designing-electronics.com

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TOP STORY

MPU-based SOMs

As the embedded market continues to evolve, developers may need to transition from a microcontroller (MCU) to a microprocessor (MPU) to handle increased processing requirements. To help with this transition and reduce design complexities, **Microchip** has expanded its portfolio of MPU-based system-on-modules (SOMs) with the SAM9X60D1G-SOM ARM926EJ-S-based embedded MPU running up to 600MHz. Software for the SAM9X60D1G-SOM is available with bare metal or RTOS support through MPLAB Harmony3 or complete Linux mainlined distributions.

The SOM, based on the SAM9X60D1G System in Package (SiP), is a small 28 mm x 28mm hand-solderable module that includes the MPU and DDR in a single package, along with power supplies, clocks, and memory storage. The SAM9X60D1G-SOM is Microchip's first SOM equipped with 4Gb SLC NAND Flash to maximize memory storage of data in application devices, while the on-board DDR reduces the supply and price risks associated with memory chips. The small-form-factor SAM9X60D1G-SOM also includes an MCP16501 power management IC (PMIC), which simplifies the power design effort to a single 5V voltage rail to enable lower-power systems.

To offer the features an Ethernet-connected system might require, the SAM9X60D1G-SOM contains a 10/100 KSZ8081 Ethernet PHY and a 1Kb Serial EEPROM with pre-programmed MAC address (EUI-48). Customers can further customize their design based on the level of security protection required, such as secure boot with on-chip secure key storage (OTP), hardware encryption engine (TDES, AES and SHA), and True Random Number Generator (TRNG).

www.microchip.com

Industrial grade 3D ultrasonic collision avoidance sensor

With the autonomous vehicle industry booming and mobile robots (such as automated forklifts, AMRs, and AGVs) experiencing exponential growth levels, the safety of humans and machines is kept at the forefront of manufacturing efforts. The market has come to realize that 3D collision avoidance is a necessity, since the obligatory 2D safety LiDARs can only deliver two-dimensional data output not matching highest safety needs.

The **Toposens** 3D Ultrasonic Echolocation Sensor ECHO ONE and Toposens PROCESSING UNIT address the unmet need for higher safety of mobile robots in industrial settings. Based on the principle of echolocation as seen in bats, the sensor sends the obtained data in a 3D point cloud format to the processing unit, which is equipped with easy-to-configure advanced 3D collision avoidance software.

toposens.com

BLE TPMS for automotive OEMs

Interest in Bluetooth Low Energy (BLE) tire pressure monitoring system (TPMS) implementations is on the rise as vehicles become more connected, electrified, and autonomous. While common in consumer applications like speakers and headphones, BLE is relatively new in the TPMS space for vehicle OEMs and is enabled by newer vehicle system architectures that can support BLE functionality.

Sensata's new BLE TPMS leverages its field proven tire pressure monitoring sensors by replacing the ultra-high frequency (UHF) radio with BLE radio to enable two-way communication. These new BLE TPMS solutions are available in both clamp-in and snap-in configurations, are optimized for long battery life, and deliver the same pressure, temperature, and auto-location capabilities as Sensata's existing UHF TPMS solutions.

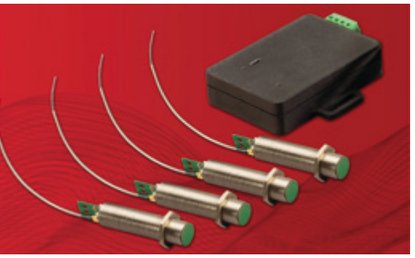
www.sensata.com

Wireless gap measurement probe for rotating machinery

MTI Instruments, a US-based manufacturer of advanced test and measurement equipment, has announced the introduction of its Accumeasure Wireless Gap Measurement Probe System. The system consists of up to four battery-powered, wireless capacitance probes paired via Bluetooth to their receiving device.

The wireless capability and compact form factor of the battery-powered probes are designed specifically to measure gaps in difficult-to-reach or

inaccessible locations. Unlike eddy current probe systems, capacitance probes are not susceptible to temperature drift, have built-in calibration, and are immune to magnetic field interference.



The capacitance probes transmit displacement (gap) readings ranging from 0.1 to 2.0mm from fixtures to the rotating machine surface. Measurements are optimized for machines with a surface velocity of 6,000 SFM. Data from the receiver via RS-485 Modbus RTU interface protocol can be used for real-time monitoring of vibration and bearing health.

mtiinstruments.com

Compact preamplifier measures signals up to 22GHz

Obtaining useful results from EMC measurements often fails because the measurement levels are too low or because the measurement tools used are not sensitive enough. These issues are addressed by **Langer EMV-Technik's** PA 2522 preamplifier with its amplification of 25dB. The PA 2522 amplifies low measurement signals over an extremely wide frequency range from 10MHz to 22GHz with very low noise and a constantly high dynamic range. This means that sources of interference with very low levels can now be clearly detected on measuring equipment.

The signal amplifier, which is handcrafted in Germany, is a consistent further development for EMC applications. In combination with a matching near-field probe (from Langer EMV-Technik, for example), it is possible to perform harmonic measurements of high-frequency signals up to 22GHz. With its compact design, the PA 2522 can be integrated into development environments in a versatile way. Directly connected to the 50Ω input of a spectrum analyzer or oscilloscope, the preamplifier simultaneously protects sensitive measuring equipment from overvoltage.

www.langer-emv.de

Crystal applications with USB4 retimers

With some high-speed signals, it's necessary to augment redriver functionality with retimer capability

The first crystal oscillator, which was implemented using a piece of Rochelle salt, was created by American scientist Alexander M. Nicholson in 1917 while working at Bell Telephone Laboratories. A key initial use of these early components was in stabilizing the frequency of amplitude modulation (AM) radio transmitters in the 1920s. In the past few decades, crystals have been used to create accurate transmit frequencies for all of the key computer interfaces, including USB, PCIe, and Ethernet.

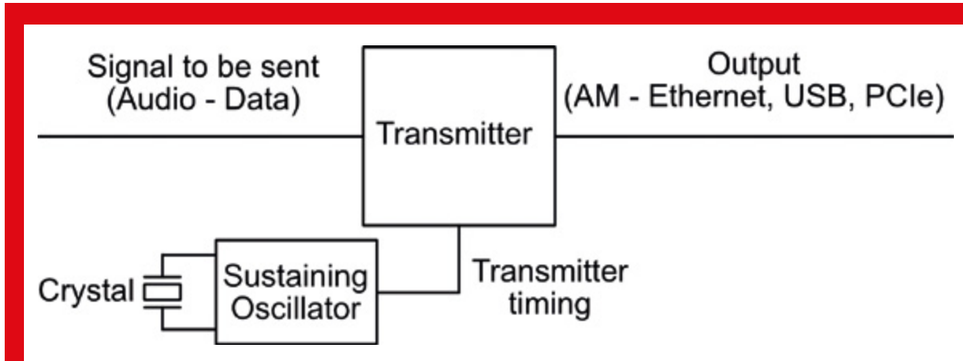
Of course, things are more complicated that they used to be in the 1920s. Today's high-end interfaces may require the use of both redrivers (a.k.a. repeaters) and retimers. Since the quality of a signal degrades as it propagates down a wire, redrivers are used to regenerate signals, thereby boosting the signal quality of high-speed interfaces.

Unfortunately, simply boosting the signal is no longer sufficient in the case of modern high-speed protocols in which both the data and the clocking information are encoded in a single differential signal. Although a redriver amplifies the signal and "sharpens its edges," it fails to address jitter, which refers to any deviation from true periodicity of a signal. Thus, in the case of some high-speed signals, it's necessary to augment redriver functionality with retimer capability. USB4 is the latest version of the 25-year-old USB family of interfaces. USB4 is particularly useful in high-bandwidth display and storage applications. However, the advent of USB4 has brought the need to use retimers in all but the smallest form-factor systems. This is because the higher speed of USB4 as compared to earlier generations causes excessive frequency dependent loss when traversing the system's printed circuit board. Earlier generations of USB could often get by using analog redriver circuits, but these have been found to be insufficient for USB4 because redrivers improve only the eye height and not the eye width.

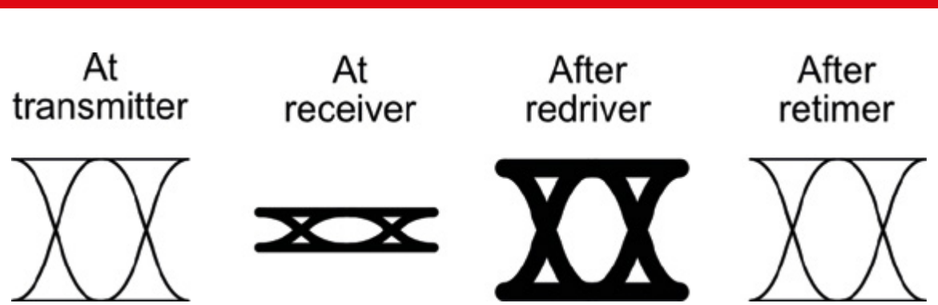
Crystals are used in USB4 retimers because these circuits must generate a clean transmit clock when operating in certain modes. USB4 retimers must operate in a long list of different modes that are determined during operation via negotiation. This is because the USB-C connector over which USB4 operates is sometimes known as "the one connector to rule them all." The USB-C connector supports all the speeds and widths of USB as well as the DisplayPort and Thunderbolt protocols, among others.

The modes that need a new transmit clock are the lower speeds of USB, that is USB1 and USB2 when operating in Separate Reference Clock with Independent Spread spectrum clock (SRIS) mode. This is because these two rates operate in a half-duplex mode and—as a result—do not have a continuous receive clock to work with.

USB4 retimers are generally protocol-aware, so they can handle the clocking differences found in SRIS mode by utilizing the "SKP"



Crystal oscillators have been providing timing for transmitters for more than 100 years (Source: Kandou)



Augmenting redriver functionality with retimer capability (Source: Kandou)

add/drop opportunities found in the protocol. USB3 and USB4 operate in full-duplex mode with a continuous signal, so the opportunity arises to use lower-latency bit-level retiming based on the recovered clock signal.

The crystal source is also used for the link for all operating speeds in certain training and calibration modes as well as in some test modes. The crystal also typically provides the clock to internal portions of the retimer device.

Crystals create an accurate and stable frequency because their oscillation results from the flexing of the physical crystalline material in an electric field. Since a crystal has a specific size, shape, and mechanical stiffness, it can flex only within a specific small frequency range.

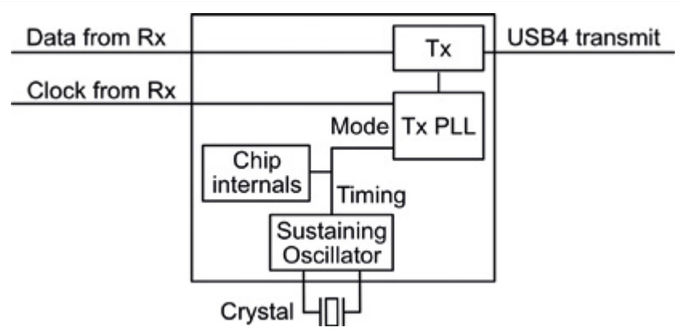
Efficient sustaining crystal oscillator circuits for USB4 applications include both single-ended and differential crystal oscillator structures. With differential oscillators, capacitively coupling the two sources adds DC stability.

The crystals that are used in USB4 retimers are the same as, or similar to, those that are used for USB4 sources. They must be cost effective as they carry the economics of the retimer device instead of that of the source device. These components typically have small form factors with an example being a 2mm x 1.6mm part. Typical specifications for such a crystal would have a nominal frequency of 25 MHz, would operate in a fundamental mode, and would have a clock accuracy of +/- 300 parts per million (PPM) or better.

The drive for ever smaller and less expensive future solutions will likely see the oscillator integrated or otherwise brought inside the package via a microelectromechanical system (MEMS) device or small crystal. The possible use of retimers in USB-C cables further heightens the need for size-constrained and low power solutions.

To address a wide variety of use models, Kandou is currently shipping USB4 retimers in volume.

www.kandou.com



Crystal oscillator use in a USB4 retimer device (Source: Kandou)

Considerations when designing for power

System designers often have to choose between standard, custom, and modular power supplies

When designing a system that requires some form of power conversion, the power source (power supply or battery) is often one of the last items to be considered. In some ways this makes sense because the total power requirement for the system and the different voltages used within the system must be identified first before the power supply is selected. However, that may not leave enough time to properly choose the power supply that best meets all the needs of the system. Let's look at some of the key considerations when choosing a power supply in the design of your end system.

Don Baldwin, Technical Support Manager for Power, Sager Electronics

The type of output current limit required to power the system load(s) affects the type of power supply that needs to be selected. A constant voltage output with a hiccup-mode over-current limit protection scheme is designed for a more resistive type of load, such as the controls or displays within a system. A hiccup-mode over-current limit will shut down the output once the over-current point is reached, and then turn back on after a short time to see if the load has fallen below the over-current point. If it has, the power supply will continue to provide power. If it has not, then the output will shut down again and repeat the cycle until the load is reduced, thereby causing the output to "hiccup."

"If the power supply is designed to constantly meet the peak power requirements for the load, then you may be using a power supply larger than is necessary"

By comparison, a constant current output is designed to reduce the output voltage and maintain the output current until the output voltage reaches a low limit and the output is shut off. This type of over-current protection is designed for highly capacitive loads or battery charging.

Sager Electronics recently worked with a customer who required both a constant current output for charging batteries and a constant voltage output to power their system load. We identified the PBA series power supply from

COSEL to power both output requirements—constant voltage or constant current. Working with Sager's electrical and mechanical engineers to design a custom control board, a sheet metal enclosure, and DC/DC converters to regulate the battery voltage to the load, the customer was provided with a custom power solution using standard AC/DC and DC/DC power supplies.

Another consideration when designing your end system is its peak and steady state power requirements. Steady state refers to the power the system needs on a regular basis to perform its basic tasks, while peak refers to the power needed for a short period to perform a special task for the system. Driving a pump, a motor, a print head, or a highly capacitive load are examples of systems whose peak power needs may be substantially more than their steady state requirements. These items need extra power to begin moving or operating at start-up, after which they revert to require significantly less power to maintain their operation. If the power supply is designed to constantly meet the peak power requirements for the load, then you may be using a power supply larger than is necessary. Power supplies with peak/boost capability, or supplies that have both convection and air-cooled ratings, can be used to power these types of loads.

"A common design challenge is to decide between a single output supply in conjunction with multiple DC/DC converters vs. a custom power supply"

Rather than sizing the power supply for the worst-case peak current, a better option is to use a power supply that can provide the peak current while being designed for the non-peak operating power. For example, some power supplies are designed to meet peak power requirements two to three times their normal output ratings. In this case, the peak power rating will be specified with a maximum duty cycle and for a limited period. Calculations need to be made to ensure the power supply can meet the peak power requirements while maintaining an average power level below the steady state power capabilities of the power supply. If the peak power requirements are for a short enough duration with a reasonable duty cycle, the power supply can be designed for the lower steady state power requirements and still provide the power needed for the peak power requirements. This allows the system to use a smaller, less expensive power supply that still meets all the system power requirements. Sager stocks the leading manufacturers of peak power supplies such as Cincon, MEAN WELL, RECOM Power, TDK-Lambda, and others.

Another common design challenge is to decide between a single output supply in conjunction with multiple DC/DC converters vs. a custom power supply. Suppose your power supply needs to provide multiple output voltages to run all the different loads within your system. In that case, a single output supply with multiple DC/DC converters may not be the best solution due to space and complexity of the design. A custom power supply may be able to meet all your needs; however, such a device may have a long design cycle with high costs for non-recurring engineering (NRE) and agency approvals, and perhaps have minimum quantities that do not match your requirements. Even if a custom power supply does appear to offer the best choice, it may be that the system design is still in flux, the final output voltages and currents are not set in stone, but you still need power supplies to work out the final design, so what do you do?

One option is to consider a modular/configurable power supply. A modular power supply provides the ability to have up to 24 different outputs in a variety of sizes and power levels with low minimum quantities, no long design cycle, and no additional NRE charges or safety agency approvals. The modular power supply can be configured to provide the output voltages and currents your system needs to operate all of its different loads. Some of these outputs can even be configured for constant current operation or have peak power capabilities. The latest generation of modular products offers size, price, performance, features, and quality enhancements, making them attractive and reliable solutions. With an expansive inventory of power modules and chassis, coupled with our years of applied experience and expertise, Sager can provide a configured solution that meets your precise power requirements.

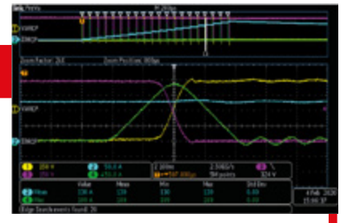
What if you take the power supply outside the system and employ an external power supply? This removes the heat the power supply produces and eliminates the space required for the power supply from the system enclosure. Now the consideration becomes how the power supply connects to the system enclosure and the loads within the system. One of the critical issues here is choosing an appropriate connector for the system before choosing the external power supply. External power supplies have a designated standard output connector based on the power level and the manufacturer of the power supply. If the connector in the system does not match the connector on the power supply, a modified standard version of the power supply may be required to have the proper mating connector attached, with minimum order quantities and potentially higher costs.

A final consideration is whether a design relies on batteries as a primary or secondary power source. Batteries, which accept, store, and release electricity on demand, power everything from small electrical devices to medical devices, robotics, electric vehicles, and more. As automation and electrification becomes increasingly common across all industries, a design engineer will need to consider rechargeability, energy density, power density, shelf life, safety, form factor, cost, and flexibility when deciding which battery solution to use. Sager Electronics' growing line card of battery solutions and custom battery pack capabilities can help solve your battery design requirements.

With a world-class line card in interconnect, power, and electromechanical products, and expert technical sales and support, Sager has the standard, custom, and modular power products, and solutions for any power system design.

www.sager.com

Pre-switching beats hard-switching and soft-switching



One of the core tasks performed by power conversion systems is switching, which is implemented using semiconductor devices like BJTs, thyristors, MOSFETs, and IGBTs. When these devices are turned on or off, the transition time is short, but it is not instantaneous. The time taken to transition between states results in wasted energy, which occurs at the intersection of voltage and current waveforms and is known as switching loss.

The traditional switching approach, known as hard-switching, involves simply forcing the device to turn on and off (commutate) by using the current or voltage signal to directly control the device. In addition to being hard on the device and resulting in switching loss, hard-switching also generates noise in the form of electromagnetic interference (EMI). A more recent technique, known as soft-switching, was introduced in the 1980s. The idea is to use additional components to implement a resonant circuit that switches when the voltage is zero, thereby minimizing the intersection of the voltage and current waveforms and significancy reducing switching losses and EMI. However, traditional soft-switching forced-resonant circuit topologies have limited adaptability across varying input conditions and load ranges.

Pre-Switch, Inc. has solved the issues of computational limitations, cost, and complexity that previously prevented forced-resonant soft-switching from achieving widespread success. Known as pre-switching, this technology is based on the use of an embedded artificial intelligence (AI) integrated circuit (IC) called Pre-Flex, which precisely controls and adjusts the timing of a very small and low-cost resonant circuit to ensure that there is minimal overlap of current and voltage waveforms of the switching devices.

The Pre-Flex IC learns and adapts in-circuit on a cycle-by-cycle basis to guarantee optimal soft-switching despite any changes in input voltages, output loads, system temperatures, and manufacturing tolerances. In addition to eliminating up to 95% of total switching losses, pre-switching technology also significantly reduces EMI because there is virtually no power radiated during transistor commutation. Furthermore, the technology can be used to enable virtually any desired dV/dt per switching cycle, which is a large enabler for newer, faster-switching, wide-bandgap (WBG) devices.

www.pre-switch.com

Silicon Carbide, SEMIKRON, and ROHM Semiconductor

SEMIKRON, headquartered in Nuremberg, and the Kyoto-based company ROHM Semiconductor have been collaborating for more than ten years with regards to the implementation of silicon carbide (SiC) inside power modules.

ROHM produces SiC components in-house in a vertically integrated manufacturing system and thus delivers high quality, energy-saving products while achieving a constant market supply. ROHM's production subsidiary SiCrystal, located in Nuremberg, Germany, plans to strongly grow its silicon carbide wafer capacities and human resources – to produce several 100,000 substrates a year.

Recently, ROHM's latest 4th generation of SiC MOSFETs has been fully qualified in SEMIKRON's eMPack modules for automotive use. Furthermore, SEMIKRON has announced it has secured a billion-Euro contract to supply its innovative eMPack power modules to a major German car maker, beginning in 2025.

www.rohm.com
www.semikron.com

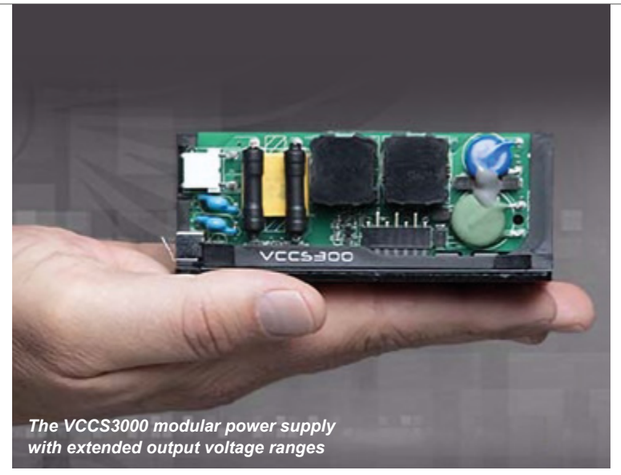
Got power?

Power supply selection should not be an afterthought

When you are designing a new system, the power supply you choose should not be an afterthought. Vox Power is a power supply manufacturer from Ireland that offers a range of unique high-density AC/DC power solutions for a wide variety of industrial, medical, and technology markets.

For example, the Vox Power VCCS300 fan-less power supply series delivers a silent 300 watts of continuous output power in a rugged and miniature 4" x 2" x 1.61" package, which can be cooled using conduction, convection, or forced air cooling techniques.

Now available with standard output voltages of 12, 15, 24, 28, 36, 48 and 56VDC the VCCS300 platform can also be tailored to suit any other customer specific output voltage ranging between 12 – 58VDC without costly safety approvals and time-consuming custom designs being undertaken.



The VCCS3000 modular power supply with extended output voltage ranges

The Vox Power VCCS300 meets the latest international medical (BF Rated) and ITE safety approvals and is perfectly suited for use in ventilators and lab equipment as well as battery charging and PoE applications in addition to the more established industrial, IT, and medical markets.

The product is suitable for Class I or II equipment and carries multiple immunity and MIL-STD compliances including MIL-STD 810G, MIL-STD 461F, and MIL-STD 704F making it perfect for applications in rugged and high-vibration environments.

www.vox-power.com

Memory Suppliers See Innovation Opportunities – and Challenges

The semiconductor memory business thrives on innovation, strategic alliances, and production efficiencies, but the challenges are legion too

In the semiconductor memory business, every innovation counts as does every penny invested in technology and manufacturing advances. Recent investment and divestiture actions at the top memory vendors and their smaller competitors point to the significance of combining innovation with strategic initiatives to thrive in the marketplace, according to analysts and industry executives.

Memory semiconductor suppliers are being compelled to couple innovation with other strategic initiatives, including the addition of software suites and other IPs, collaboration with customers and, mergers and acquisitions that can help boost scale and create new opportunities for stakeholders. The M&A actions have led to the forced exit of some manufacturers, allowing survivors to hone their competitive edge by adding design engineering teams, technical employees, and production facilities.

Intel Corp. showed this trendline in the second quarter. Rather than doubling down on a losing business amidst huge technology challenges, the company announced steps to exit its Optane memory business, adding to other actions it had previously taken in the highly competitive market. By 2025, the company would have completely wound down most of its memory operations, depending instead on former rivals for its internal needs.

"We further sharpened our focus in the second quarter [by] selling our drone business and making the difficult decision to wind down our efforts in Optane, as we embrace CXL, a standard which Intel pioneered," said Patrick Gelsinger, Intel's CEO, during a call with analysts. "These add to actions last year in NAND and the sale of McAfee."

While Intel is exiting the memory market, other suppliers are digging in and expanding research, design, and other development activities, including the expansion of existing production facilities and plans to build new ones as in the case of Micron Technology. The company recently unveiled plans to spend as much as $150 billion over the next 10 years on new fabrication plants.

Memory makers are planning to add new fabs because they see opportunities to building competitive advantages through design engineering and collaboration with customers seeking innovative solutions in a wide range of product areas, including in AI, connectivity, data, cloud infrastructure and PCs.

SK Hynix is a prime example of a memory manufacturer that appears focused on setting the innovation agenda in the business. The company agreed in 2020 to acquire Intel's NAND business for a total of $9 billion but a chunk of that deal will close in 2025. That is when SK Hynix expects to take over all of Intel's remaining NAND assets, "including certain IP related to the manufacture and design of NAND flash wafers, R&D employees and the Dalian fab workforce," according to Intel when it updated the details of the transaction last December. If the deal closes in March 2025 as expected, SK Hynix would need to pay Intel the final bill of $2 billion, the company said.

New opportunities, new business

Reflecting the opportunities it sees in differentiated technology solutions, South Korea-based SK Hynix, did not pool the Intel acquisitions into its existing business. Instead, the world's second largest memory chip maker, floated a new business named Solidigm to explore what it calls "advancements in storage technology [that] are critical to unlocking data's unlimited potential."

Solidigm is owned by SK Hynix but based in Silicon Valley and headed by Robert Cooke, formerly head of Intel's non-volatile memory solutions group. It formally began operations in December 2021 to focus on creating what the company described as "next-generation SSD solutions optimized for data center applications through roles in hardware and software development, debugging, system engineering, and more."

"The establishment of Solidigm is an unprecedented opportunity to reinvent the data memory and storage industry," Crooke said in a statement announcing the creation of the company. "As a global leader of innovative NAND products and solutions, we are committed to expanding the possibilities of data that fuel human advancement – all while building a team culture that enables agility and excellence."

Exclusively sponsored by Mouser Electronics

Robert Cooke**, CEO at **Solidigm

While Solidigm may be new as an enterprise in the semiconductor industry, its roots go deep in the memory market. It started life with billions of dollars in revenue from the old Intel business and the potentials for faster growth and market penetration under SK Hynix. Before agreeing to sell the business, Intel reported its NAND division had sales of approximately $2.8 billion for the first half of 2020 and contributed "approximately $600 million" to the operating income of its non-volatile memory solutions group business.

SSD in focus

Prior to the Intel NAND memory transaction, SK Hynix too had a long history in the SSD market, having introduced 96-layer 4D NAND flash in 2018 and 128-layer 4D NAND flash products in 2019. It promised to combine its own internally developed products with the Intel NAND products "to establish a higher value-added 3D NAND solutions portfolio, including enterprise SSDs." Those opportunities should widen as Solidigm becomes better established in the market and as it leverages design innovation opportunities in collaboration with customers.

The NAND flash market promises huge growth opportunities. Market Research Future sees the SSD market expanding to $86.5 billion by the end of this decade propelled higher by the growing demand for faster data access, "memory-driven infrastructure and remote edge deployments," and small-form factor products.

"Other benefits that SSDs can provide include durability & reliability, faster data processing than hard drives, lightweight & silent working features, and more practical sizes/form factors," the researcher said. "Today, SSDs are extensively used in businesses, gaming, smartphones, servers, and smart wearable & gadgets. Their compact design, low power consumption, and high speed make SSDs an indispensable component in smart wearable devices and gadgets."

Market Research Future expects the SSD market to growth at a compounded growth annual growth rate, (CAGR), of 15.2 percent between 2020 and 2030. This would make it one of the fastest-growing segments of the global semiconductor industry, which is forecast to expand at a strong but slower rate during the same forecast period. The SSD market growth rate is not expected to be uniform, though, with North America forecast to lead the expansion on surging demand from the data communications market.

The SSD market is also fragmented and may experience further consolidation in the years ahead. Current Players include companies like IBM, SK Hynix, Samsung, Micron, Toshiba, Kingston Technology, SanDisk, Lite-On, and Western Digital. However, these companies are not competing solely on production excellence and supply availability.

They are forming alliances, collaborating on product development, and striving to gain competitive advantages through mergers and acquisitions as in the case of SK Hynix and Intel. Design innovations and other technology initiatives have also helped the market leaders, according to industry executives and observers.

Samsung, for example, in July rolled out what it termed its second-generation Smart SSD, which can process data directly, reducing the transfers between the CPU, GPU and RAM. The new Smart SSD was jointly developed with customers who contributed software and other IP on in-built Arm cores. Collaborative development activities like this have become essential to push the technology forward as companies race to offer it as an alternative to regular HDDs.

"Commercialization of the first-generation SmartSSD, in collaboration with AMD, established that the computational storage market has great potential," said Jin-Hyeok Choi, executive VP and head of memory solution product & development at Samsung Electronics, in a statement. "With the upgraded processing functionality of the second-generation SmartSSD, Samsung will be able to easily address increasing customer needs in the database and video transcoding sectors, as we expand the boundaries of the next-generation storage market."

Samsung said the new SSD is powered by adaptive SoCs from Xilinx, a unit of AMD.

"The second-generation Samsung SmartSSDs enable improved CPU efficiency and greatly reduced energy consumption by efficiently integrating the computing and storage functions in data centers," said Sina Soltani, VP of Sales, AECG, data center and communication group at AMD. "As data-intensive applications continue to grow, second-generation Samsung SmartSSDs will deliver the superior performance and efficiency required for this expanding market."

SEMICONDUCTOR MARKET WATCH

Dazed and confused about switches?

Switches are ubiquitous, so why do so few of us use the correct terminology?

Even though their underlying technologies are more than 100 years old, electromechanical switches continue to permeate today's electronic products. For example, I just looked at the spiffy new RIGOL DS1054 oscilloscope sitting on my desk ("my precious") and counted 39 pushbutton switches on the front panel alone.

Yes, we could use touch screens to replace many switch operations, but there's something satisfying about the tactile feedback provided by honest-to-goodness electromechanical devices, which are more rugged and reliable in hostile environments like industrial settings.

What is a switch?

In electrical engineering, the term "switch" refers to an electrical component that can disconnect or connect a conducting path in an electrical circuit, thereby interrupting the electric current or diverting it from one conductor to another.

Switches come in a wide variety of shapes and sizes, from the knife switches favored by Igor and Frankenstein ("It's alive! It's alive!") to magnetic switches to mercury tilt switches. As fate would have it, mercury tilt switches are one of the few switches that don't bounce, which is ironic since so few of us use them in the first place (see also my column on switch bounce and debounce in the July/August issue of DENA).

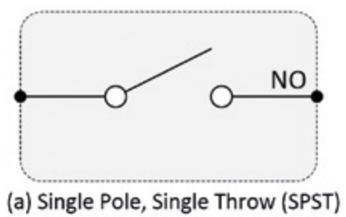
Switches may be operated by hand, automatically operated (actuated by machine motion, e.g., by a limit switch), or process operated (actuated by physical changes in some process. e.g., temperature, pressure, humidity, level, flow, pH level).

Poles and throws

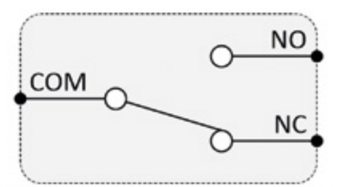
The term "poles" refers to the number of electrically distinct switches that are controlled by a single actuator. The term "throws" refers to the number of separate wiring paths (other than "open") that are associated with each pole.

In the case of toggle switches, I tend to think of the contact connected to the fixed side of the actuator as being the pole, and the contact associated with the moving side of the actuator as being the throw. (In this context, the term "actuator" refers to the part of the switch to which an external force is applied to operate the switch, for example, a lever, rocker, knob, or button.)

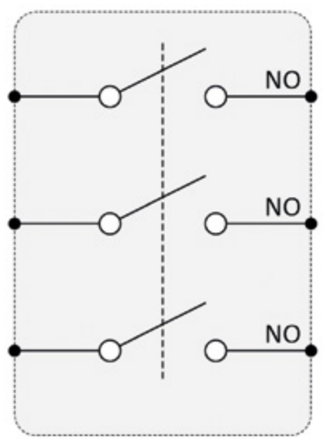
Single-pole, single throw (SPST) switches, particularly pushbutton



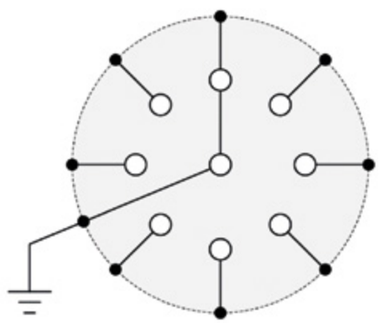
(a) Single Pole, Single Throw (SPST)



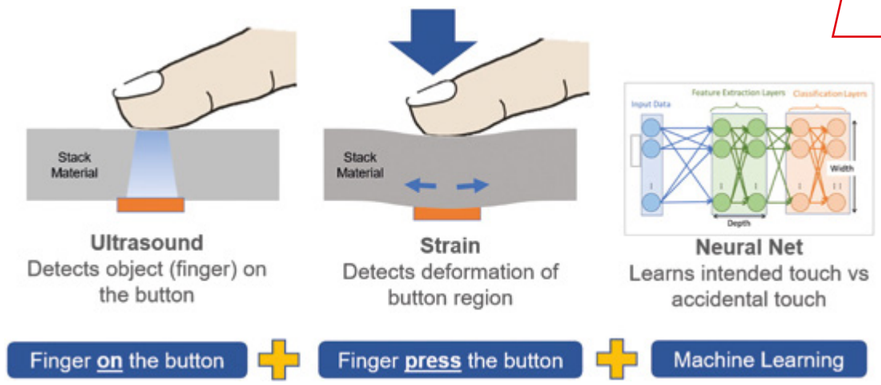
(b) Single Pole, Double Throw (SPDT)



(c) Triple Pole, Single Throw (3PST)



(d) 1P8T Rotary Switch



switches, are typically "open" (not connected) by default, so their throw contacts are referred to as being normally open (NO), but normally closed (NC) versions are also available. In the case of single pole, double throw (SPDT) switches, the common terminal is usually annotated as "COM."

Pushbutton switches are commonly of the "momentary" variety, which means they are active only while the pushbutton remains pressed. However, "latching" versions—push once to activate and push again to deactivate—are also available.

In the case of more complicated switch configurations (typically anything more than single and double poles and/or throws), such as multi-throw rotary switches, it's common to start using numbers like 1P8T (one pole, eight throws).

Make and break

Consider an SPST switch. When this switch is in its OFF state, it is said to be "open" because the effect is the same as if the switch were to be removed from the circuit leaving an "open circuit," which refers to an electrical circuit that is not complete. By comparison, when the switch is in its ON state, it is said to be "closed," in which case the effect is the same as if the switch were to be replaced by a piece of conducting wire.

It's also common to use the term "make" (i.e., "making the connection") to refer to closing the switch, and "break" (i.e., "breaking the connection") to refer to opening the switch.

In the case of a switch with more than one throw, like an SPDT toggle switch, for example, then the most common type is classed as break-before-make (BBM). This means the moving contact breaks the existing connection with the current throw before making a new connection with the new throw. These are also known as "non-shorting switches."

Although they are less common, it's also possible to obtain make-before-break (MBB) switches in which the moving contact makes connection with the new throw before breaking its connection with the existing throw. These are also known as "shorting switches."

SPCO and DPCO

When we think of an SPST switch, we may also think of it as operating in an ON-OFF manner. In the case of a SPDT switch, we might describe this as operating in an ON-ON manner.

There are also toggle and rocker switches that are like SPDT switches—including using identical schematic symbols—except they have three positions for the lever (rocker). These are known as single pole, changeover (SPCO) or single pole, center off (SPCO) devices. Similarly, there are double pole, double throw equivalents called double pole, changeover (DPCO) or double pole, center off (DPCO). We may think of these switches as operating in an ON-OFF-ON manner.

Who do you trust?

There are, of course, many purveyors of switches. One of my favorites is C&K (ckswitches.com), which recently became part of Littelfuse (littelfuse.com), not least that the company was formed by Charles A. Coolidge, Jr. and Marshall Kincaid in 1957, which is the same year I decided to grace this planet with my presence.

One reason I favor C&K is that they offer 55,000+ base products and support 8,500,000+ switch configurations and combinations. Their strength is their ability to offer a full range of catalog products that can be rapidly customized into tailored solutions for their clients, of which I'm one.

The future is now

Will we always be chained to electromechanical switches? Probably not. For example, the folks at UltraSense Systems (ultrasensesys.com) have developed an ultrasonic sensor that makes a grain of rice look large by comparison.

This sensor can be mounted behind, or embedded in, a control surface of any practical thickness, because its ultrasonic signal can penetrate anything from hard plastic to stainless steel up to 5mm and 2mm thick, respectively.

In addition to the ultrasonic transceiver, four tiny piezo strain gauges allow this little scamp to detect deformations as small as 100nm in the surrounding material. It also boasts a neural touch engine (NTE) that supports native machine learning (ML) that can be taught to differentiate between intended vs. accidental touches. It probably goes without saying that the one thing this little beauty doesn't give us is any form of switch bounce.

As always, we certainly do live in exciting times.

www.logiswitch.com

OGN series fuse holder is now THR compatible

Surface-mount technology (SMT) components are used with solder reflow processes to fully automate the assembly. While through-hole technology (THT) components offer a board-mounted solution, they are typically not designed for the rigors of a reflow process. In these cases, a second soldering step is necessary. This additional step is time-consuming and allows additional margin for error.

The solution is through-hole reflow (THR) components that combine the features of PCB THT mounting with a component capable of withstanding the high thermal stress of a reflow oven.

SCHURTER is known for its compact high-performance fuse holders, and the OGN series open fuse holder for 5x20 mm fuses is no exception. In addition to existing THT and SMT versions, the series now offers a version that is compatible with THR solder processes.

www.schurter.com

Increased access to MIL-PRF-55342 chip resistors

New Yorker Electronics, Co., Inc., a global franchised distributor of passive electronic components, discrete semiconductors, and supply chain services, has announced the expansion of its ready-to-ship inventory of Vishay Dale (Military M/D55342) RCWPM thick film and E/H thin film surface-mount resistor series.

These QPL MIL-PRF-55342 chips are widely specified for employment in the broadest range of mission-critical military, aerospace, weapons systems, satellite, handheld communications, and any military/non-military design in which space is limited. Vishay's high reliability RCWPM thick film and E/H thin film resistors, together with multiple lines of Vishay resistors are now available from New Yorker Electronics.

www.newyorkerelectronics.com

Meet the smallest DFN MOSFETs in the world

Nexperia has announced the release of a new range of 20V and 30V MOSFETs in the world's smallest DFN package, the DFN0603. Nexperia already offers ESD protection devices in this package and has now succeeded in bringing it to their MOSFET portfolio, a feat as yet unmatched in the industry.

Next generation wearable and hearable devices are incorporating new levels of artificial intelligence (AI) and machine learning (ML), creating several challenges for product designers—available board space is at a premium and heat dissipation becomes a problem.

The ultra-low-profile DFN0603 package, measuring only 0.63 x 0.33 x 0.25mm, uses 13% less space than MOSFETs in the next smallest package (the DFN0604). This size reduction has been achieved without compromising device performance; in fact, the RDS(on) of these devices has been reduced by 74%, helping to improve efficiency and enabling wearable equipment designers to achieve greater power density.

www.nexperia.com

Crystal oscillators deliver peak performance in non-space applications

Q-Tech Corporation has introduced the QTCC353 Series of miniature SMD crystal oscillators, which are designed to provide superior performance over MEMS devices in a wide-range of non-space military, communications, instrumentation, and avionics applications.

Their unique 3-point XO mount and miniature, ultra-low-profile (3.2 x 5 x 1.2mm) packaging provides the industry's best combination of footprint/headroom, mechanical stability, and electrical performance. These devices also offer industry-leading mechanical and frequency vs. temperature stability, along with better vibration and shock tolerance than their MEMS counterparts.

The devices, housed in a hermetically sealed, ceramic package with gold contacts, are tested for MIL-STD-202 compliance for vibration (Method 204.D) and shock (Method 213.I).

www.q-tech.com

SMT heat pipes for thermal management

These novel SMT solutions pre-empt thermal issues in a unique way

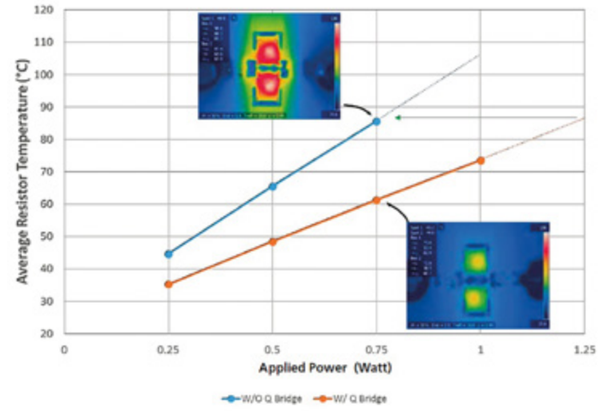
Thermal management has always been an important part of design but is gaining prominence with the development of wide-band-gap semiconductors. The improved frequency and power capability of these devices are raising the average operating temperature of power conversion and amplifier circuits, thereby stressing surrounding components.

Copper-based heat pipes have great thermal conductivity but are also electrically conductive. Large ground planes and heat sinks work well but transferring heat to these devices from the source can be difficult to optimize. A novel thermal management solution is SMT heat pipes, like the Q-Bridge series from Kyocera-AVX. These are packaged in familiar EIA case sizes similar to MLCCs but are not electrically conductive and have extremely low capacitance loading. These SMT heat pipes fill a thermal management solution gap for applications needing to be smaller and lighter yet retain their performance and reliability at higher temperature operating conditions.

These SMT heat pipes are manufactured using Aluminum Nitride or Beryllium Oxide with thermal conductivities ranging from 40 to 380mW/°C and packaged in EIA case sizes from 3737 down to a miniature 0302. Capacitance values can get as low as 7 femtofarads (fF) and top out at 0.21pF, which makes them ideal for mounting directly on to transistor and IC signal pins.

Mounting follows traditional guidelines but three termination options exist for users to review different thermal conductivity and capacitance values. The varied amounts of metallization on the ceramic, cross-sectional area of the ceramic chip, and the amount of surface area contacting the heat source all contribute to these parameters. Voltage ratings are correlated to their size and range from 100 to 4000V. From reducing thermal noise in LNAs to cooling GaN transistors, their wide range of specifications make these viable for many applications encountering thermal and size design constraints.

Multiple tests were performed to quantify the improvements afforded by SMT heat pipes. The illustration shows two series resistors in parallel with a pair of Q-Bridges. The resistors were powered up until they reached 1W or until they heated up to 85°C, whichever came first. The heat pipes were mounted on the common resistor pad and the opposing terminations were connected to heat sinks. At 0.75W the uncooled resistors had already reached 85°C, while the cooled resistors only measured roughly 62°C. The cooled resistors could achieve 1W and were well below the maximum allowed component heating. A second test held the power constant at 841mW and instead compared the cooling performance of a metal heat sink against a singular SMT heat pipe. The heat sink attached to the resistor reduced heating by 17°C, while the Q-Bridge reduced heating by 45°C.



Increased resistor power handling with two Q-Bridge devices

SMT heat pipes are one example of how the passive electronics industry is keeping up with active component trends. Designing high temperature capacitors, inductors, resistors, etc. to be able to withstand harsh environments is important, but it's also relevant to know that there are devices like the Q-Bridge that are intended to pre-empt thermal issues in a unique way. Further, the availability of miniature pick-and-place-capable SMT heat pipes is a game changer. This device family can easily enable optimized end circuit performances ranging from lowered noise floors to lower operating temperature actives, thus increasing reliability.

www.kyocera-avx.com

"Large ground planes and heat sinks work well but transferring heat to these devices from the source can be difficult to optimize"

Modern thermal analysis overcomes complex electronic design issues

By combining finite element analysis with computational fluid dynamics, designers can perform complete system analysis using a single tool

Today's modern electronic designs require ever more functionality and performance to meet consumer demand. These requirements make scaling traditional, flat, 2D-ICs very challenging. With the recent introduction of 3D-ICs into the electronic design industry, IC vendors need to optimize the performance and cost of their devices while also taking advantage of the ability to combine heterogeneous technologies and nodes into a single package. While this greatly advances IC technology, 3D-IC design brings about its own unique challenges and complexities, a major one of which is thermal management.

To overcome thermal management issues, a thermal solution that can handle the complexity of the entire design efficiently and without any simplification is necessary. However, because of the nature of 3D-ICs, the typical point tool approach that dissects the design space into subsections cannot adequately address this need. This approach also creates a longer turnaround time, which can impact critical decision-making to optimize design performance. A more effective solution is to utilize a solver that not only can import the entire package, PCB, and chiplets but also offers high performance to run the entire analysis in a timely manner.

Celsius thermal management solutions

Cadence offers the Celsius Thermal Solver, a unique technology integrated with both IC and package design tools such as the Cadence Innovus Implementation System, Allegro PCB Designer, and Voltus IC Power Integrity Solution. The Celsius Thermal Solver is the first complete electrothermal co-simulation solution for the full hierarchy of electronic systems from ICs to physical enclosures. Based on a production-proven, massively parallel architecture, the Celsius Thermal Solver also provides end-to-end capabilities for both in-design and signoff methodologies and delivers up to 10X faster performance than legacy solutions without sacrificing accuracy.

By combining finite element analysis (FEA) for solid structures with computational fluid dynamics (CFD) for fluids (both liquid and gas, as well as airflow), designers can perform complete system analysis in a single tool.

For PCB and IC packaging, engineering teams can combine electrical and thermal analysis and simulate the flow of both current and heat for a more accurate system-level thermal simulation than can be achieved using legacy tools. In addition, both static (steady-state) and dynamic (transient) electrical-thermal co-simulations can be performed based on the actual flow of electrical power in advanced 3D structures, providing visibility into real-world system behavior.

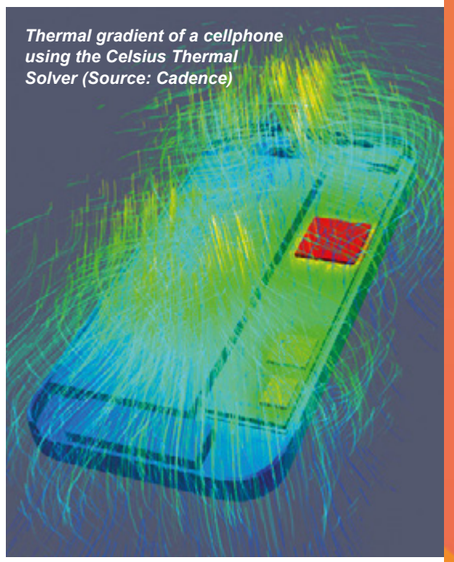
Designers are already co-simulating the Celsius Thermal Solver with the recently acquired Future Facilities' 6SigmaET electronics thermal simulation software, which provides state-of-the-art intelligence, automation, and accuracy. The combined workflow that ties Celsius FEA thermal analysis with 6SigmaET CFD results in even higher-accuracy models of electronics equipment, allowing engineers to test their designs through thermal simulations and mitigate thermal design risks.

Conclusion

As systems become more densely populated with heat-dissipating electronics, the operating temperatures of those devices impact reliability (device lifetime) and performance. Thermal analysis gives designers an understanding of device operating temperatures related to power dissipation, and that temperature information can be introduced into an electrothermal model to predict the impact on device performance.

The robust capabilities in modern thermal management software enable new system analyses and design insights and empower electrical design teams to detect and mitigate thermal issues early in the design process—reducing electronic system development iterations and costs and shortening time to market.

www.cadence.com



Thermal gradient of a cellphone using the Celsius Thermal Solver (Source: Cadence)

Chip design never looked more appealing

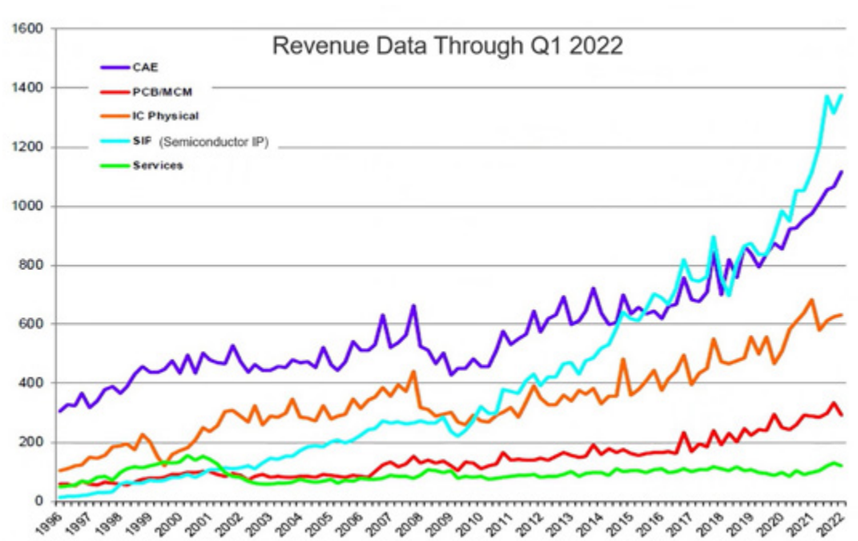
ESD Alliance serves the needs of chip, package, and manufacturing engineers

It's a great time to be a chip designer or a verification engineer, even though these jobs are increasingly more difficult as challenges get tougher and the need to bring design, packaging, and manufacturing closer together becomes more acute. In parallel, competitive time-to-market pressures continue to demand ever shorter schedules.

Fortunately, engineers rarely run from a challenge. They're also captivated by new applications for chips growing exponentially in various markets, including the popularity of an open-source instruction set architecture (ISA) known as RISC-V that highlights the catchphrase "Democratization of Chip Design."

The electronic system design (ESD) market that supports chip design and verification via electronic design automation (EDA) tools and semiconductor IP is also entering an exciting period. The ESD market is hot again. Demands for automation tools and IP are rising as chip and system complexity increases. ESD is where electronics begins and is a vital component of the global electronics industry. With industry revenue at approximately $13 billion, ESD is small but mighty and serves the needs of a disparate ecosystem of chip, package, and manufacturing engineers that develop products driving the $2 trillion global market for electronic products. As a result, all EDA and Semiconductor IP product categories increased revenue in Q1 2022, according to the most up-to-date SEMI Electronic Design Market Data report.

Through supply chain shortages, semiconductor downturns, and semiconductor companies looking more like systems houses and vice versa, electronic system design suppliers globally are the much-needed problem solvers. They supply state-of-the-art design and verification tools and IP for the chips, printed circuit boards, and multi-chip modules that power leading edge electronic systems and products. Hardware-assisted verification (solutions that include hardware emulation and FPGA prototyping) can handle hardware/software co-design. Front-end design solutions enable the ability for designers to effectively implement a "shift left" methodology where more of the critical design decisions occur early in the design cycle.



Electronic Design Market Data report (Source: ESD Alliance, a SEMI Technology Community)

Semiconductor manufacturers continue to push the envelope on new processes that deliver new levels of performance. The electronic system design community is responding, as always. ESD companies play a pivotal role in this push by providing the essential technologies, methodologies, and design automation tools to support these new processes.

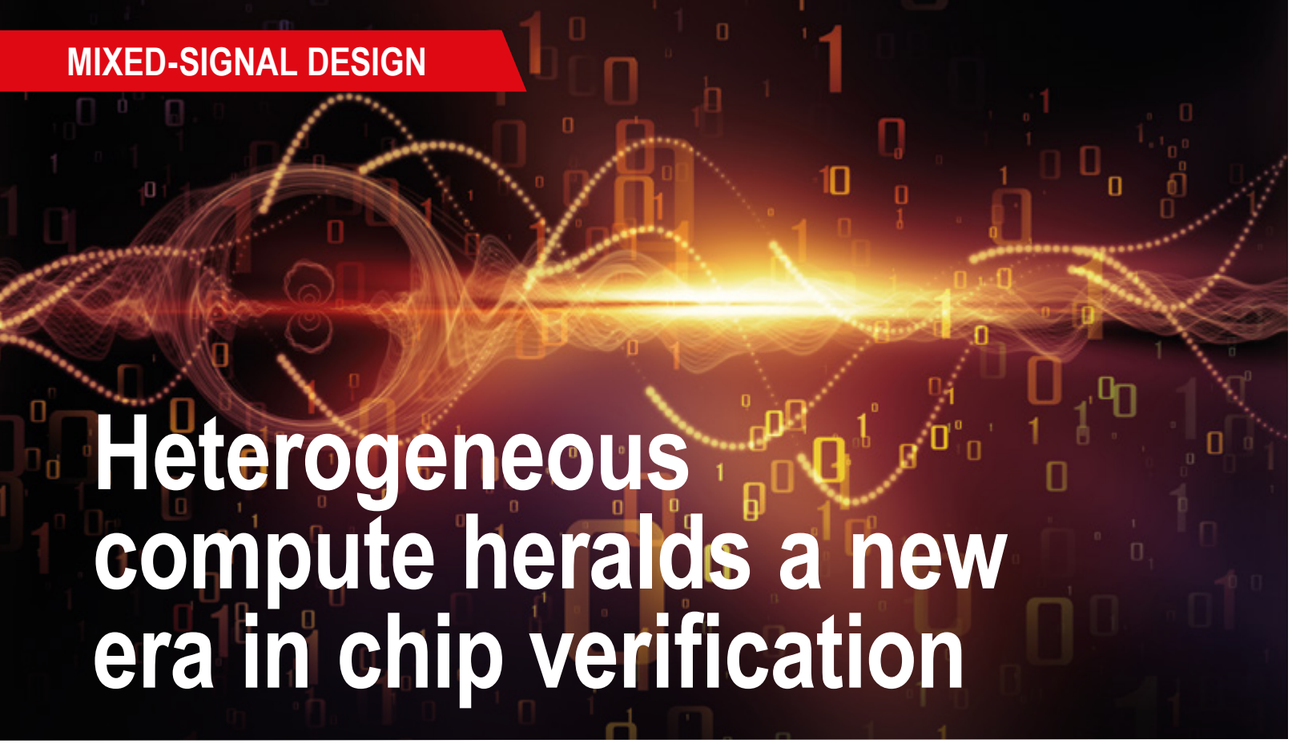
New applications are especially encouraging to engineers who love a challenge. With AI chips and AI techniques now giving design tools a huge boost, it was inevitable that applications for semiconductor-based solutions would ignite, and they are. Applications for cloud-based computing, automotive electronics (including autonomous driving), and 5G and 6G communications seem almost commonplace today. Up next is MedTech where funding is going into chips for drug discovery, patient monitoring, and remote access among other applications. Applications involving IoT and edge computing are a particularly attractive area as data processing moves down from the cloud and is located where the data is collected in real time.

Security and safety are other application areas that are growing rapidly and attempting to stay one step ahead of threats and breaches, while minimizing the occurrence and consequences of accidents such as roadway collisions.

The most galvanizing new application space may be the open-source silicon movement that has the potential to democratize chip design. This is expanding the community of specialized designers to an environment of creative enablement where anyone anywhere with innate skills can get their chip designs into silicon. It's likely that this movement and subsequent innovations will empower the semiconductor and electronic system design communities to think differently.

All told, chip design never looked more appealing. Recent industry events, including SEMICON West and the Design Automation Conference, seemed to bear this out. Both were filled with young, enthusiastic engineers from many parts of the world eager to launch themselves into careers in electronics. In many ways, this could be considered the "Golden Age of Chip Design."

www.semi.org/en/communities/esda



Heterogeneous compute heralds a new era in chip verification

Sumit Vishwakarma, Product Manager, AMS Verification for Siemens EDA explains why it is no longer sufficient to simulate analog and digital blocks separately in a "divide and conquer" approach

We are at a time when the computing performance benefits of Moore's law are coming more slowly and at a higher cost, even as artificial intelligence (AI) applications are driving demand for extreme compute performance. According to the non-profit research firm OpenAI, the amount of compute performance used to power the largest AI training runs has increased exponentially since 2012—doubling every 3.5 months.

Data processing and computing power are moving into the cloud, which offers significant flexibility and scalability achieved by the deployment and use of massive infrastructure based on uniform computing platforms working in parallel. This infrastructure is comprised of powerful servers running the fastest processors. However, as the demands on cloud application processors continue to increase, so does the complexity of the underlying System-on-Chip (SoC) devices. New heterogeneous compute architectures are designed to bring together the CPU, GPU, and accelerators into one SoC, often in multicore configurations to accelerate specific applications and algorithms. The complexity of heterogeneous architectures is resulting in a need for more focus on how we verify and validate the functionality of these SoCs.

As design complexity has spiked, so too has the complexity of verifying these increasingly sophisticated devices. SoC verification has become an exercise of applying many unique methodologies for each of the different classes of sub-design within a design. The advent of new technologies such as constrained-random data generation, assertion-based verification, coverage-driven verification, formal model checking, and intelligent testbench automation (to name just a few), has changed the way we see functional verification productivity. However, most of these new technologies have not been extended to verify mixed-signal design challenges.

So, why do we need to worry about mixed-signal verification for these SoCs? One major reason is the fact that data centers have adopted newer processing techniques by integrating accelerators—specifically, graphics processing units (GPUs)—to support emerging AI and deep learning workloads. GPUs are high-performance, high-throughput chips that require I/O bandwidth on the order of Gbps and high-bandwidth memory interfaces. Though these GPUs can provide much-needed compute acceleration, one GPU is not enough, and so servers today often incorporate networks of 8 or 16 GPUs. The GPUs work in conjunction with the main CPU and memory, and communication between these compute processors and memory takes place over a physical interconnect.

Design and verification teams working in this space realize that the performance of the design is key, and that verifying this performance is no longer simply a digital verification exercise. The performance of these communication networks will determine the overall throughput of the system, and this can become a potential bottleneck resulting in slower response times from cloud servers. These I/O interconnects are implemented by high-speed PHYs comprised of complex mixed-signal circuitry with a significant amount of digital design interlaced with analog design. The high bandwidth memory interfaces use DDR PHYs with DLL-based clocking circuits which are very sensitive to device noise and variations in process, voltage, and temperature (PVT).

SerDes represent the basic building blocks of PHYs, and SerDes designs are always evolving, whether it is a new adaptive equalization scheme or digitally assisted analog blocks in the architecture. One of the most critical components in the SerDes is the clock generation, which is primarily performed via a phased locked loop (PLL).

In a traditional PLL, the control data is represented as an analog voltage. As all sub-blocks are vulnerable to different sources of voltage noise, the performance can easily be degraded. This is especially a problem in advanced semiconductor process nodes where supply voltages are scaled down, decreasing the voltage headroom and signal to noise ratio. Additionally, in these types of processes, analog properties such as linearity or device matching grow increasingly inferior, as analog loop filters built from resistors and capacitors are not scaling down with the technology. All of this led to the emergence of digital PLL architectures, which tend to benefit from process scaling. Despite the benefits that digital PLLs offer, there are also new challenges that arise, such as quantization errors and non-linearities in the control loop. These can degrade the performance and complicate the analysis compared to traditional PLLs.

The level of communication between the analog and digital components in today's SerDes interconnects is vastly more complex than it was in the past. The interplay between these realms is so integral to the functionality of the SerDes that it is no longer sufficient to simulate analog and digital blocks separately in a "divide and conquer" approach. Designers must simulate these two domains collectively, utilizing an array of advanced mixed-signal verification strategies to obtain the coverage closure required for first-pass silicon success.

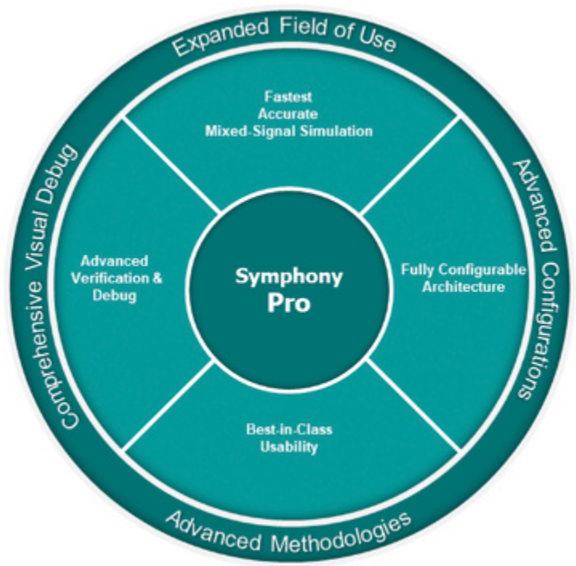
Simulating the behavior of a mixed-signal design requires both digital and analog solvers to work in conjunction in a synchronized fashion. In mixed-signal simulation, analog solvers become the bottleneck in meeting the overall performance goal for verification. To achieve reasonable simulation speeds, many mixed-signal engineering teams employ analog behavioral modeling. However, models are becoming more challenging to develop, incorporate, and utilize effectively at smaller technology nodes (like 5/3nm) as design complexity, process variation, and physical effects add to the number of variables that need to be considered.

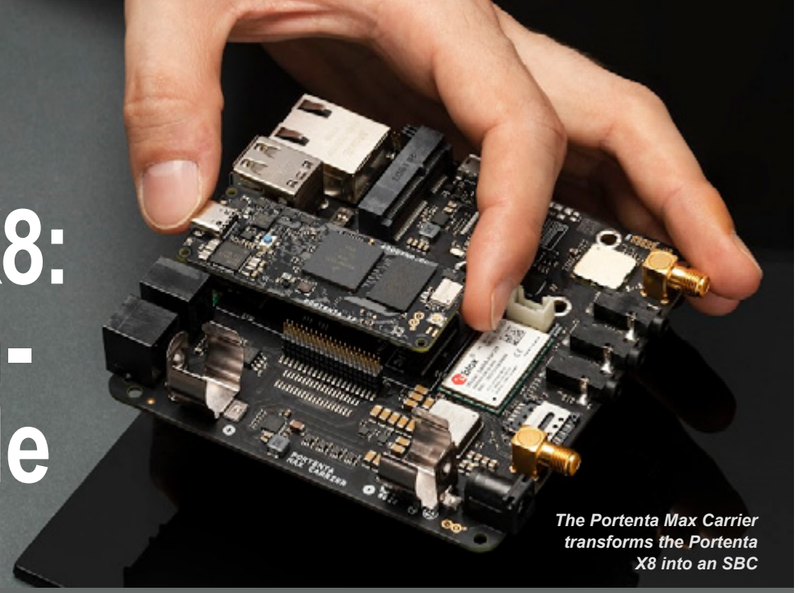
In mixed-signal design, errors most often occur at the interfaces between analog and digital blocks. Mixed-signal debug gets even more complex when the design employs advanced, low-power techniques. For example, data corruption in a digital block due to faulty power sequencing can pass to an analog block, resulting in inaccurate voltage conversion. Scenarios like this are difficult to debug by analog designers who are unaware of digital low-power techniques.

Digital verification methodologies are mature, organized, and have mastered the art of automation. Analog and mixed-signal verification, on the other hand, traditionally relied on direct verification methods. While this might have been sufficient in the past, increasing complexity and design sizes necessitate more thorough and automated verification of mixed-signal SoCs. Analog verification teams must go beyond traditional methodologies like directed tests, sweeps, corners, and Monte Carlo analysis. Teams need to embrace digital verification techniques to facilitate regression testing of mixed-signal SoCs. These techniques include automated stimulus generation, coverage, and assertion-driven verification combined with low-power verification and automated debug for improved productivity.

Siemens EDA offers comprehensive support for these advanced methodologies with the Symphony and Symphony Pro mixed-signal platforms. Symphony offers an average of 2 to 5X speed-up over traditional mixed-signal simulators while maintaining SPICE accuracy. It is fully configurable to work with all industry-standard digital solvers and provides robust debug capabilities within an easy-to-use environment. In addition, Symphony's mixed-signal simulator offers a unique machine learning-based variation-aware mixed-signal solution with Solido Variation Designer.
In summary, extending the support for digital verification methodology for mixed-signal designs in modern EDA platforms is improving the coverage closure for heterogeneous SoCs, which can speed time to market.

eda.sw.siemens.com





The Portenta Max Carrier transforms the Portenta X8 into an SBC

Portenta X8: The two-in-one module combining Arduino and Linux

The X8's hybrid combination of microprocessor and microcontroller offers developers unprecedented flexibility

The company that fired up the maker movement has strategically grown into a full-fledged industrial partner over the past few years. The recent launch of their latest, most powerful module to date—a groundbreaking Arduino/Linux hybrid—shows just how far Arduino Pro has come. And it also sets the bar high for the further developments that are sure to open even greater opportunities for innovators everywhere.

The Gen Z and Millennial cohorts, who grew up tinkering with Arduino—perhaps getting their first taste of coding thanks to Arduino educational bundles—are now entering the workforce and progressing in their careers, bringing with them a whole new approach to technology and engineering. Compound this with the industrial internet of things (IIoT) and Industry 4.0 revolution, and what you have is tremendous potential for growth through innovation.

In this context, Arduino has evolved with its huge active user base—over 30 million people globally—expanding from the maker go-to brand to qualified industrial partner, enabling companies to seize unprecedented opportunities thanks to high-performance technological solutions.

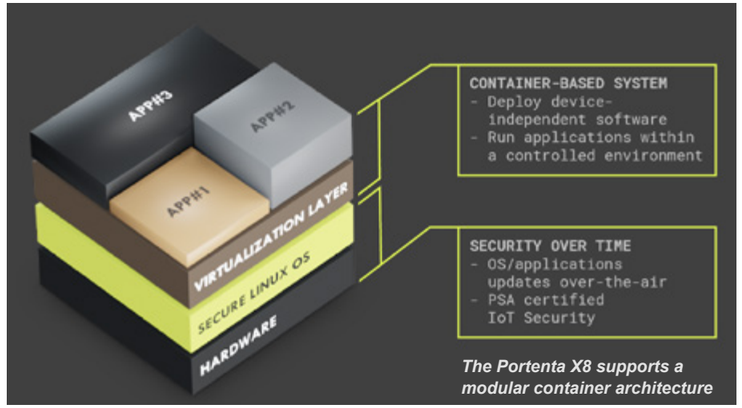
The company's dedicated business unit, Arduino Pro, has collected a plethora of success stories and recently played a crucial role in securing Arduino a Series B funding round of $32 million led by the global deep technology investor Robert Bosch Venture Capital, which was joined by Renesas, Anzu Partners, and Arm.

Arduino currently offers a complete ecosystem that includes hardware, software, and an entire digital infrastructure with Cloud services, integrated development environment (IDE), web editor, and a command-line interface (CLI) for advanced users. On top of all this, Arduino still keeps everything it does intuitive, versatile, and open-source, so business clients can reduce complexity, shrink time to market, and improve return on investment (ROI) while steering clear of vendor lock-in.

Among the new ranges of modules rolled out specifically to meet industrial clients' needs, the Portenta family includes high-performance, industry-rated products designed to deploy powerful artificial intelligence (AI) algorithms and machine learning (ML) on the edge.

Within this concept, after the success of the H7 module, this spring Arduino Pro upped the ante with the launch of the Portenta X8: a powerful, industrial-grade system-on-module (SOM) with the Linux operating system (OS) preloaded onboard, making it a plug-and-play solution capable of running device-independent software thanks to its modular container architecture. Onboard Wi-Fi/Bluetooth connectivity allows users to carry out OS/application updates remotely, always keeping the Linux kernel environment at top performance levels.

The X8's hybrid combination of microprocessor and microcontroller offers developers unprecedented flexibility to complete real-time tasks and high-performance processing simultaneously and securely, running existing Linux apps on a system that puts them immediately in communication with Arduino microcontrollers. This innovative Arduino/Linux combination is essentially two products in one.



The Portenta X8 supports a modular container architecture

The multiprocessor platform features a compact form factor of 66 x 25 mm, with the STM32H747XI dual-core Cortex-M7 up to 480MHz + M4 32-bit Arm MCU up to 240MHz (as used on the Portenta H7), plus an NXP i.MX 8M Mini Cortex-A53 quad-core up to 1.8GHz per core + 1x Cortex-M4 up to 400MHz.

The X8 includes the customizable, open-source Linux microPlatform OS—using the cloud-based DevOps platform from Foundries.io—which has been created using best industry practices for end-to-end security, incremental over-the-air (OTA) updates, and fleet management.

Furthermore, the X8 has achieved PSA certification (see sidebar) and includes the NXP SE050C2 hardware security element to provide key generation, accelerated crypto operations, and secure storage. It has also achieved Arm SystemReady certification (see sidebar) and integrated Parsec services, making it one of the market's first Cassini Products available to developers. This enables the migration of cloud-native workloads from the Cloud to the edge, and it contributes to a cloud-native developer experience across the brand's diverse and secure IoT ecosystem.

With Portenta X8, developers can leverage popular programming languages like Python, JavaScript, Java, Go, and Rust among others. It was designed for edge computing in industrial contexts, but also lends itself to building automation and smart agriculture applications.

On top of this, any X8-based project can be effortlessly bumped up a notch with advanced features provided by the Portenta Max Carrier. This carrier can transform Portenta modules into single-board computers (SBCs) or reference designs for Industry 4.0, further augmenting connectivity options with LoRa, NB-IoT, and more, plus it can be powered via external supply or battery. In a nutshell, this carrier takes developers' innovation capabilities to the max.

With products like the Portenta X8, Arduino Pro has made a huge leap forward in terms of performance, security, and user experience for enterprise customers, keeping its promise to make everyone the innovator in their field: from smart cities to smart agriculture and from AI-powered factories to automated buildings, today's engineers can count on Arduino to get the job done.

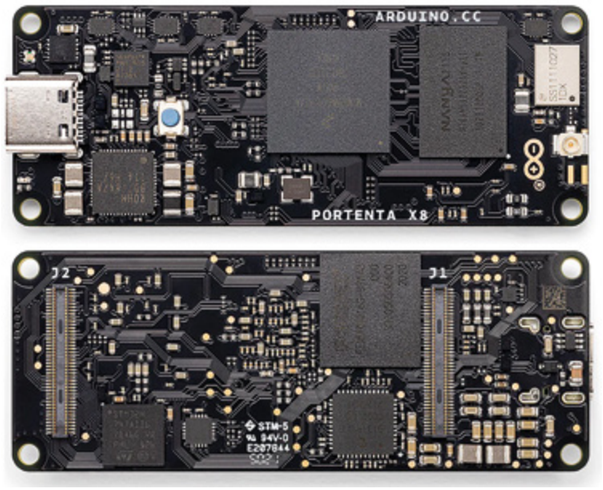
www.arduino.cc/pro

PSA Certified is a security certification scheme for Internet of Things (IoT) hardware, software and devices. It was created by seven stakeholder companies as part of a global partnership. This security scheme was created by Arm Holdings, Brightsight, CAICT, Prove & Run, Riscure, TrustCB, and UL.

Arm SystemReady is a compliance certification program based on a set of hardware and firmware standards: Base System Architecture (BSA) and Base Boot Requirements (BBR) specifications, plus a collection of supplements.

"Arduino has evolved with its huge active user base—over 30 million people globally—expanding from the maker go-to brand to qualified industrial partner."

Meet the Portenta X8



Advanced plastic enclosures for medical devices

The first thing clinicians and patients see and touch in the case of a medical device is the enclosure

Healthcare is one of the most demanding sectors for electronics. Lives are at stake. Electronics designed for hospitals, general practitioner (GP) surgeries, and other clinical environments must represent the absolute pinnacle of quality, and visibly so.

In fact, medical electronics must exude excellence in terms of their aesthetics, ergonomics, functionality, and reliability. This all starts with the very first thing that clinicians and patients see and touch—the enclosure.

Every electronics enclosure—regardless of application—must be robust to a certain degree. That is obvious. But the medical sector can be particularly demanding. Devices will have a hard life. They will be used heavily day after day because constrained hospital budgets mean there is never quite enough equipment. And the equipment will be passed between many users, some of whom may be newer and less well trained than others due to staff recruitment and retention issues.

All of these devices have to withstand every hard knock that comes their way and still look as new as possible because no patient wants to be treated with equipment that looks or feels old and tired. In the not-so-distant past, electronics designers had to specify bespoke housings for their products. Back then, standard enclosures were simply too generic to meet the specialist requirements of the healthcare sector.

"All that has changed now," says Robert Cox, Vice-President of Marketing at OKW Enclosures, Inc. "The latest generation of standard plastic enclosures is application-specific and yet still highly versatile. It's as if they were molded as bespoke housings. They don't look 'standard' at all."

OKW's CARRYTEC handheld enclosures are designed for tough portable medical instruments

Thanks to new technology, enclosures can be customized very quickly in the small volumes required by manufacturers of highly specialist medical equipment. As a result, they can go straight to an OEM's production line, ready for installation of any printed circuit boards (PCBs) and other components. This applies right across the medical electronics sector—including desktop, handheld, and wearable devices—with electronics that are wired or designed to operate remotely.

Enclosures for wired medical devices

Wired remote controls seem to proliferate in hospitals. Controllers wired to beds and monitors are the most obvious examples. These must remain attached by wire to the apparatus they are controlling, not least because the idea of infrared remotes going missing or being mixed up is unthinkable in a healthcare setting.

OKW's contoured CONNECT enclosures exemplify the genre. This housing comprises two snap-together enclosure shells—one convex—the other flat, offering electronics designers a choice of fronts. Cutouts enable the easy installation of accessory cable glands with kink protection and integrated strain relief. Accessories also include wall holders and bedrail clamps.

Like many of the latest generation of application-specific standard enclosures, CONNECT is molded from an ASA+PC-FR blend rather than ABS, which was the go-to thermoplastic in the past. ASA+PC-FR combines the UV stability of Acrylonitrile styrene acrylate with the strength of Polycarbonate to create a plastic with enhanced flammability resistance (UL 94 V-0).

Robust handheld enclosures for medical instrumentation

Enclosures for portable diagnostics apparatus and other medical instrumentation must be particularly resilient because this sensitive equipment has to survive life in A&E departments, intensive care, or in outdoor emergency response situations.

CARRYTEC (IP 54 optional) has a tough integrated handle equipped with a soft-touch insert for added comfort. This handle doubles as a grip when the enclosure is mounted inversely on a suspension arm. Accessories also include a rail clamp, docking stations for charging and data transfer, along with zipped side bags for probes or cables. These probes and cables can remain connected to the device at all times for speed and convenience of operation. →

"The latest generation of standard plastic enclosures is application-specific and yet still highly versatile. It's as if they were molded as bespoke housings. They don't look 'standard' at all"

MEDICAL ENCLOSURES

Ergonomic wearable enclosures

Handheld enclosures must always be highly ergonomic because—not surprisingly—they spend their whole lives being handled. However, the bar is raised even higher for wearable enclosures because they will be in direct contact with users for extended periods of time—worn by a doctor or nurse for a long and grueling shift, for example, or by an elderly patient as the lifeline care alarm they never want to take off.

BODY-CASE is a wristwatch-style enclosure designed to fit a standard 18 mm strap for a range of bio-feedback applications. It can also be clipped to a belt or pocket, or suspended from a lanyard. This makes it suitable for geolocation electronics but also frees up the users' hands for sterile clinical procedures.

Like CONNECT, BODY-CASE is also molded from UV-stable ASA. Unlike CONNECT, however, the two sections are assembled using tamperproof Torx screws, which is an important consideration for the medical sector. Sandwiched between the two ASA sections is a soft-touch TPV sealing ring that adds both IP 65 ingress protection and extra color for branding.

Control center enclosures for desks and walls

Versatility is important for desk and wall-mount enclosures. If one type of housing can be used in both settings, then so much the better, not just for continuity of design language but also for the very real savings that can be passed on to budget-conscious hospitals.

PROTEC (IP 65 optional) is a new square enclosure for wall-mount and desktop control electronics. It is available in three variants: Version I has a deep recessed interface area at the rear; Version II conceals this recess under a snap-on cover; and Version III has a screw-fitted larger cover that doubles as a desk stand. These ASA+PC-FR enclosures feature a larger recessed top that can accommodate a touchscreen display or membrane keypad.

All of the enclosures discussed here address the goals stated at the beginning of this article by satisfying the needs of modern medical electronics products with respect to exuding excellence in terms of their aesthetics, ergonomics, functionality, and reliability.

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