### THE PUBLICATION FOR DESIGN ENGINEERS

DESIGNING ELECTRONICS NORTH AMERICA AN MMG PUBLISHING TITLE

**MAY/JUNE 2022** 

## WE'RE HERE!

HARDWARE, SOFTWARE, ANALOG, DIGITAL, DESIGN, AND TEST WE HAVE YOU **COVERED!** 

> ALSO FEATURED ON PAGE 27 - Vox Power's VCCM600 conduction cooled configurable power supply series

esign starts here

DEMANACA

55

**®TDK** 

nte

**ELECTRONICS** 

**Start with Digi-Key** 

ETE

muRata

h/E

120

Colox

18





POWER Choose Choosing a rack-mount power supply





**TEST PRODUCTS MIKROE** launches Planet Debug

E XILINX More products **More suppliers** A More NPI 1.800.344.4539 YAGEO **DIGIKEY.COM** 

Panasonic

mole

DIKIK

ABH

Losin

I MICROCH

be

Idialo

TE

Digi-Key is an authorized distributor for all supplier partners. New products added daily. Digi-Key and Digi-Key Electronics are registered trademarks of Digi-Key Electronics in the U.S and other countries. © 2022 Digi-Key Electronics, 701 Brooks Ave. South, Thief River Falls, MN 56701, USA LITEON

SS ECIA MEMBER

ENTE

14 Littett

onsemi

Amphenol

RENESAS

E

BK PREC

Con

N/E

nolex

#### Contact

DESIGN

EDITORIAL Managing Editor: Clive 'Max' Maxfield max@designing-electronics.com Director of Media & Communications: Thomas Smart esigning-electronics.com

CIRCUI ATION Circulation Manager: Vicky Leary Circulation Account Manager: Liz Poole

ADVERTISING Director of Sales: Emma Evernden emma.evernden@designing-electronics.com

Production & Design Manager: Josh Hilton josh.hilton@designing-electronics.com

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

Articles appearing in this magazine do not necessarily express the views of the Editor or the publishers. Every effort is made to ensure the accuracy of information published. No legal responsibility will be accepted by the publishers for loss arising from articles / information contained and published. All rights reserved. No part of this publication may be reproduced or stored in a etrieval system or transmitted in any form without the written consent of the publishers.

#### **EDITOR'S WORD**

#### **Print Rules**, **Online Drools!**

I predate the internet. I also predate much of what we now consider to be normal with respect to the tools and technologies we use in today's electronic designs.

My first position upon leaving university was as a member of a team designing CPUs for mainframe computers. When it came to design tools, we were armed with the state-of-the-art for that time (you may know these tools as pencil and paper).

As a practicing engineer, I very much enjoyed the magazines that landed on my desk ... and then the internet arrived. It wasn't long before print magazines were a thing of the past and everyone was proclaiming the wonders of having everything online.

While we all appreciate the timely access to information afforded by the internet, many of us prefer our magazines in print. Thus, I am delighted to welcome you to this inaugural print edition of DENA (younger readers should ask their elders to demonstrate how the search and page-turning functions work).

Max Maxfield CLIVE 'MAX' MAXFIELD

Editor, DENA



by: Cummings / DENA is printed of 2022 MMG Publishing Ltd

Issue 1, Vol.1 No.01 / Published 6 times per year by MMG Publishing Limited / MMG PUBLISHING US Ltd, Normandale Lake Center, 8400 Normandale Lake Boulevard, Suite 920, Bloomington MN 5543 / Tel: 866.364.0951 / Fax: 952.378.2770 Printed ustainably sourced paper stock ISSN 2043-9504 ©





#### **TOP STORY**

#### Fast voice app development

XP Semiconductors has announced Voice Intelligent Technology (VIT), said to be industry's first comprehensive, local voice control software package with online training tools free for customers, regardless of end application production volumes. Based on advanced deep learning, VIT is a ready-to-use library that provides a far-field audio front end supporting up to three microphones, an always-on wake word engine and a voice command engine. NXP's free online tools let customers define a wake word and voice commands themselves, using simple text entry and without the need for voice recordings.

NXP's vice president and general manager, IoT edge processing product line, Joe Yu, said:"Voice is the interface of choice for many smart technologies, including those in smart homes,



smart cities and smart factories. By reducing the complexity of voice application development, we've made it easier and faster to bring new, on-device voice control to market."

nxp.com

#### Winning Wi-Fi combo

Renesas Electronics has announced 10 new Winning Combinations that combine Wi-Fi 6 and 6E chipsets from Celeno Communications with a range of Renesas solutions including embedded processing, analog, power, timing and connectivity. The new Winning Combos include solutions for IoT, industrial, infrastructure and other applications.

Winning Combinations are engineeringvetted designs that are designed to let customers take advantage of an elevated platform for their design ideas, accelerating product development cycles and lowering overall risk in bringing designs to market. Renesas offers more than 300 Winning Combinations for a wide range of customers and markets.

Renesas' senior director of the system and solutions team, DK Singh, said: "These new solutions illustrate clearly that the Celeno Wi-Fi solutions are



extremely complementary with the Renesas product portfolio. In a very short time, we have delivered Winning Combinations with Celeno technology that further our mission of enabling intelligence from the cloud to the endpoint sustainably. Customers understand and appreciate that we are leading the market in providing integrated solutions to help them get innovative products to market faster and more efficiently."

www.renesas.com

#### Videos unlock connector trends

Mouser Electronics and Amphenol Communications Solutions are teaming up to bring engineers a new video series dedicated to unlocking the latest connector trends. The Plugged In video series features experts from Amphenol and host Paul Golata from Mouser, who discuss the latest trends, leading topics and key products connecting the future. The first video focuses on lighting solutions for indoor and outdoor applications. Amphenol is no stranger when it comes to offering a range of NEMA and Zhaga connectors for the growing lighting industry.

Mouser stocks Amphenol Communications Solutions lighting interconnect products, including receptacles, bases, domes and connectors. These components meet ANSI/NEMA and Zhaga standards, suiting IIoT applications including smart

cities and intelligent buildings. The FLM series complies with Zhaga Book 20 specifications, while the FLS series meets Zhaga Book 18 regulations. The FLA series is compliant with ANSI C136.41 standards and designed to mate with FLB series bases and domes. The FLH series provides IP67-level protection and is RoHS compliant.

www.mouser.com



#### Automotive cybersecurity gualification

Analog Devices' Wireless Battery Management System (wBMS) is certified to ISO/SAE 21434, the new standard for cybersecurity risk management throughout a vehicle's lifecycle from concept, product development and production, to operation, maintenance and decommissioning of electrical and electronic systems.

TÜV NORD Mobilität, the assessor for this qualification, affirmed that

#### WURTH ELEKTRONIK MORE THAN YOU EXPECT

## **KEEP IT SIMPLE!**



#### **MEMS Sensor Portfolio & Customer Service**

Sensors are an integral part of every future application. Measuring temperature, humidity, pressure or acceleration has never been easier. Take advantage of services like our Software Development Kit and Evaluation Boards available off-the-shelf. Detailed documentations as well as the direct support by trained engineers will leave no questions open. With excellent measuring accuracy and long-term stability, the sensors provide high precision and accurate output values with intelligent on-chip interrupt functions.

Combine sensors and wireless connectivity – start your IoT application today: www.we-online.com/sensors





**3** Axis Acceleration perature Sensor IC WSEN-ITDS WSEN-TIDS

Absolute Pressure Differential Pressure WSEN-PADS WSEN-PDUS



Humidity WSEN-HIDS

- Support by engineers within 24 h
- Excellent measuring accuracy
- Factory calibrated & ready to use
- On-chip interrupt functions
- Implemented algorithms
- SPI & I<sup>2</sup>C digital interfaces

#SensewithMEMS

#### **NEWS**



ADI's wBMS is the first automotive system certified for ISO/SAE 21434 The assessment confirmed that ADI performed appropriate assurance measures within the product development to fulfil the CAL 4 requirements.

TÜV NORD Mobilität's SVP, Leif-Erik Schulte, said: "With ADI considering the CAL 4 classification conditions throughout product development, the cybersecurity assurance measures complied with the highest requirements. This system certification is a key element to build trust across the full electrification ecosystem-from energy storage to OEMs to consumers-to support EV adoption and help reduce emissions."

Analog Devices' general manager of battery management systems, Roger Keen, added: "Improving the security and accuracy of EV batteries removes roadblocks in end-users' buving considerations and advances OEMs' decisions to expand their EV offerings."

www.analog.com

#### Wireless charging with authentication

Microchip Technology has announced the new industrial grade TrustFLEX ECC608 and automotive grade Trust Anchor TA100 combined with Microchip secure key provisioning services for Qi 1.3 power transmitters. This all-in-one secure storage subsystem includes key provisioning for consumer and automotive systems.

The Qi 1.3 specification mandates addition of a secure storage subsystem with secure key provisioning including X.509 certificates to cryptographically verify the source and quality of the certified power transmitter. When a receiver (eg in a cell phone) is placed on a Qi 1.3 power transmitter, it may initially accept a 5W charge or no charge at all. After a successful X.509 based ECC authentication proving the charger is an approved, 'do no harm' device, the phone will safely accept a 15W charge reducing charging time.

Microchip Technology's vice president of the security products business unit, Nuri Dagdeviren, said:"Our WPC secure storage subsystem solutions demonstrate Microchip's continuous commitment to facilitating high volume deployment of state-of-the-art security architectures within embedded systems."

www.microchip.com



#### New Dallas design center

Nexperia is opening a new design center in Dallas. Texas. The center will

Nexperia's general manager business roup, power and signal conversion, to establishing R&D activity in North

proposal to the CEO of Nexperia, towards more differentiated, unique such ambitious growth plans."



#### **RISC-V** gets hard real-time C++ support

Segger's Embedded Studio for RISC-V (V6) uses real-time memory management designed to improve efficiency and response time when allocating and freeing up memory, satisfying requirements for hard realtime in applications written in C++.

Segger's founder, Rolf Segger, said: "C++ applications require a lot of memory allocation and deallocation behind the scenes, often without the programmer being aware of it. C++ applications especially see an enormous benefit from our new real-time heap manager. Embedded Studio is the first toolchain that I know of that guarantees fast, constant-time heap operations. These responses are extremely fast, bringing true real-time to embedded systems programmed in C++."

Embedded Studio also now provides developers with a C++17 Compiler and C++17 Standard Library, combining the efficiency and compact code of Segger's emRun runtime and emFloat floating-point libraries.

The package includes generic container templates (sets, vectors, lists, queues, stacks, maps), standard algorithms (sorting, searching, transformations), function objects, iterators, localization, strings and streams and utility functions for everyday use cases.

www.segger.com

#### Testing high quality security apps

Imperas Software has announced the beta release of its ImperasDV architectural validation test suites for RISC-V Physical Memory Protection (PMP).

Imperas Software's CEO. Simon Davidmann, said:"In any verification plan, the opportunity to use more tests is always a useful option, but as is often the case some tests are more useful than others. Test suites have many useful qualities, perhaps the top two are coverage and specification completeness.

"The RISC-V PMP test requirements are significant given the complexity of the specification and security implications for any implementation errors. The Imperas mutating fault simulation technology ensures the test coverage, and the Imperas reference model covers the full envelope of the PMP specification, so when combined these produce a useful architectural validation test suite for any RISC-V processor targeted at security applications."







TECHNOMET is our latest and most advanced range of instrument housings. Standard features include snap-on trims which hide all the fixing screws, ventilation slots, bail arms, ABS tilt feet and an internal chassis for fitting PCBs. The enclosures can also be supplied fully customized to your exact specifications.

METCASE ENCLOSURES 800 965-9872 | www.metcaseusa.com

#### **NEWS**

Chair of the RISC-V International Architecture Test SIG, Esperanto Technologies' Allen Baum, added: "A key part of the RISC-V privilege specification that is fundamental for OS and application security is the PMP feature. Enabling its correct operation is essential for security applications, and the Imperas PMP test suites are a valuable contribution to the RISC-V compatibility and verification community."

Imperas.com

#### **ALUMINUM INSTRUMENT ENCLOSURES**













#### **DESKTOP/PORTABLE CASES**

Ask about your own custom version!



# FPGA-based single wire aggregation for FPGA and non-FPGA designers

SWA provides a way to reduce cost, reduce space, and increase the reliability of the system

Many of today's electronic systems involve two or more printed circuit boards (PCBs). A perennial problem for system designers is connecting the boards together to transfer data between them. A very common solution is to mount multi-pin connectors on the boards and to use multi-wire harnesses or flex to link them together.

Unfortunately, each connector pin is a potential point of failure. Thus, in addition to adding cost and consuming space, connectors are often the overwhelming factor regarding the reliability or lack thereof—in an electronic system. Contra wise, minimizing the number of inter-board connections reduces cost, reduces space, and increases the reliability of the system. Not surprisingly, designers of a wide range of systems—from handhelds to notepad computers to industrial controllers desperately wish to minimize the number of connector pins and inter-board wires.

One point worth noting is that many of these inter-board signals typically provide only relatively low speed communications using general-purpose input/outputs (GPIOs) or serial interfaces like I2C (inter-integrated circuit) and I2S (integrated inter-IC sound bus).

#### Single wire aggregation

The idea behind single wire aggregation (SWA) is to take multiple signals and aggregate them into a time division multiplexed (TDM) signal that requires only a single inter-board wire. One way to do this would be to create a custom applicationspecific integrated circuit (ASIC) for each product.

multiple disadvantages associated with custom ASIC solutions, including the fact that they are expensive and time-consuming to develop. Even worse, any algorithms and functions they contain are effectively "frozen in silicon," which means they cannot adapt to changing requirements, such as the head of sales unexpectedly announcing: "Our biggest customer says we need to replace one of the I2S interfaces

Unfortunately there are

with two I2C channels." The solution is to use lowcost field-programmable gate arrays (FPGAs),

such as iCE40 UltraPlus devices from Lattice Semiconductor. One huge advantage of using FPGAs to implement single wire aggregation is that they are extremely flexible and can be quickly and easily customized to implement the required numbers and types of the various

communications channels.



The statement in the preceding paragraph—that FPGA-based SWA solutions can be quickly and easily customized—comes with a small caveat, which is that you have to be familiar with designing FPGAs.

If you are an FPGA designer, in the case of its SWA solution, Lattice provides full reference design resources for use with its industry-leading iCE40 UltraPlus FPGAs:

- The source code for an easily modifiable parameterized SWA reference design ready to run on the Lattice Radiant design tool.
- Free access to the Lattice Radiant design tool.
- An associated Reference
  Design User Guide.
- An SWA demonstration and development board.

Unfortunately, not every design team has access to FPGA design expertise. Fortunately, Lattice also has solutions for non-FPGA designers.

#### SWA for non-FPGA designers

FPGA designs are captured using hardware description languages (HDLs) like Verilog or VHDL, and then running



a hardware compiler called a logic synthesis engine, which takes the HDL and generates a configuration file, also known as a bitstream. Anyone can load this bitstream into the FPGA without having to know anything about designing FPGAs.

The first SWA solution for non-FPGA designers is based on Lattice providing a suite of five pre-synthesized bitstreams. These configurations, which are based on an analysis of multiple real-world products, have been selected to address the requirements of a wide range of system designs.

A Bitstream User Guide is available from Lattice's SWA webpage (https://bit. ly/3O5Blaw). This guide describes how anyone can load one of the preconfigured bitstreams into an iCE40 UltraPlus FPGA. But wait, there's more, because Lattice also offers a free SWA design service. If you visit Lattice's SWA development board webpage (https://bit. ly/37KsISc), you can use an interactive form to specify the unique combination of channels you require for your design, and the Lattice design team will email the corresponding bitstream file to you.

#### iCE40 UltraPlus FPGAs

In addition to featuring an ultra-low-power advanced process with static current as low as 75µA and as little as 1 to 10mA active current for most applications, iCE40 UltraPlus FPGAs are also available in multiple package options to fit wide range of applications needs, from an ultra-small 2.15 x 2.50mm WLCSP package optimized for consumer and IoT devices to a 0.5 mm pitch 7 x 7mm QFN for cost-optimized applications.

Of particular interest is the fact that the configuration bitstream can be loaded directly into SRAM-based configuration cells, thereby allowing iCE40 UltraPlus FPGAs to be reprogrammed over and over again. This is the best option during the prototyping phase of a project because it allows you to experiment with different designs and bitstreams.

If the SRAM-based configuration approach is used when the iCE40 UltraPlus is deployed in a product, then the configuration can be loaded via an on-board MCU or from an external SPI Flash memory device. Alternatively, iCE40 UltraPlus FPGAs also contain a one-time programmable (OTP) on-chip non-volatile configuration memory (NVCM), which is best suited for mass production. Once the NVCM has been programmed, the device will automatically,

#### DESIGN

ard or Module B	
125 (up to 3)	-
I2C (up to 7)	-
GPIO (up to 7)	-
otal 7 Channels	

quickly, and securely boot from this configuration.

#### **Bits and Bytes**

The single wire communication between the FPGAs runs around 7.5 megabits-per-second (Mbps). The design is also configurable-the number of I2C/I2S busses and GPIOs and single wire protocol packet length can be adjusted, and the single wire protocol between the FPGAs is robust with error detection and retry features. A brief summary of the various features is as follows:

- Up to seven channels can be aggregated.
- The raw data rate on the single wire interface is ~7.5Mbps or higher.
- The system supports variable packet length for efficient use of the single wire bandwidth.
- A retransmit feature is offered when a parity error is detected on the receiver side.
- The system supports both I2C Fast-mode (400kbps) and Fastmode Plus (1Mbps).

I2C Interrupts can be realized using GPIO with event-based transmission.

 I2S supports single stereo channel, 48kHz sampling rate, with up to 32 bits per sample, and with bi-directional support.

#### Summary

Many of today's electronic systems involve multiple circuit boards. Furthermore, many of these systems use multiple interfaces of different types—like I2C, I2S, and GPIO—to collect data from peripherals and sensors and to communicate this data between boards.

Lattice has developed an innovative new way for system architects and developers to use tiny, lowcost FPGAs to implement single wire aggregation, which can dramatically reduce the number of inter-board connections. thereby increasing the reliability of the system while also reducing its size and cost. This solution can be customized by developers with FPGA design experience. Even better, it can be quickly and easily deployed by developers with no FPGA experience whatsoever!

www.latticesemi.com

#### **INTERCONNECTION** WHAT'S NEW



#### Small but tough

Cinch Connectivity Solutions has expanded its mil-aero circular MD801 series, a lightweight, ultraminiature connector with small form factors and high-density capabilities, ideal for aerospace, military and other harsh environment applications. The product can be adapted for commercial applications including UAVs, vehicle communications, satellite systems, radios and display systems.

The connectors are available as plugs or receptacles with standard crimp, solder and PC tail terminations for board mount applications. They are engineered to provide full performance in extreme environments with protection against cross mating and vibration. The shells (available in sizes 5, 6, 7, 8, 9, 10 and 13) include jam nut receptacle, square flange receptacle and in-line plugs—compatible with leading competitive equivalents. Contact arrangements range from 1 to 130. Finishes include OD/cadmium and electroless nickel.

belfuse.com



#### USA made for rapid delivery

A full line of standard and custom OEM sparkplug and distributor terminals, insulation boots and battery terminals that comply with IATF, SAE and ISO requirements are available from ETCO.

The company's products include 1,800 standard parts that meet IATF 16949:2016, SAE J2031 and 2032, and ISO 9001:2015 standards and are available with compatible wire-attach equipment and booters. Featuring spark plug and distributor terminals, insulation boots and battery terminals, all parts are manufactured in the USA for rapid delivery.

Designed to simplify automated and manual assembly operations for OEMs and harness makers, products can be supplied in strip form or loose. They can be stamped from brass, tinned steels, stainless steels, beryllium copper, phosphor bronze and other alloys with thicknesses ranging from 0.006 to 0.078in and tolerances to 0.0005in.

www.etco.com





Emile Berliner receives the patent for the gramophone. James Blyth builds the first electricity generating wind turbine. Herman Hollerith receives a U.S. patent for his punch-card calculator. Sager opens its first location in Boston, Massachusetts.



#### All great things begin with a single step - or in Sager's case a single storefront.

Recognized as the first distributor in the industry, Sager opened for business one hundred thirty-five years ago in downtown Boston, Massachusetts, servicing the growing interest in radio technology.

Under the vision and leadership of Joe Sager, the company established a thriving business that put the needs of its customers first. Since then Sager has grown into a North American distributor of interconnect, power, thermal and electromechanical products and a provider of custom design and manufacturing solutions.





Sager Electronics, a TTI Inc., Berkshire Hathaway Company www.sager.com | 1.800.724.8370

And after 135 years, Sager still operates just as Joe envisioned – based on a commitment to exceeding expectations and keeping the customer at the center of its business philosophy.

#### AUTOMOTIVE

# Protecting sensitive ICs in today's electrified vehicles with multilayer varistors

In light of current TVS diode shortages, it's worthwhile exploring MLV alternatives

As e-mobility continues to expand, the automotive industry is presented with many design challenges, like fitting more robust electric motors, controls, and modules into a vehicle while maintaining reliability and signal integrity and reducing weight—where possible—to extend battery life and driving range.

Innovations like the One Pair Ether-Net (OPEN), miniaturization of passive electronic components, and integrated circuit (IC) advancements all contribute to alleviating e-mobility design challenges, but the recent shortages of IC devices have put the spotlight on an occasionally underappreciated element of circuit design circuit protection. IC shortages

will make each module precious and there will be more emphasis to ensure reliable operation in the high transient energy environment that is an automobile.

The urgency for improved circuit protection is compounded not only by the increased quantities of ICs in an electric vehicle, but also by the fact that a common circuit protection implement is a silicon-based device; the transient voltage suppression (TVS) diode. Shortages are expected to impact TVS diodes as well, but the multilayer varistor (MLV) is a viable alternative. TVS technology provides physical, electrical, and cost advantages in circuitry.

In light of possible TVS diode shortages, it is worthwhile exploring the design, performance, and pros/cons of MLVs versus TVS diode technology.The goal is to expand e-mobility solutions preventing overvoltage damage to ICs



0603 Auto Grade Diode



SMAJ33CA Diode



0805 Auto Grade MLV

TVS Diode and MLV cross sections with active areas highlighted in red

from electrostatic discharge (ESD), switching transients from inductive loads such as small motors, relays, latches, and servos, and large energy transients like load dump, which is generated after an alternator is disconnected from the battery after starting the engine.

The MLV is constructed in a very similar fashion to multilayer ceramic capacitors (MLCCs), albeit with a different material set. The bulk of the device is a monolithic construction of metal conductive electrode layers and a zinc-oxidebased ceramic. This material is a semiconductor and has non-linear voltage to current characteristics like back-toback Zener diodes, making it a bidirectional device. At a predefined voltage level, the MLV will begin to shunt current to ground and subsequently clamp voltage to protect sensitive ICs. MLVs can be designed for a wide range of clamping voltages and magnitudes of transient energy. Some additional advancements of MLVs include low ratios of operating to clamping voltage, flexible terminations, 175°C operation, and OPEN Alliance qualified devices that are designed to preserve signal integrity on those lines, in addition to overvoltage protection.

One of the biggest advantages of MLV technology is the extremely high volumetrically efficient active areas that are dissipating transient energy. By comparison, TVS diodes rely on a single P-N junction to clamp voltage. Even if it is a bidirectional diode with two P-N junctions, only one of them will activate during a transient event. The large internal volume of active material becomes increasingly significant for MLVs in highly repetitive transient environments, like an input/ output (I/O), human machine interface (HMI), or say a smart combustion chamber that can generate varying magnitudes of sparks based on fuel/air mixture and depending on whether a performance or fuel economy drive is selected.

The multiple layers of an MLV distribute transient energy evenly across all layers, e.g., if there are 10 layers then each layer will dissipate 1/10 of the incoming transient. These layers also provide redundancy if one of the layers begins to degrade making for an extremely reliable device.

MLVs also require no temperature derating until rated operating temperatures are reached, very much unlike typical TVS diodes that must derate their transient energy capability for anything above room temperature (25°C). This has unique implications for MLV technology in high temperature applications. An EIA 0805 MLV can actually outperform an SMA packaged diode at high temperatures despite being much smaller. You can see this yourself by comparing the datasheets for a SMAJ33CA TVS diode with an energy rating of 0.6J and a 0805 MLV with an energy rating of 0.3J. Although the TVS diode begins at a higher power handling capability, it decays linearly with temperature until the smaller MLV overcomes the diode's performance at 85°C, again in a much smaller package size.

Reliability across temperature is another parameter that should be accounted for. Consider a test where a

#### AUTOMOTIVE

sample of MLVs and TVS diodes were subjected to their 25°C rated peak current transient waveform at 65°C. 85°C, and 125°C. MLVs have no temperature derating up to their maximum operating temperature and had zero failures when subjected to the same transients across temperature, which was expected.TVS diode failures began at 65°C and were all short circuit failure modes, reinforcing the fact that derating rules for TVS diodes should be strictly followed. Additionally, larger or heat sink-integrated TVS diodes would need to be used to maintain reliability, but sizeor cost-constrained designs would benefit from the use of more thermally efficient MLVs.

There are several unique features of MLVs that set them distinctly apart from TVS diodes. MLVs have inherently higher capacitance than TVS diodes, but this quality can be exploited as a dual-purpose EMC capacitor and circuit protection element to consolidate the number of components required to perform the same function. In the case of high-speed signal lines that cannot tolerate capacitive loading, low capacitance designed MLVs would be used. MLVs also have intrinsically low parasitic inductance or equivalent series inductance (ESL), allowing for fast conduction times, thereby suppressing transients as soon as possible.

Some transients are characterized by subnanosecond rise times, and impedance contributions by ESL of these devices become significant at these high frequencies. MLVs and many TVS diodes have comparable response times, except for silicon TVS diodes that are wire bonded. These respond slower to suppress fast rise time transients because of higher ESL due to the material, arc length, and the stitch or ball bond of the wire to the silicon die.

In summary, there are many benefits to using MLVs and—in light of the recent IC shortages and expected silicon based TVS diode shortages it is worthwhile to learn more about these passive components that can play a critical role in circuit protection.

MLVs are volumetrically efficient, they can get very small, they are thermally resilient requiring no derating, and they boast inherently high reliability from their large active areas that uniformly distribute transient energy. They arrive in many sizes and ratings to meet harsh load dump levels of energy, or low capacitance types for high-speed signal lines. They can also be designed to meet very specific standards like the **OPEN** Alliance standard for MLVs on automotive ethernet

Kyocera-AVX has developed two MLVs that are OPEN qualified for 100BASE-T1 (PN: VCAS04AP704R7LATWA) and 1000BASE-T1 (PN: VCAS04AP701R5YATWA) networks. These devices meet strict low capacitance, low leakage, low weight, and tight tolerance design constraints. Whether it's passive electronic components or active devices, materials or systems advancements, innovations like these contribute to optimizing e-mobility.

www.kyocera-avx.com

#### **AUTOMOTIVE**

## Efficient prediction of ESD discharge current using SEED

System efficient ESD design (SEED) is a modelling methodology aiming to predict the ESD robustness of a system, evaluating transient currents and voltages during an ESD event

According to the OPEN Alliance, Automotive Ethernet in the form of 100BASE-T1 is becoming increasingly popular and will be used by various car OEMs around the world. The OPEN Alliance is proposing a measurement called "ESD Discharge Current Measurement" which gives an estimation of the overall system-level ESD robustness of the system. This test determines

the residual current into the PHY (physical layer interface), identifying the ESD robustness class according to human body model requirements.

System efficient ESD design (SEED) is a modelling methodology aiming to predict the ESD robustness of a system, evaluating transient currents and voltages during an ESD event. It is based on equivalent

circuit and behavioural models. Transmission Line Pulse (TLP) and Network Analyser measurements are typically used as input for characterisation of an individual element or system part. Together with an appropriate model for the ESD generator, this methodology has been used to study ESD events on system-level elements for high-speed data transfer applications such as USB 3.0.



Applying the SEED methodology to replicate the ESD Discharge **Current Measurement Test** recommended for 100BASE-T1 applications allows designers to draw conclusions on how different parameters like parasitic inductance of the external ESD protection device and its trigger and snap-back behaviour influence system-level ESD robustness. Furthermore, it allows designers to predict

the electromagnetic stress to which other passive devices in the application are exposed during an ESD event.

To measure the current that flows into a PHY during an ESD event, a special PCB is recommended by the OPEN Alliance. This test network resembles the Medium Dependent Interface (MDI) in which the PHY is replaced with a resistor network. The network consists of an external ESD

device, the common mode termination (CMT) elements, a decoupling network, a common mode choke (CMC) and a 100BASE-T1 PHY (IC).

SEED is developed to perform system-level ESD analysis using transient simulations. To do so, it is essential to have an appropriate model for each part of the target system. Further, to reduce the modelling effort and accelerate the simulation process,

## **Advanced Magnetics** for ADAS



Coilcraft offers a wide range of AEC-Q200 qualified products engineered for the latest advanced driver assistance systems, including high-temperature, high-power-density power inductors for radar, camera and LiDAR applications.

Our compact Power over Coax solutions offer significant board-space savings while providing the high signal performance





#### From high-current, high-efficiency power inductors to filter components for a variety of communications buses, Coilcraft has the magnetics for all of your Advanced Driver Assistance Systems

needed for today's high-resolution and highspeed cameras.

Also choose from our broad selection of common mode chokes and filter elements for a variety of communications buses.

To learn more about our advanced solutions for ADAS and other automotive/ high-temp applications, visit us at www.coilcraft.com/AEC.

#### AUTOMOTIVE



a behavioural modelling approach is used. The model, which is tuned to reflect the device's typical static and dynamic characteristics, is implemented in form of an equivalent circuit consisting of lumped elements, controlled sources and feedback loops, and S-Parameters blocks.

To perform system-level simulations and achieve good agreement with measurements, a model of the ESD generator must be configured and tuned. The parameters of this model are tuned to fit the simulated current waveform on the measured waveform of the ESD generator. Wherever possible, comparisons between simulated and measured time domain current curves in both first and second peak regions of the discharge should be performed, and a good agreement between the simulation and real-world measurements should be observed

The common-mode termination network and decoupling capacitors are represented in the simulation using lumped elements. The decoupling capacitors separate the IC and the connector pins galvanically, and they protect against slow pulses (e.g., Surge), but not against fast ESD pulses.

The model for the CMC is divided into small-signal and large-signal parts. The small-signal model can be derived from S-parameter measurements of the CMC. A fitted lumped circuit model could also be used in order to speed up the simulation time. Since S-Parameters only enclose the small-signal behaviour, partly including dynamic response and completely ignoring the saturation effect, an extended model should be developed to improve dynamic and include saturation behaviour as well.

For better protection of the IC against high ESD currents, it is important that the external protection triggers before the CMC goes into saturation mode. The high voltage drop across the CMC allows the external protection device to trigger. This means it's important to ensure that the ESD protection device triggers first. However, it is not sufficient to consider only the static part of the CMC's IV-curve for prediction of the overall system robustness. The dynamic response of the choke itself plays a crucial role in the validation of the peak currents

flowing into the IC during the first peak of the ESD event.

For modelling of the full CMC behavior, the S-Parameterbased CMC model (the smallsignal model) is extended with two additional model blocks. The first block is responsible for transition from the static case into the saturation region, whereby the resistance change of the CMC signal throughpath is modelled. To realize this, a voltage-controlled changeable resistor (i.e., a voltage-controlled switch) is added in parallel to the main model. For determination of the onset time of the saturation effect, an RC network is used to control the state of the switch in dependence of the input voltage level and rise time.

A feedback loop keeps the switch control circuit in a defined condition throughout the entire ESD event duration. The second block added to the small-signal CMC model improves the representation of its dynamic behaviour, which mainly governs the voltage overshoot generated by the CMC. This is implemented by adding a rise time filter into the signal path of the full CMC model. The overall model is fitted by variation of the parameters related to each model block. According to the OPEN Alliance specification, the external ESD protection is placed near the system board connector. In this position, it can guarantee a certain robustness level of the overall system, protecting not only the IC but all discrete components located in the signal path.

The static behaviour of the ESD protection device, consisting of leakage, snapback (turnon), linear and non-linear (thermally unstable) regions, is modelled with the help of voltage-controlled switches and a diode SPICE model. The RC network and feedback loop are responsible for the state of the switches during a second peak of the ESD pulse. The dynamic behaviour of the model is implemented via two RC integration networks combined in such a way as to control the voltage drop over ESD protection as well as its decay time during the first peak of the applied ESD pulse.

The main advantages of the extended dynamic model are correct representation of the thermal behaviour of the ESD protection device and a more accurate description of both the effect of conductivity modulation and inductive overshoot. The conductivity modulation effect is of highest importance for the representation of the voltage overshoot that occurs on the external protection side and will be translated over the CMC to the IC's I/O pin in the form of peak current.

Once the various parts of the SEED model have been created, the complete system model must be validated against measurements of a reference board with and without external ESD protection using TLP.

A correctly implemented SEED model is suitable not only for qualitative but also quantitative prediction of the overall system-level robustness. Moreover, it can be used for preliminary tests using different system blocks and components. (A more detailed discussion of this topic is available in our whitepaper at https://bit.ly/3jecPpC.)

www.nexperia.com

### Automotive relays up to 80A

CIT Relay & Switch is offering automotive relays from low current to 80A with voltage ranging from 6 to 72VDC. PC pin and quick connect mounting methods offer multiple choices for design engineers, along with the option of mounting tabs in plastic and metal.

WHAT'S NEW

Applications include cars, trucks, tractors, buses, golf carts and more.

Used to let a low amperage circuit switch a higher amperage circuit like headlights, relays are also used to switch multiple systems simultaneously using one output. A single output connected to multiple relays allow opening and/or closing simultaneously.

Most automotive electrical relays are SPST or SPDT. CIT also offers a shroud option and sockets for mounting solutions.

www.citrelay.com



## Taking ambient lighting to the next level

Melexis is enhancing the design of creative and animated automotive lighting with its MLX81118 multi-channel LIN RGB LED controller with 24 LED driver outputs. Capable of driving eight RGB channels, the device reduces the bill-ofmaterials and simplifies the design of interior and exterior lighting. Features include a new dual input-voltage capability that lowers LED power dissipation for LIN applications.

Independent PWM control, configurable up to 16-bit resolution, lets the controller achieve any color point and brightness level. The device suits applications where multiple RGB LEDs need to be controlled via one LIN node within one or several modules, for example, door trims or dashboard applications.

www.melexis.com



## Superior PSRR in power dense footprint

Diodes Incorporated's new AP7347DQ low dropout (LDO) voltage regulator is optimized for noise-sensitive power-related automotive applications. This automotive-compliant high output accuracy LDO is AEC-Q100 Grade 1 qualified, manufactured in IATF 16949 certified facilities and supports automotive production part approval processes (PPAPs).

Applications include ADAS, automotive wireless communication systems, RF subsystems, and infotainment power sources.

A 75dB power supply rejection ratio (PSRR), combined with an output noise of just  $60\mu$ Vrms, gives the AP7347DQ performance advantages. It is available in 12 fixed output voltage variants with a ±1 per cent voltage-output accuracy, which is maintained across its entire -40 to 125°C operational temperature range. Its 1.7 to 5.5V input voltage range gives it the versatility to address numerous automotive application requirements, while its  $60\mu$ A quiescent current mitigates standby power losses.

www.diodes.com

#### New process boosts SBD performance

Rohm Semiconductor has expanded its Schottky barrier diode (SBD) portfolio with 24 new compact, high efficiency models. These devices, 178 in total, suit protection and rectification circuits in automotive, industrial equipment and consumer applications.

The RBR and RBQ series have been expanded to include compact, high current, high voltage products for rectification and protection in a range of applications.

A new process let Rohm improve the chip performance of both series by 25 per cent (VF of the RBR series in particular) over conventional products. Furthermore, the RBR series features low VF characteristics—key to improving efficiency and reducing loss. Twelve of the products adopt a compact package (PMDE) that reduces mounting area by 42 per cent compared to existing products (PMDU package).

www.rohm.com

# Why is low power consumption so critical in smart devices?

Designers are faced with conflicting demands for higher functionality while consuming less power everywhere and, whether they run from mains electricity, a battery, or energy harvesting, minimising their power and energy requirements is critical, both to ease the management of large numbers of devices and to "green" the IoT edge.

Smart devices are spreading

On the other hand, each successive generation whether a smart sensor, IoT gateway, autonomous controller, smart applianceis expected to provide more capabilities and capacity, handle more complex situations more intelligently, and respond more guickly. Traditionally, microcontrollers have been the main choice in power-conscious systems such as those used in IoT applications However, with the increasing demand of processing power, microprocessors are being sought out.

Using the latest embedded processors to minimise power consumption

As the apparently conflicting demands for lower power with greater performance and sophistication intensify, frugal power management is increasingly important using techniques like granular low-power operating modes with the gating of clock signals to halt specific peripherals and the power gating of unneeded domains to avoid leakage current.

Chip designers refine and improve these techniques with each generation of devices. In addition, further innovations continue to extend the power-conscious embedded designer's toolbox; like the Energy Flex architecture of the i.MX 8ULP and i.MX 8ULP-CS families announced recently by NXP.

As well as the intrinsic energy savings gained through the latest 28nm FD-SOI process technology, the Energy Flex architecture features advanced design techniques and heterogeneous domain processing. Application-level processing running a rich operating system (OS) on the chip's Cortex-A35 cores is separated from realtime processing managed by a real-time OS (RTOS) running on the Cortex-M33 embedded-class core. An optional Fusion DSP in the real-time domain handles low-power keyword detect. and there is a separate Flex domain with a HiFI 4 DSP for advanced audio and voice processing. Altogether, Energy Flex improves efficiency by up to 75%

Then there is the µPower subsystem, controlled by a dedicated core, which is implemented specifically to handle power management. This can manage more than 20 different powermode configurations across processing domains, thereby helping developers properly utilize the flexible powersaving opportunities available

#### Power-management features in i.MX 8 Processors The features of the new ultralow-power (ULP) devices

The features of the new ultralow-power (ULP) devices build on techniques employed in other i.MX processors—

such as the i.MX 8 familiesto minimize wasted power. The Arm platform, L2 cache phase-locked loop (PLL), and peripherals are managed as separate power domains Independent clock gating to the peripherals limits dynamic power by halting operation. Clock gating can be turned on and off quickly, although some leakage current occurs because the peripheral continues to receive power for biasing. Power gating tackles leakage by removing the biasing and can be applied on-chip or at the power supply, i.MX processors allow individual power gating to the Arm, PLL, and peripheral domains in standby mode.

In addition, i.MX processors use Dynamic Voltage and Frequency Scaling (DVFS), which reduces both frequency and voltage to complete required tasks with the lowest possible power consumption. The way the voltage and frequency are modified in response to changes of the load is determined in software. DVFS can be highly effective because power is reduced according to the square of the voltage. There is also Dynamic Process Temperature Compensation (DPTC), which adjusts the voltage in relation to die temperature to prevent power losses resulting from temperature increase.

#### Also, there is

heterogeneous—or big. LITTLE—processing using a combination of Arm Cortex-A application processor cores and a Cortex-M microcontroller (MCU) core. The MCU core, running an RTOS, handles low-level and real-time tasks efficiently and allows the device to remain aware in a low-power state ready to



wake the higher-performing Cortex-A cores when needed.

In addition, active well biasing allows CMOS transistors to be optimised for high performance in active modes while also minimising leakage in standby mode (he leakage can be reduced by up to 15 times).

#### Using system power modes to reduce

power consumption The various system power modes take advantage of the aforementioned features to slow down, halt, or turn off various parts of the device to save power while ensuring all required functions are performed properly. While in the Run mode, which is the normal operating mode, the core frequency and operating voltage can be dynamically changed within a range. In the Wait and Doze modes, certain clocks are gated, with operation resuming on receipt of an interrupt. In the State-Retention mode,

the MCU and peripheral clocks are gated and the supply voltage is reduced to a minimum. There is also a **Deep-Sleep** mode in which clocks are gated, power to the Arm platform is turned off, and normal operation resumes on interrupt. In the **Hibernate** mode, on the other hand, all clocks and power domains are turned off and operation resumes in the same way as a cold boot.

Ultra-low-power devices can have even more system power modes to give extremely granular control: this is where the µPower subsystem of the i.MX 8ULP and i.MX 8ULP-CS families comes in, with a dedicated RISC-V core to manage the device's 20 power modes.

This article has provided only an overview of the myriad mechanisms available to help manage the power consumption of applications running on i.MX 8 processors. Utilizing them to best effect demands extensive study that can still leave your application consuming more power than is ideal. At Anders, our embedded-systems engineers have extensive experience in minimising the power consumption of i.MX 8 processors and modules to achieve lower energy demands and longer battery life. Contact us today to find out how we can help your next design do more with less.

www.andersdx.com

#### CIRCUIT PRODUCTS

## Increased surge protection, reduced footprint

Littelfuse has announced its Xtreme varistor series. Constructed with a proprietary powder formulation developed by Littelfuse, these smaller varistors offer robust surge performance that helps prevent damage, fire hazards and catastrophic failure even under extreme circumstances.

Application examples include home automation, large/small appliances, outdoor LED lighting, smoke detectors/fire alarms and smart meters.

Littelfuse global product manager, EBU passive product management, Johnny Chang, said: "The Xtreme varistors provide numerous design advantages over several technologies currently on the market. The combination of their small footprint, wide operating voltage range and high surge current rating, will result in more robust protection for your latest product designs."

www.littelfuse.com



#### **Capacitors withstand 150°C**

NIC Components new NSPE-UT series surface mount SMT aluminum electrolytic capacitors feature a 150°C operating rating and extended lifetimes at reduced temperatures (ie >10 years at 105°C) for 8 and 10mm case sizes.

The series meets AEC-Q200 and is available in six sizes; 6.3 by 8 to 10 by 16.5 covering capacitance values from  $47\mu$ F to  $470\mu$ F in voltage ratings of 35 and 63VDC. Operating temperature range is -40 to 150°C. Ripple current rating to 5.7Arms (increased RCR at 125°C operation).

The company states hybrid construction (polymer and liquid electrolyte) provides superior performance supporting 5G cellular remote radio head, plus higher voltage systems such as 48VDC automotive, 57V IIoT and -48VDC/-60VDC power for fixed and mobile telecommunication and datacom network equipment.

The SMT construction is halogen-free, RoHS/REACH compliant and compatible with 260°C peak Pb-free reflow soldering processes. Evaluation samples are available on request.

www.niccomp.com



#### Performance in compact packaging

TT Electronics has announced four new product families in its variable resistor portfolio. These include three encoder lines and a line of single turn potentiometers. Applications include: professional audio, medical, machine controls and home appliances.

TT Electronics' director of engineering, Brian Stephenson, said:"We continue to expand our variable resistors portfolio to meet the challenging demands of the pro-audio, industrial, and medical markets—all while providing product designers the flexible, high reliability options they require. These new product families offer high performance in compact packaging, optimized for demanding applications where space is limited."

EN10 encoders feature an insulated hollow shaft, IP40 rating and 100,000 cycle rotational life (minimum) in a 10mm package. EN16AB includes an IP51 rating in 16mm packaging, while EN18AB offers either IP51 or IP67 versions in its 18mm footprint. Both EN16AB and EN18AB offer a rotational life of 30,000 cycles (minimum).

www.ttelectronics.com

## Chip inductors suit demanding applications

Gowanda Electronics has introduced its first SMP0603 ceramic core chip inductor series for power including test and measurement, industrial control and automotive. The inductors can also be used in RF applications in commercial, medical and military markets.

Performance of the 37 parts in the SMP0603 series includes 1.8 to 27nH inductance, 0.01 to 0.04 DCR ohms and 1,750 to 3,400mA DC. All Gowanda's chip inductors meet a total mass loss (TML) outgassing requirement of 1.0 per cent max when tested to ASTM E595. Standard terminations are gold-plated nickel and RoHS-compliant.

The inductors feature a flat top cover for pick and place assembly and suit reflow soldering. Operating temperature range is -40 to 125°C.

www.gowanda.com

#### DESIGNED TO ENHANCE E THE AUTOMOTIVE EXPERIENCE

From body electronics, drivetrain and safety to comfort and infotainment electronics, KYOCERA AVX components continue to outperform and maintain a strong & reliable connection, keeping you at the forefront of technology.







WWW.KYOCERA-AVX.COM

## Design engineers pitch in to combat semiconductor shortages

The role of engineers is evolving as they help their employers respond to ongoing shortages in the semiconductor supply chain

esign engineers have typically spent very little time pondering the efficacy of the supply chain that will get their products to market. They are just not wired like that. Once a design is completed it is tossed over to procurement and manufacturing making the sourcing of components someone else's responsibility. This is a luxury few companies can afford anymore.

SEMICONDUCTOR MARKET WATCH

Nowadays, the task of ensuring a smooth production process and ontime delivery of electronics goods has become the job of everyone in the design and supply chains. Huge changes are occurring in the electronics design chain fueled by the pains of the current semiconductor shortages. Companies are facing massive spikes in average selling prices and pulling everyone in for solutions. This time. design engineers are

leading the band of solution providers because the entire process begins with them, according to observers.

The design chain is being forced to adopt new tactics in response to the shortages. In fact, design engineers are now in the vanguard of helping to develop and create resilient supply chains, say industry sources.

"The shift from designing based on *first choice* to designing based on first available for a prolonged period is a ripple effect from the overall shortages that could significantly impact the electronics industry," said Peggy Carrieres, VP of sales enablement and supplier development at Avnet Inc., in a statement. "However, it also represents an opportunity for engineers to lean on their partners with added visibility into the supply chain to ensure they are creating flexibility in their designs based on

market conditions to avoid compromising quality." Obviously, the era of design engineers paying lip service to design for manufacturability (DFM) ended sometime after the outbreak of COVID-19 resulted in a shutdown of major global economic activities in early 2020, leading eventually to one of the semiconductor industry's worst bouts of shortages. Researchers at management consulting firm Bain & Company say senior executives are looking for a multi-faceted solution to the shortages crisis and have pulled design engineers into the fray because the challenges are not expected to disappear anytime soon.

"The problem, as many executives are painfully aware, is there are no quick fixes," said Peter Hanbury, Bill Radzevych and Benjamin Grant, at Bain & Company in a report. "Although there's now a light at the end of the tunnel, we expect the current shortage to last at least through the second quarter of 2022. Furthermore, the reality is we're going to see more of these kinds of global supply chain disruptions in the future, and likely not only among semiconductors."

These changes are rippling through the industry inundating electronics engineers with catchy new phrases they must now embrace and deploy during the product design phase. While design for manufacturability (DFM) has for long been a popular lingoalthough favored mostly by component engineers rather than design engineers-a new set has joined the lexicon. Observers said design for resilience (DFR) and design for availability (DFA) must be on the minds of design engineers as they shepherd their ideas to production.

Today, by default, design engineers are compelled to think also like component engineers. DFR and DFA are related, self-explanatory

acronyms, according to industry sources. "Designing for resilience is a preemptive move. Engineers do this when the company isn't facing an imminent supply disruption, but the company still sees a reason to prepare for that possibility," said the Bain & Company group."This means the company has ample time to design a product to avoid reliance on vulnerable components and build in more flexibility. This could happen upstream, before a product is in market, or it could happen downstream when a product is already in the market and would benefit from a more fundamental, deep redesign."

DFA, on the other hand, "comes into play when there's already a supply disruption and the company needs to make urgent, targeted product adjustments to rapidly respond, using available components," they noted.

A recent survey by component distributor Avnet Inc. reported similar findings. The survey respondents mainly engineers-told the pollsters that engineers believe their role is changing as they help their employers respond to the ongoing semiconductor shortages. Coupled with the shortages puddle they must wade through is the ugly specter of counterfeiting, which has emerged even more aggressively as counterfeiters seek to take advantage of the situation. Avnet reported.

"76% of respondents said they expect counterfeit components to increase, but another 8 in 10 (83%) "The task of ensuring a smooth production process and on-time delivery of electronics goods has become the job of everyone in the design and supply chains"

emphasized that they work with distributors to lessen the chance of encountering those counterfeit parts," the company said."But Avnet found that availability is impacting more than just where engineers are seeking the parts for their designs—it is also impacting how they create said designs. In the wake of the shortages, two-thirds (64%) of respondents said their company is designing more based on availability of components over preference."

How can design engineers help in mitigating the effects of the ongoing shortages on enterprise operations and efficiency? Options include "replacing back-ordered components with similar but more feature-rich units (for example, swapping in chips with more memory) and using consumer-grade chipsets that receive additional quality tests," McKinsey & Co., suggested, in a report.

Engineers at distribution companies are also trying

#### Same-day shipping

The Newest Products for Your Newest Designs<sup>®</sup> to assist with more recently introduced Best Practices. Raymond Yin, director of technical content at Mouser Electronics offered four key actions OEMs and design engineers can take. They are:

Expand the AVL (approved vendor list) up front. Qualify new suppliers and alternate sources in the design process rather than scramble to find replacements when the line is down.

Make sure to have alternate solutions in pin compatible packages where possible. These aren't necessarily the exact part number desired (they could be more expensive, for example), but those that would work should the primary be unavailable.

 Use the product information functions within CAD tools to make sure there is some availability for product being put into a schematic. Parts that are perpetually "out of stock" should probably be avoided.

 Establish relationships with key distributors and manufacturers. Product line and business unit engineers can sometimes provide 1-2 pieces for engineers to complete prototypes or evaluations.

Other possible actions identified by design engineers include increasing design reliance on software, thereby cutting back on the number of components on the board and increasing the design modularity. To cut down on the total number of parts used, many design engineers are going further by simplifying the product architecture.

Some companies have increased their investments in design resilience activities and are getting component engineers more closely involved in the design process to reduce the probability of a complete redesign in the event certain components became unavailable.

Design engineers are also working closely together with other segments of the manufacturing system, said Bain & Co.'s researchers. Some enterprises are providing the structure for this kind of collaboration by creating what they termed "agile engineering design teams" that can be deployed to address potential bottlenecks, they said.

"The most successful companies start by deploying an agile team with the right skills to quickly and effectively achieve the redesign and give it a set of clear goals and incentives to deliver on the project," the researchers said."This type of effort should be focused solely on ameliorating areas affected by the supply shortage and doesn't usually warrant a full-size product design team. The most effective agile engineering teams rapidly modify software to accommodate new parts, adjust the current product to free up resources for more important features, and use rapid prototyping and testing to validate the new designs."

M mouser.com

Order with Confidence

#### SOLUTION SIMULATOR

## **ROHM Solution Simulator adds new thermal analysis function**

The only simulator in the industry to enable webbased electrically and thermally coupled analysis

ROHM Semiconductor has announced the addition of a new thermal analysis function to the ROHM Solution Simulator. This new feature allows circuit and system designers in the automotive and industrial markets to collectively verify power devices and driver IC thermal issues on different solution circuits.

The ROHM Solution Simulator, which runs on ROHM's website, makes it possible to carry out a variety of

Model

from component selection to individual device and even system-level verification. This enables easy and accurate verification of ROHM products, such as silicon carbide (SiC) power semiconductor devices, driver/power supply ICs, and passive components (e.g., shunt resistors) in solution circuits under near-actual application conditions.

Released in 2020, the ROHM Solution Simulator lines with the company's overall focus, which is developing and supporting application circuits that maximize the characteristics of driver ICs and power devices designed to supply high power in the automotive and industrial equipment markets. In this context, the ROHM

**ROHM Solution Simulator Thermal Analysis Function** 

(Ex: PTC Heater)

ROHM Solution Simulator significantly reduces development load for applications where heat is an issue

Model

Simulation Results

full circuit verification of power semiconductor and analog ICs. The tool is free of charge, and the software has been well received for its applicability and high accuracy.

The newly added thermal analysis function can be implemented in solution circuits for devices and applications where heat is likely to become an issue in electronic circuit design. Examples are positive temperature coefficient (PTC) heaters (heaters specifically designed for electric vehicles without internal combustion engines) equipped with insulated-gate bipolar transistor (IGBTs) and shunt resistors, as well as DC/DC converter ICs and LED drivers in order to meet the increasing demand

to simulate temperature during circuit operation.

The ROHM Solution Simulator is the only simulator in the industry that enables web-based electrically and thermally coupled analysis of not only the semiconductor chip (junction) temperature during operation, but also pin temperatures as well as thermal interference of board components on solutions circuits that include both power semiconductors and ICs along with passive components. As a result, thermal analysis that used to take as much as one full day can now be performed in about ten minutes (100x faster than conventional methods). This allows users to guickly and easily check the temperature of various parts of devices prior to prototyping (instead of after, as is currently the case), thereby reducing the need for rework. At the same time, the amount of development resources required for applications where heat is an issue decreases.

Going forward, ROHM will continue to implement thermal analysis functions in solutions circuits compatible with the ROHM Solution Simulator, focusing on the latest SiC devices, to further reduce the resources required for application development and prevent issues.

www.rohm.com

## **More new products**



#### Order with confidence mouser.com/new

Simulation Results



#### POWER

POWER PRO

PRODUCTS

## Choosing a rack-mount power supply

Distrelec's head of product management, Rodrigue Mao, explores important factors to consider when selecting a rackmount power supply

There are different types of rack mounted supplies: floorstanding and compact. Rack enclosures are versatile and provide solutions for different applications. 42U, 45U and 48U are common heights for floor-standing racks and enclosures, with bespoke options up to 58U, where U equals 1.752in. Usually, width ranges from 19 to 24in. Wider enclosures can accommodate cabling without blocking airflow. If a system is operating in an environment with no temperature regulation, this is key.

The rack's load rating indicates the weight it can safely support. Total the weight of each rack item, then add a safety factor. If the rack is regularly moved, look for rolling or dynamic load rating, plus the fixed or static load rating.

Ensure rack depth is sufficient for items and wiring. Consider the minimum bending radius of wires and connector depth. A cable with excessive bending radius is subjected to undue stress and may break.

Always select a supply without fans or forced air conditioning which have a very high efficiency and therefore generate little heat loss. The operational temperature range standard must be minimally cleared to verify the supply is valid.

Because DIN rail power supplies are often small, their systems are frequently put on the backplate, protecting them from harsh environmental conditions.

DIN rail mounted power supplies are designed constant supervision. However, any piece of equipment could fail. To minimise risk, ensure the supply is secured against short circuits, overloads, overheating and overvoltage.

AC/DC power supplies must meet IEC 60950-1 for IT and industrial equipment. Isolation testing is typically performed with two voltages: 3kVAC and 4kVAC. Each device must pass a 3kVAC input-to-output isolation test to comply. The 3kVAC test is also required by the IEC61010 standard, covering test and measurement equipment.

Optimal power supply efficiency is achieved under partial load. Most power supplies are rated at least 80 per cent. 80 Plus accreditation indicates at least 80 per cent efficiency at 20, 50 and 100 per cent loads. A 500 Watt power supply with 80 Plus

certification would draw 625

watts of electrical power on the input side at full load (100%). Of this, 80% (500W) is delivered as electrical power on the secondary side and 125 watts are losses that must be dissipated as heat. With an efficiency of 90%, the power loss is reduced to 55 watts. According to the EU directive, losses in stand-by mode must not be higher than 0.1 W.

Especially in test or development systems, DC voltage output accuracy is crucial. A stable DC voltage is often required in any fluctuations, outages, surges or changes to the current DC output. Also in industrial applications, current outputs ensure the power supply output remains stable during uncommon output surge current demands. Many modern power supplies are protected against overvoltage and over-current and often provide cooling by free air convection.

www.distrelec.com





#### Small but tough

Cosel has added two open frame compact power supplies for demanding industrial applications to its LHA series. The LHA10F and LHA15F are said to be 15 per cent smaller and offer a leakage current 50 per cent lower than conventional products. Operating temperature range is -10 to 70°C. The supplies are UL/EN62368-1 certified.

Input voltage range is 85 to 264VAC single phase and conform to the safety standards input voltage range of 100-240VAC (50/60Hz). Five output voltages are 3.3, 5, 12, 15 and 24V with respective currents. On both versions, the 3.3V output voltage can be adjusted from 2.85 to 3.63V. All other voltages are fixed.

www.coselusa.com

#### Full load with convection cooling

TDK has introduced 1.5 and 3W models to its CCG series DCDC converters which can provide full load in ambient temperatures from -40 to 85°C with convection cooling. Applications include battery powered equipment, process control, data communications, telecommunications and test/measurement products.

Output voltages are  $3.3, 5, 12, 15, \pm 12$  or  $\pm 15$ V, while dual output versions can be connected to provide a single 24 or 30V supply. All voltages and output power combinations can operate from either a 4.5 to 18, 9 to 36 or 18 to 76VDC input.

Single output models can be adjusted using the trim terminal over a -5 to 10 per cent range for non-standard voltages. All models are protected against over-current and the output can be inhibited using the remote on/off function. The input to output isolation voltage is 1,500VDC.

The converters share a common plastic case measuring 15.7(l) by10.4(w) by 11.5mm (h). A choice of through-hole or surface-mount terminations is available in both power levels.

www.tdk.com

#### Adjustable near-to-zero output

Powerbox has announced a 1200W OFI1200A AC/ DC power supply for industrial applications. Optimized for conduction cooling, the supply is said to deliver high performance levels across a baseplate temperature range of -40 to 95°C without a fan. Input range is 85 to 305VAC with power factor correction. Output voltage and current can be adjusted from near zero to maximum for each model.

To help customers precisely adjust voltage and current the OFI1200A offers two analog inputs, VTRM and ITRM. Output voltage and current can be adjusted from near zero to the maximum specified per model. For example, the 28V output can be adjusted from near zero volts up to 33.6V, and the output current from near zero amps up to 43A. The output voltage can also be adjusted using the onboard potentiometer.

The OFI1200A series has a three-year warranty and conforms to the European RoHS, REACH and Low Voltage Directives. The product carries the CE, UKCA and cURus markings.

www.prbx.com



#### Quiet supply packs power

Vox Power's VCCM600 conduction cooled configurable power supply series is designed to combine the advantages of a modular power supply with the reliability of a fanless architecture. The unit delivers a silent 600W (up to 750W peak power for 5s) in a 4 by 7 by 1.61in package. The product suits medical and industrial applications where reliability or audible noise are a concern.

The VCCM600 series can be configured as a conduction, convection or forced air cooled solution, allowing use in environmentally controlled environments to harsh industrial conditions. Each configured solution can accommodate up to four isolated DC output modules with outputs from 1.5 to 58VDC at 150W per channel. Each module utilises 100 per cent SMT components for reliability. Additional features include a 5V/1A bias supply and 5-year warranty.

www.vox-power.com

#### **ENERGY TECH**

## Designing Sustainable **Energy Technology**

feature bypass diodes.

when cell shading occurs,

to efficiently generate

current. The generated

thereby allowing the panels

current is direct current (DC),

which is then converted to

alternating current (AC) by

an inverter, and ultimately

transferred to a power

grid. From this point on,

appliances and tools draw

Aided by appropriate semiconductor diodes and transistors, solar panels are leading the way among renewable energy sources

Over the past twenty years, sustainable energy has evolved significantly. Improvements in renewable energy technology have led to higher power conversion efficiency, with high projected growth rates over the next ten years in the automobile and commercial power markets. Leading the way among the various renewable energy sources are solar panels, which are popular due to their ease of accessibility.

Along with accessibility, solar panel power conversion efficiency (PCE) has greatly improved since



#### Bypass diode implementation

this AC signal from the its inception, with modern consumer panels capable power grid. Depending on of outputting a 22% figure. the powered device, the AC In order to achieve a high signal may be converted PCE, solar panel networks to DC, which is often further modified by means These diodes are used to of a DC-DC converter. prevent unwanted power consumption and hotspotting

#### **Bypass diode**

implementation In a normal operating state, solar cells convert incident solar radiation into electric current, essentially acting as sources. If a cell in the string was to malfunction, however, the cell would instead become an electrical impedance. The most common solar cell

malfunction is cell shading, which unfortunately is unavoidable; cell shading can quickly become fatal to the solar cell network. The shaded cell(s) will begin to drop voltage rather than source current. This leads to hotspotting, since the shaded cell(s) dissipate a large amount of the power generated by the working cells.

> Hotspotting will likely damage or destroy the shaded cell(s) and could potentially cause an environmental hazard. Even if there is no damage to the system, there is still a





#### DC-DC Conversion (MOSFET implementation)

significant power loss, which causes the overall PCE to decrease. In order to avoid this scenario, bypass diodes are placed in parallel with solar panel cells. Under normal operation, these bypass diodes are reverse biased and will not interfere with circuit operation. In the case of cell shading, the bypass diodes provide an alternate, low-resistance path for current. While the overall power generated by the system will still be lower, there is no damage to the working or shaded cell(s). In an ideal design, each cell would have its own bypass diode. However, due to cost implications, bypass diodes are typically placed in parallel with anywhere from 10 to 20 series cells.

Schottky rectifiers are the recommended technology type for bypass diodes. The fast switching properties and low forward voltage of Schottky rectifiers help solar cell networks maintain a relatively lossless performance. Central manufactures multiple

Schottky rectifiers-both through-hole and surface mount packages-that meet desired bypass diode specifications. Typically, a bypass diode has a reverse breakdown rating between 60V and 100V, more than enough to block the combined cell voltages in normal operation. For forward conduction, the bypass diode must conduct the large amount of current that is generated by the active cells. This current range can vary depending on application, making Schottky diodes that can rectify 6A or higher an ideal solution.

#### **MOSFETs in inverters** and DC-DC converters

The direct current generated by the solar cell network must be converted to alternating current before it can be delivered to a power grid. This is done through the use of inverters, which are switching circuits comprised of MOSFETs. Four N-Channel MOSFETs are used in the standard DC to AC inverter topology, where two parallel branches

#### **ENERGY TECH**

of two series MOSFETs are connected via a common load. Two of the four MOSFETs are switched on and off such that current across the load produces a natural half-square wave.

In order to produce a half-sine wave rather than a half-square wave, a pulsewidth modulator (PWM) can be used to drive the MOSFET gates. PWMs are controlled drivers that have a modifiable pulse width. which is executed using comparator topology. Modifying the pulse width that drives the MOSFET gates regulates how long each MOSFET is switched on or off. The less time a MOSFET is switched on, the lower the duty cycle of the load current. By modifying the pulse width over time, the load current can be averaged as a half sine wave, with short pulses producing low amplitude portions and long pulses producing high amplitude portions.

After the formation of the half sine wave, the two

MOSFETs that were open during the first half of the period are used in the same manner as the previous two. They are switched on and off so that current across the load produces a naturalhalf square wave, except load current direction is reversed. Combining the two generated signals creates a full sine wave that can be stepped-up or steppeddown with a transformer used for power distribution.

Appliances and electronics that use DC power must convert the AC signal from the grid back to DC. This is completed through standard AC-DC rectification using a bridge rectifier, load, and smoothing capacitor. After rectifying back to DC, there is often a DC-DC stage used to either boost or buck the DC signal. This sets the DC voltage level in order to ensure its compatibility with the power requirements of the given device. Both boost and buck DC-DC converters make use of switches, often MOSFETs, to alter the path of current flow.

#### **ENERGY TECH**



By changing the available path to the current within the circuit, the inductive element of the converter will reverse polarity and in-turn alter the output signal.

#### Implementing SiC Schottkys in DC-**DC converters**

Aside from the MOSFETs and passive components necessary to design a DC-DC converter, Schottky diodes are required to regulate current flow. Schottkvs are often selected for this type of asynchronous design because they can turn on and off very quickly, leading to higher levels of efficiency due to low energy loss. In boost mode, only one Schottky diode is required. When the MOSFET is switched off and the inductor flips polarity, the Schottky diode turns on and allows forward conduction to the load. In buck mode, two Schottky diodes are required. When the MOSFET is switched off and the inductor flips polarity, one Schottky diode conducts to the load-just as with the boost converter-and the other Schottky diode

to the inductor, acting as a battery in the circuit.

Rather than use standard Schottky diodes, silicon carbide (SiC) Schottky diodes can be used in DC-DC converters to ensure a more efficient design. This is due to the innate material composition of silicon carbide as well as its wide bandgap potential of 3.26eV. Since the bandgap shrinks with temperature increase, the wide starting bandgap allows SiC to remain functional in much higher temperature ranges. SiC, in turn, has an enhanced thermal conductivity of 490 W/(m\*K) (6H form), which is much larger than that of silicon at 149 W/ (m\*K). This greatly helps to avoid increases in leakage current at higher operating temperatures.

The wide bandgap of SiC also directly contributes to another important property: high breakdown voltage potential. The critical electrical field (the required potential per meter for electrical breakdown)

provides a path from ground

bandgap potential. For this reason. the breakdown voltages of SiC Schottkys can be designed to occur in the range of 600V to 1200V, which is much higher than the 200V breakdown maximum seen in silicon Schottky processes. This

increases with increased

makes SiC a more effective voltage blocker and less prone to high leakage currents at lower voltages.

The most enticing property of SiC however, is its lossless switching characteristics. Every silicon diode, whether standard or Schottky, takes a set amount of time to turn on and off. At high frequencies this is detrimental to operation because cumulative charge loss over multiple periods can be extremely high. SiC displays superior electron drift velocity, which is defined as electron mobility given a specific electric field potential. While intrinsic carrier mobility figures for silicon and SiC are quite similar, electron drift velocity is considered to be the key parameter due to its non-proportional change at high electric field values.

The value of electron drift velocity at high electric fields of SiC can reach double that of silicon, with a top value of 2E7 centimeters per second.

#### Conclusion

As noted earlier, renewable energy continues to grow in popularity with strong continued growth projected throughout the next decade. **Central Semiconductor** is keenly aware of the importance of this growing technology and has responded by placing a large emphasis on designing devices that are both parametrically advanced and highly efficient. With the key factor being energy sustainability, an important focus of Central's product development efforts for these applications is to design devices that are as lossless as possible. It is Central's goal to continue supporting these applications, in addition to many others, by designing and manufacturing the most efficient and innovative discrete semiconductors in the industry.

www.centralsemi.com

Semiconductor Corp.

## Your solutions provider for standard & custom discretes

#### The design support you require

Since 1974, Central Semiconductor has been the go-to manufacturer for customers around the world who want innovative and reliable discrete semiconductors. Satisfying engineers' most demanding design requirements for the latest applications and delivering exceptional quality are passions for the Central team. Your vision is our mission, just ask.

#### Standard products

Central manufactures standard semiconductors in surface mount, through-hole, and bare die forms. Diminishing source legacy devices are also readily available.

#### Rectifiers

- Schottky Diodes & Rectifiers
- Switching Diodes Zener Diodes
- Current Limiting
- Diodes General Purpose Transistors

#### RF Oscillator Transistors

- Darlington Transistors
- MOSFETs & JFETs
- Protection Devices
  - Thyristors
  - Silicon Carbide
  - Multi Discrete Modules



#### For the ideal discrete semiconductor solutions your designs require, visit www.centralsemi.com or call 1.631.435.1110.



#### Custom & semi-custom solutions

When standard devices do not meet your design requirements, Central excels at developing custom solutions. These may be new to Central or new to the world.

#### Central's engineering team can develop your ideal solutions at all levels of the design process, including:

- Parametric electrical screening
- · Plating options for through-hole devices
- Custom device development
- Up-screening for high-reliability applications
- Super Industrial<sup>™</sup> and Spacellite<sup>™</sup>
- Product services & vendor managed inventory



#### **COBOTS**

## **Collaboration in the** workplace: How a new generation of cobots is improving the nature of manual work

technology can make work less dangerous, strenuous, and tedious, but this calls for sensitive implementation and a commitment to reskilling. This article shares insights from Nicola O'Byrne, ADI's global ambassador for robotics

Automation

Even before the start of this decade, various forces were combining to widen the adoption of robotics technology. Robots were being installed in greater numbers, chiefly in factories, but also more widely in scientific laboratories, warehouses, and logistics facilities, and even in such traditionally labor-intensive domains as horticulture

Then, in March 2020, those forces were suddenly redoubled with the onset of the SARS-CoV-2 pandemic, which is more popularly known as COVID-19 (the virus

itself is SARS-CoV-2. while the disease it causes is COVID-19). The "new normal" of the coronavirus crisis has imposed the need for social distancing in workplaces, boosted the volume of e-commerce transactions and the demand for fulfilment services, and shown industry that its farflung, globalized supply chains are surprisingly fragile. Robotics has an important part to play in industry's response to these coronavirusinduced phenomena.

Innovations in the technology of robotics

systems have made

them guicker and easier to implement than ever before. As the technical challenges involved in robotics become easier to solve, the spotlight is shifting to people and processes. Robotics technology can lead to profound changes to patterns of staff deployment, to the requirement for skills and training, and even to organizational culture and to society at large, and these changes deserve careful attention from organizations

and public bodies.

#### High level guidance for companies implementing robotics programs

To help guide industry through this change, Analog Devices has made Nicola O'Byrne its global ambassador for robotics. O'Byrne is an engineer with years of experience in developing components and technology for robotics systems such as motors, simultaneous localization and mapping (SLAM) modules, and safety event detection.

Now she advises ADI's customers, and its customers' customers, on

the wider issues involved in the introduction or extension of robotics. This higher-level view is more important than ever, she says, because the coronavirus pandemic is driving companies to adopt robotics technology faster than before. And if they take account of the issues that O'Byrne is raising, they can ensure that their deployments are not only quick but also effective and good for the company and the communities it operates in

"We know from real-world experience that robots are huge productivity enhancers on the factory production line," she says. "The classic uses of robots involve the deployment of large, expensive machines which take weeks to install, commission, and program."

"Since the coronavirus pandemic took hold, we have been seeing growing interest in the deployment of new types of robots, including collaborative robots, known as cobots.



#### **COBOTS**

Absence because of illness or self-isolation makes it harder to plan work rosters, and the need for social distancing in the workplace means that-in some settingsemployers simply cannot accommodate their usual complement of workers. Robots or cobots offer the potential to take up the slack."

The pandemic has also put pressure on global supply chains that were already feeling the strain of U.S.-China trade tensions and Brexit. One

common response is to reshore production, so that products are manufactured closer to the point of purchase or use.

Again, robots play an important role. As O'Byrne says, "Reshoring can be good for business continuity and resilience, but manufacturers producing in western Europe or North America do not have access to low-cost labor in the same way that they do in China or other Asian nations. Robots solve the workforce problem. They also provide

#### **COBOTS**

the additional benefit of enabling a more modular and flexible approach to production operations, supporting moves towards mass customization."

#### New roles for new types of robots

According to O'Byrne, this new wave of automation is not just about more of the same. Innovative organizations are finding new ways to automate, which require new kinds of robots and new skills in their human operators. She says, "One of the biggest new developments is in the design and deployment of cobots. The role of cobots is to take away the grind and strain involved in much manual labor. They can do the tedious, effortful, or dangerous tasks such as polishing, milling, drilling, or cutting, under the guidance of a human operator." Studies have shown that safety at work is enhanced while working with cobots.

The operation of cobots alongside human operators means that the power they use and the space they occupy must be much more limited than for a conventional standalone robot. This means that they must be aware of their environment, so that

they slow down or stop when they detect a person close to a moving part such as a tool or the arm of the cobot.

Cobot manufacturers are also finding new ways to enable faster and easier commissioning and programming. O'Byrne says, "Cobot manufacturers have introduced a highly abstracted approach to programming. In many cases, the user does not need to write a single line of code-the operations of the cobot can be configured via a tablet-style console. Then the operator can perform guided programming, positioning the cobot arm in a sequence of points in space, and pressing a button on the console to store the sequence in the cobot's memory."

Smaller, cheaper cobots that are quicker and easier to deploy is industry's vision for the wider adoption of robotics. The combination of a cobot and human can achieve much greater output more safely than humans on their own. This is giving rise to exciting opportunities to reimagine work and the workplace. What we are used to thinking of as manual work could be transformed, eliminating physical strain, tedium, and danger, as well

as the scope for human error, and freeing workers to perform more stimulating work that makes better use of their cognitive abilities.

But O'Byrne insists that this transformation needs careful management if industry is to retain the consent of the communities in which is works. She says, "Today, humans are fearful that robots will replace people, particularly the least qualified and lowest paid sections of society. While I understand the fear, I think it's misplaced. In fact, the introduction of robots takes tasks away from humans, but not jobs. People have to do what the cobots cannot do: manage the process, use creativity to refine or reinvent it, and build the team that works with the cobots. These are functions that require humanity, not machinery."

And O'Byrne says that those who are already employed to perform a task are often the best people to configure, operate, and manage the cobot. She says, "In a factory, it's the people on the shop floor who have the most intimate knowledge of the process, so they know best how to integrate cobots into it. Of course, this change in their

role requires some additional skills and knowledge, but organizations can bring their staff and the wider community with them if they support that transition with generous programs for training and reorganization. I think public bodies can usefully play a role here too, for instance, to extend the provision of vocational robotics courses for graduates to enhance their value to a first employer."

A win-win outcome from the adoption of new robotics technologies is possible, but the lesson from experts such as ADI's Nicola O'Byrne is clear. As she says, "Technology is at the heart of successful implementations of robotics, but take care of the people and the process as well if you want to enjoy the full benefits that the new generation of robots have to offer."

www.analog.com

"Smaller, cheaper cobots that are quicker and easier to deploy is industry's vision for the wider adoption of robotics"





34 May/June 2022 · designing-electronics.com

## 

#### **METAVERSE**

# Understanding how immersive mixed reality will power the metaverse

The metaverse has the potential to change many things, including the way in which we design and test electronic systems

The way in which automotive and aerospace businesses, enterprises, and industry leaders utilize technology for everyday tasks is set to undergo one of the most drastic evolutions ever. Just a few short years ago at the time of this writing, it was all but impossible to conceive of any sort of technology that could have a greater impact than networked computers, the internet, or even mobile computing. Now, however, the immersive mixed reality powering the metaverse is challenging just that for all these industries, and more.

#### What is mixed reality?

There are so many different "realities" these days that it's easy to get confused, so a brief overview is as follows. Physical reality (PR) refers to the real world we see around us. At the other end of the spectrum, we find virtual reality (VR) in which the reality is completely generated by a computer. In addition to education



#### The reality-virtuality continuum

and entertainment, VR has tremendous application in industry for training, such as teaching crane operators how to manipulate heavy loads in adverse conditions.

Augmented reality (AR) refers to an interactive experience of a realworld PR environment in which the objects that reside in the real world are enhanced by computergenerated perceptual information, sometimes across multiple sensory modalities, including visual (with text and/or images and graphics), auditory, haptic, somatosensory, and olfactory.

In fact, AR is only one side of the coin, because we also have diminished reality (DR), which is also known as deleted reality, and which is the complement of AR. As opposed to adding information or stimuli to a real-world scene, DR involves removing or diminishing information or stimuli from the real world. Examples would be to fade down (or out) extraneous voices or other sounds when you are conversing with someone in a noisy environment, fading or blurring portions of the scene you are viewing, or completely removing objects or

people from the reality with which you are engaging. And there's also augmented virtuality (AV). As opposed to

AR, in which objects and scenes in the real world are augmented with computer-generated information, AV refers to augmenting virtual environments with realworld objects or people. Mixed Reality (MR) refers to merging of all types of real and virtual worlds—PR, AR, DR, AV, and VR—to produce new environments and visualizations, where physical and digital objects co-exist and interact in real time. Mixed reality does not exclusively take place in either the physical or virtual world but is a hybrid of reality and virtual reality. All of this can be visualized as a reality-virtuality continuum spanning 100% physical reality at one end of the spectrum and 100% virtual reality at the other end.

#### What is the

metaverse? Published in 1992, *Snow Crash* is a science fiction novel by the American writer Neal Stephenson. Like many of Stephenson's novels, it covers history, linguistics, anthropology, archaeology, religion, computer science, politics, cryptography, memetics, and philosophy.

The term "metaverse" has its origins in *Snow Crash* as a portmanteau of "meta" and "universe." Originating from the Greek meaning "after" or "beyond," meta is also used to mean "more comprehensive" or "transcending" when used as a prefix. (Although "Metaverse" is always initial capitalized in Stephenson's fiction, the lowercase "metaverse" is more commonly used by everyone else except at the beginning of a sentence.)

For the purposes of our discussions here, the metaverse is understood to be a universal mixed reality world that is facilitated by the use of virtual and augmented reality headsets.

#### How will companies leverage digital twins?

A "digital twin" is a virtual representation that serves as the real-time digital counterpart of a physical person, object, process, or system. Today's IT leaders are building metaverses-knowledge workers and things being represented by digital twins-virtual worlds where people, consumers, workers, all gather to communicate, collaborate, and share through a virtual presence on any device. For example, automotive and aerospace companies will build immersive virtua spaces, a.k.a. metaverses, that will allow employees to virtually collaborate using their digital twin through chats, emails, video calls, and even face-to-face meetings. Well-known companies

like Microsoft, Accenture, and Facebook, which itself is now called Meta, are all paving the way toward this new reality of business, but there are companies working behind the scenes building immersive



#### **METAVERSE**

reality, modeling, and simulation technologies that will ultimately power these new metaverses

#### What can companies do with metaverses?

Microsoft, in particular, believes that individuals will engage with one another in an immersive experience once they can co-exist in a virtual setting where they exist as avatars, perhaps even one day as holograms. The company expects people to access virtual settings from its Mesh for Teams application through mixed-reality headsets like HoloLens, as well as everyday smartphones and laptops.

In one of the earlier enterprise-level buildouts, Accenture has been developing a "virtual campus" where its employees meet for coffee, parties, presentations, and other virtual events. The company also leverages this virtual meeting space when onboarding new employees so they can build their own virtual (digital) twins.

## Modelling is at the center of powering the metaverse

In these metaverses, digital twins based on modeling and simulation play a leading role. Simulation allows automotive and aerospace design teams to take copies of the digital twins of their creations, run simulations on them, and then identify optimizations that are too complex to find by monitoring the physical environment alone.

The power of simulation will be a game-changer for enterprises and businesses throughout the metaverse in a variety of industries, such as optimizing production planning in the automotive sector, accelerating design in the aerospace industry, improving overall production efficiency for manufacturers, and increasing accuracy for consumer-packaged goods companies. Many companies are poised to leverage virtual simulation to make better business decisions and generate the greatest return on investment.

Optimum immersive reality systems are needed to support ultra-realistic, highfidelity digital twin visuals during the modeling and simulation process; precise fusion of the virtual-on-realworld in a multi-platform

#### **METAVERSE**

environment and the ability to demonstrate a variety of realistic environments.

A new kind of application that is enabled by tight integration between real and virtual worlds, the metaverse is facilitated by multitude of new technologies broadly in five groups as shown below:

- Communications and computing infrastructure: The metaverse will need to perform largescale, compute-heavy tasks and access large databases to merge the real and virtual worlds.
- Management technology: The metaverse will need a lot of resources like energy, compute, etc. This layer manages and allocates the most optimal resources required to run the metaverse.
- Fundamental common technologies: Artificial intelligence (AI) and spatio-temporal consistency are fundamental common technologies required for the metaverse.
- Virtual reality object connection: The metaverse will create 1:1 connections between real and virtual world objects, and technologies like

blockchain and identity modeling will enable this.

 Virtual reality space convergence: The metaverse will fundamentally need a new medium to interact.
 PR (PR, AR, DR, AV, and VR), brain-computer interfaces (BCIs), and gaming technologies will enable this.

Immersive reality solution providers offer a variety of fundamental and foundational technologies required to run industrial enterprise metaverses, including virtual reality space convergence, communications and computing infrastructure, and security and privacy.

#### Virtual reality space convergence Ultra-low latency high fidelity

rendering: Low latency is extremely critical to provide an immersive experience in a metaverse. GridRaster's AR/VR partners provide unparalleled realism of environments by leveraging ultra-low latency remote rendering on cloud/on premise in full fidelity and wirelessly streaming the solution to affordable commercial-off-the-shelf (COTS) devices in the form of head-mounted displays (HMDs), tablets and desktop computers.

High-precision 3D Al-based spatial mapping: Uses high-fidelity remote spatial mapping with high-fidelity 3D scene reconstruction, scene segmentation, and 3D object recognition using 3D vision and deep learning-based Al with precise fusion of the real and virtual worlds to merge the real world

and virtual worlds.

Game engines: Consumer game engines have limitations in that they can handle only a metaverse that can fit in a single server. The metaverse will be ever-growing as more digital twins are created to simulate real objects in the virtual world. The right AR/ VR partners have created a data-centric simulation

engine that scales for any complexity of metaverse.

and computing infrastructure Cloud computing/edge computing: Industrial enterprises will subscribe to multi-cloud, edge cloud. Depending on different factors like data sensitivity, latency, and cost, different parts of the metaverse need to be run at different cloud/edge locations in a distributed manner. Our AR/VR partners automate running the metaverse

for industrial enterprise.

Messaging framework: In a distributed metaverse there is a need to update the metaverse at global scale so users can collaborate seamlessly. Our AR/VR partners have messaging framework updates distributed to the metaverse at global scale.

#### Security and privacy

Security and privacy are among the biggest issues facing today's world. Since the metaverse has digital twins as an integral part, it will have much richer data. Security and privacy in the metaverse cannot be solved by traditional security tools, so our AR/VR partners have built tools that handle the security and privacy related to digital twins.

#### Conclusion

The metaverse is going to be important for all businesses, enterprises, and consumers. Today, people and employees can only experience the internet when they log online using their computer or mobile device, but with new connectivity, devices, and technologies powered by immersive mixed reality, we will be able to experience the internet all around every single day.

www.gridraster.com

#### WHAT'S NEW



#### Heatsinks cool diverse components

Advanced Thermal Solutions now provides heat sinks for component sizes ranging from 27 to 70mm square. This wider size range accommodates semiconductor components, including FPGAs, ASICS and other package types, in applications such as telecom, optics, test/measurement, and military.

ATS fanSINKS feature cross-cut, straight aluminum fins. They support omni-directional airflow for optimum cooling from attached fans and ambient air. To optimize heat transfer, the sinks are provided with a pre-assembled thermal interface material.

fanSINKS attach securely to components using a plastic frame clip and stainless steel spring clip. For larger components, fanSINKS mount to the PCB using PEM pushpins that secure into 3.0mm through holes.

Each fanSINK requires its own fan, based on the application. Fans by Delta, Sunon, San Ace and other manufacturers are compatible. For secure fan attachment, ATS provides stainless steel mounting screws in a range of lengths for different fan heights.

www.qats.com

## Robust choke targets commercial applications

New Yorker Electronics has announced availability of the new Vishay IHCM common mode choke. Designed with a low-profile, surface-mount construction, the IHCM-2321AA-10 is said to be more robust than bulky toroid-based devices, while delivering superior performance across temperature ranges to 155°C.

Reduced size and volume help make the choke more resistant to shock and vibration, while the enhanced core design extends current saturation to as much as 35A. This makes the IHCM-2321AA-10 ideal for commercial-grade DC/DC converters, EMI filters and high current filters. It can also be used for noise suppression in motor control and other circuity in industrial and telecom applications.

www.newyorkerelectronics.com

## Camera modules add plug-and-play vision

Arrow Electronics has introduced a family of plug-andplay camera modules based on sensor technology from onsemi. The modules provide an effective way to incorporate camera functionality, supporting migration from proof-of-concept to mass production.

Arrow worked with Shiratech Solutions to create the camera mezzanine cards, which are compliant with the 96Boards specification. Each module is based on a different onsemi CMOS image sensor, enabling users to select functionality depending on their requirements. Target applications include artificial intelligence and machine vision, low-power IoT devices, and commercial and consumer security products.

Each mezzanine is also equipped with the onsemi AP1302 image signal processor, which takes over if the main processor does not have an integrated ISP. This IC can handle various tasks such as sensor configuration and calibration, image format conversion, basic transformations, and autofocus. Designed to improve overall system performance, the AP1302 supports onsemi image sensors up to 13MP.

www.arrow.com



#### Specify custom color enclosures in any volumes

Metcase's Technomet enclosures can now be specified in custom colors, even in low volumes. Options range from trim and bezel highlights to bespoke colors for the whole enclosure. These desktop and portable instrument enclosures are ideal for medical and wellness devices, test and measurement equipment, industrial control, peripheral devices and interfaces, switchboxes, communications and laboratory equipment.

Enclosures in the range are engineered to fine tolerances with diecast front and rear bezels that fit flush with the case body for a smooth appearance. Snap-on trims hide the fixing screws and all sizes are available with either a bail arm that doubles as a desk stand or ABS side handles. Three sizes offer a sloping front bezel.

www.metcaseusa.com

#### **TEST**

### **PRODUCTS**



#### **New RF Module extends** MT8000A 5G NR test coverage

The functionality of existing MT8000A Radio Communication Test Stations can be upgraded using Anritsu Corporation's new 0.4-7.125GHz Enhanced RF Module MT8000A-033 option, which leverages a modular architecture to facilitate extended all-in-one 5G NR test coverage.

With its built-in RF transceiver (up to 16Tx and 8Rx), this new RF module supports carrier aggregation over four bands for 5G 4x4 MIMO SA and New Radio Dual Connectivity (NR-DC), which combines FR1 and FR2 component carriers to achieve higher bandwidth.

As well as covering the FR1 band, the MT8000A platform with this new RF module also covers future NR-U and licensed 6GHz bands for flexible testing of various frequency-band combinations to improve test efficiency and optimize R&D capital investment.

www.anritsu.com



#### Keysight delivers the first BERT solution for validating 1.6 terabits per second transmissions

Keysight Technologies, Inc. (NYSE: KEYS), a leading technology company that delivers advanced design and validation solutions to help accelerate innovation to connect and secure the world, has introduced a new 120 Giga Baud (GBd) High-Performance Bit Error Ratio Test (BERT) solution (M8050A) for validating next generation chip deployments of up to 120 GBd for 1.6T (or one trillion bits per second) market with unachieved signal integrity.

Digital development and senior validation engineers are challenged with higher loss and distortions when moving from 112Gbps per lane to 224Gbps per lane. The new M8050A is designed to overcome these challenges with high signal integrity enabling more test margin. This allows customers to move to next generation 1.6T designs while maintaining the flexibility needed to quickly adopt the M8050A to new requirements in the future.

www.keysight.com



#### **MIKROE** launches Planet Debug

The embedded solutions company MikroElektronika (MIKROE) has launched Planet Debug, a hardware-as-aservice platform that enables designers to develop and debug embedded systems remotely without investing in hardware.

For just \$4/day, designers can reserve time on a remote Planet Debug station configured to their requirements, and then develop and debug their own application code remotely through MIKROE's NECTO Studio IDE (Integrated Development Environment) without having to source the hardware, wait for it to arrive, and plug it all together.

By using Planet Debug, users save time as well as money. They also get to 'try before buying,' and can change peripherals, displays, or even the MCU without needing to buy any hardware, learn any new software, or write any new code.

www.mikroe.com

#### Rohde & Schwarz adds new frequency ranges to spectrum analyzers





#### Anritsu introduces the Rubidium signal generator family

Anritsu Corporation introduces the Rubidium signal generator family that delivers outstanding signal purity and frequency stability, even at high output power levels, across a broad frequency range of 9kHz to 43.5GHz. Coupled with built-in, easy-to-use, at-location frequency and power calibration capability, Rubidium offers exceptional overall utility and long-term value in a broad range of commercial and military/aerospace measurement applications.

Housed in a 3U chassis with a 7-inch touch screen on the front panel with a traditional keypad/dial interface, the Rubidium is ideal for applications that require low phase noise such as testing radar subsystems, up/down converters, or high-speed ADCs/DACs. A wide range of options are offered to achieve optimum cost-to-function and measurement flexibility.

www.anritsu.com

#### **PRODUCTS**



Rohde & Schwarz has extended its popular R&S FPL1000 family. Two new models have been added to the range, providing capabilities from 5kHz to 14GHz and 5kHz to 26.5GHz. They combine the functionality of benchtop instruments and the portability of a handheld instrument with intuitive features to make high performance measuring on the go fast and simple.

The R&S FPL1000 is a single measuring instrument for general purpose applications and various types of measurements. It is the go-anywhere instrument for spectral measurements, for highly accurate power measurements with power sensors and for analysing analog and digitally modulated signals.

The R&S FPL1000 spectrum analyzers with new frequency ranges are part of the R&S Essentials portfolio. All models are now available from Rohde & Schwarz and selected distribution partners.

www.rohde-schwarz.com



#### **INDUSTRY NEWS**

## Investing in lead-free R&D

In this article, IPC highlights new investment in lead-free R&D, while also warning readers that high material and labor costs continue to challenge the sector The US Senate has approved an FY2022 spending package containing \$7.5 million for further leadfree R&D in defense and high-performance applications, sending the measure to President Biden for his expected signature.

IPC vice president of global government relations, Chris Mitchell, said: "With leadbased electronics becoming more difficult and expensive for the US Defense Department to procure—and with other nations now leading the world in electronics manufacturing—greater US reliance on lead-free electronics is imperative to improve military readiness and innovation.

"The migration of the commercial electronics industry to lead-free technology has created supply-chain concerns for the defense and high-performance sectors that can only be overcome through public-private R&D. These funds will support an ongoing, collaborative effort that will help ensure that mission-critical systems have full access to cutting-edge electronics from a robust global supply chain.

"It's also important to realize that the lead-free electronics R&D project is both consequential as a stand-alone project and as a test of American resolve to reassert leadership in electronics. We thank the congressional leaders who understand this issue, and we call on Congress to keep funding this project to completion over the next three years."

Participants in the two-yearold R&D program include Auburn University, Binghamton University, Purdue University, University of Maryland, BAE Systems, Boeing, Lockheed Martin, Northrop Grumman, Plexus, Raytheon Technologies and others. The R&D is being carried out under the auspices of the Defense Electronics Consortium of the US Partnership for Assured Electronics (USPAE).

In other IPC news, data shows that high material and labor costs are expected to continue for the foreseeable future while recruiting and retaining skilled talent continues to be a challenge.

IPC's March economic update and global electronics manufacturing supply chain sentiment reports found that more than nine in 10 manufacturers have experienced an increase in lead times for parts and components since the start of the pandemic, with approximately half indicating an increase of one to three months. The overall global economic picture is also complicated by the emerg-

Among other conclusions, the IPC survey results show:

ing Russia-Ukraine conflict.

 More than three-fourths of electronics manufacturers are experiencing rising material and labor costs, and most expect this to continue for six months

- Ease of recruitment, inventory available from suppliers and profit margins are declining
- Sentiment improved slightly this month, suggesting supply chain constraints are continuing to ease
- Firms operating globally are seeing a quicker rate of improvement regarding available inventory compared to those operated only in North America

IPC chief economist, Shawn DuBravac, said: "Any disruption to an already stressed supply chain can have an outsized impact. Until recently, there was a general feeling in Europe that the economy was set to accelerate and leave Covid in its rearview mirror. The Russia-Ukraine conflict changes this somewhat."

www.ipc.org

- No minimum orders
- Knowledgeable customer service
- Value-added options such as lengths, colors, packaging & labeling
- Blanket and scheduled orders available

### Interpower<sup>®</sup> North American & International Power Cords MADE IN AMERICA

Interpower North American and international cords and cord sets provide the correct amperages and voltages to end users when connecting to countryspecific mains power—our cords are ready to use right out of the box. Use them separately, or integrate custom-length cords and devices using an Interpower power distribution unit or an accessory power strip.



#### Order Online! www.interpower.com

Business Hours: 7 a.m.–6 p.m. CST

INTERPOWER | P.O. Box 115 | 100 Interpower Ave | Oskaloosa, IA 52577 | Toll-Free Phone: (800) 662-2290 | Toll-Free Fax: (800) 645-5360 | info@interpower.com

Interpower provides expert customer service Monday through Friday from 7 a.m. to 6 p.m. CST. Our knowledgeable staff will assist you in finding exactly what you need. Please find our Guide to Worldwide Plug and Socket Patterns at www. interpower.com/guide. Order 1 cord or 5,000 cords—made in the U.S.A.!







## FIND WHAT YOU NEED, PURCHASE WITH EASE

Industrial & electronic components, expertise, and technology for every application

Access millions of electronic products from world-class suppliers



Global resources with operations in over 35 different countries



Personalized customer service and technical support from a team of industry experts



Value-added services like stockroom solutions, custom components & enclosures, kitting, and more



Market-leading, global online community with over 800,000+ engineers



#### SHOP THE WAY YOU PREFER

Online: newark.com Email: order@newark.com / quote@newark.com Phone: 1 800 463 9275 M-F 7:00 a.m. - 8:00 p.m. (EST) Fax: 1 480 308 1687

**Technical Support:** Go online for live technical support or call 1 877 736 4835

Engineering Community: element14.com

#### **E-PROCUREMENT**

We can link with any eProcurement system, and our dedicated e-team will facilitate your implementation.

Email: eproc@newark.com

#### FREE SHIPPING ON ORDERS OVER \$150\*

Domestic Ground: Order M-F by 9:30 p.m. (EST)

Export: Order M-F by 6:00 p.m. (EST)

In-stock products normally ship the same day

Shipments by air have earlier cut-offs. Call for details

#### **NO MINIMUM ORDER FEES**

#### 

#### YOU CAN FIND US AT...

in G+ 🎔 fi D

\*Details at newark.com/help-delivery-information