

ELECTRONICS

NOVEMBER 2021

# Sourcing

NORTH AMERICA



**AUTOMOTIVE:  
SUPPLY CHAIN  
PERFECT STORM  
PAGE 14**

Connect  
to real-time  
data with  
**Digi-Key APIs**

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LOOK  
INSIDE ▶

# API SOLUTIONS

- Ordering
- Quoting
- Product Information
- Supply Chain
- Barcode Information



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Supporting The Authorized Channel



## On the cover – November 2021

Automotive: supply chain perfect storm  
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# Editor's Word



## The next 100-years

From time-to-time I like to step back and conduct some future gazing. The question is always the same, what will drive the electronics industry for the next 20, 50 and 100-years. Computing, mobile communications and the internet have had a good run but innovations now seem more incremental than revolutionary given the current high levels of adoption.

My best guess, unsurprisingly will be eco tech. Looking back over past decades it looks like the pulse rate of eco technology is generational: about 25-years trough to peak. As examples, it took about 30-years for both double glazing and LED lighting to be adopted on a national scale.

The path is always the same. A company develops a novel technology. Early adopters (often spending ludicrous amounts of money) embrace the technology because that's what they enjoy. Initial sales fund further innovation, cost reduction and commercialisation. Finally, government steps in with incentives and/or legislation and the tipping point is reached.

Looking at automotive, the first Nissan Leaf was introduced in 2010 and most automotive manufacturers will have a full EV offering by 2030. Following this, I estimate another 20 to 30-years for domestic heating to move to fully renewable electric or hydrogen boilers. And on it goes. Then comes electric and biofuel air transport. Maybe, ships will revert to innovative, computer controlled, sails.

One thing will remain unchanged. At the heart of all these innovations will lie an integrated circuit or two, surrounded by an array of passive and electromechanical components: and it will be our job to make sure they are delivered.

*Jon Barrett*

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Issue 110, Vol.12 No.11

Published 12 times per year  
by MMG Publishing US Ltd

MMG PUBLISHING US Ltd  
Normandale Lake Center  
8400 Normandale Lake Boulevard  
Suite 920, Bloomington MN 55437  
Tel: 866.364.0951  
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Printed in the United States  
© 2021 MMG Publishing US Ltd



ELECTRONICS SOURCING IS INDEPENDENTLY ABC AUDITED 2005/2021



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## Investing in distribution warehousing

Mouser Electronics is continuing to invest in automation in its global distribution centre to increase order processing, accuracy and speed. To date, the company has installed 102 vertical lift modules (VLMs), the most at any company in the Western Hemisphere and the fourth largest VLM installation in the world. VLMs are essentially giant vertical filing cabinets, complete with shelves and an automated elevator to bring the components to the employee's workstation. This increases efficiency and floor space and can reduce an employee's walking time by 45 per cent or more.

The centre also features Ultipack and I-Pack machines, an automated system for sealing and labelling shipments that can process up to 14 orders per minute. The company is also installing Opex Perfect Pick and AutoStore systems focused on getting orders processed, picked, packed and shipped in a short time.

Mouser's senior vice president of business operations, Pete Shopp, said: "As automation technologies continue to evolve at a rapid pace, so too do advances in warehousing and logistics. The resulting efficiencies in picking and packing help meet our goal of providing exceptional customer service."

[mouser.com](http://mouser.com)

## Cool solution for continuous power

Bottom plate cooling of Recom's RACM1200-V power supply enables continuous output up to 1,000W. In boost mode, up to 1,200W is available for up to 10s or longer with sufficient airflow. A range of output voltages and a combination of constant current limiting and hiccup mode settings suit the supply to fanless medical and industrial environments.

The product complies with worldwide safety requirements according to medical, industrial and ITE standards, plus (in standby mode) eco-design regulations. In addition, electromagnetic compatibility is according to class A interference immunity and class B emissions.

Potential applications include medical and industrial automation, food preparation applications, beds and chairs in medical surgery, robotics, automated medical analysis machines, laser systems, UV lighting applications, LED panels and chargers.

[www.rutronik24.com](http://www.rutronik24.com)



## Global distribution for RF and mmWave markets

RFMW and CML Microcircuits' business relationship has been widened to include global marketing and sales of CML's product portfolio, including CML's new S<sub>u</sub>RF range of high frequency, high bandwidth ICs targeting RF and mmWave markets.

CML Microcircuits' MD, Mark McCabe, said: "We're excited to partner with RFMW on a global basis as we increase our focus on CMLs RF components portfolio to complement our existing products. We look forward to increasing market share and growing the CML brand as customers recognize the performance advantages CML offers. RFMW's technically competent sales team is ideally positioned to help us accomplish this and expand our business over the full range of their customer base."

RFMW's executive vice president, Steve Takaki, added: "We are incredibly excited to expand our CML partnership with a global distribution agreement. Having seen customer requirements for their products outside of our former franchised territory of North America, we now have the opportunity to increase our sales efforts with integrated RF/analog devices that complement products offered from other RFMW suppliers for the RF communications market. Linearizers, quadrature mod/demos, synthesizers and their new Semiconductor Microwave RF components provide our sales team with more tools to support customer designs."

[www.cmlmicro.com](http://www.cmlmicro.com)





# QUESTIONING your power supply?

Sager Power Systems offers over 30,000 world-class AC-DC and DC-DC standard solutions, the widest range of modular power supplies available in North America and custom design services.

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## PERFECTING POWER



## In Brief

### Power and compound fab capacity projected to top 10M wafers/month

Fueled by pent-up demand for automotive electronics caused by semiconductor supply chain disruptions, worldwide installed capacity for power and compound semiconductor fabs is projected to top 10 million wafers per month (WPM) for the first time in 2023, climbing to 10.6 million WPM in 2024, according to Semi's *Power & Compound Fab Report to 2024*. [www.semi.org](http://www.semi.org)

### Cree becomes Wolfspeed

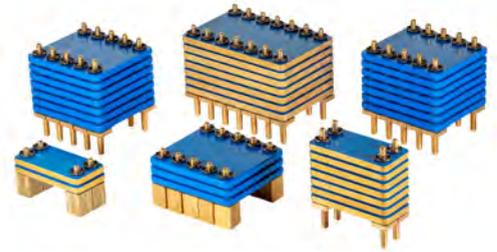
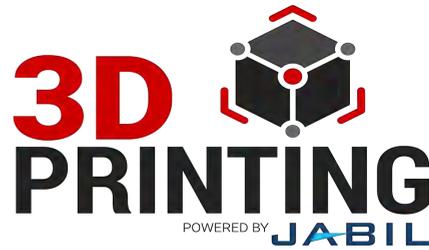
Wolfspeed, formerly Cree, has launched under its new name. CEO, Gregg Lowe, explained: "Wolfspeed is now a pure-play global semiconductor powerhouse. The next generation in power semiconductors will be driven by silicon carbide technology, with superior performance that unleashes new possibilities and positive changes to the way we live. As the original champion of this technology, we couldn't be more excited." [www.wolfspeed.com](http://www.wolfspeed.com)

### IPC commends US/EU efforts to strengthen supply chains

IPC president and CEO, John Mitchell, has issued the following statement: "IPC commends US and European leaders for reaffirming the strategic importance of the Transatlantic partnership on trade expansion, supply chain resiliency, technical standards and technological innovation at the inaugural meeting of the US-EU Trade and Technology Council (TTC)." [www.ipc.org](http://www.ipc.org)

### Protecting against lightning

Central Semiconductor has introduced its CAK3-012C and CAK6-042C series of 5G bi-directional transient voltage suppressors. These devices are designed to meet requirements for protection of voltage sensitive components from high energy transients that are most directly associated with lightning strikes and inductive load switching. [www.centralesmi.com](http://www.centralesmi.com)



## 3D printing service powers up

Digi-Key has announced a new 3D printing and additive manufacturing tool, powered by Jabil. Using the tool, Digi-Key customers can upload design files, receive instant quotes and have custom 3D products and items shipped directly to their door from Jabil.

Digi-Key's senior director, new market development, Missy Hall, said: "We are very excited to launch our new 3D printing and additive manufacturing service in order to give electrical, mechanical and industrial engineers the ability to easily create custom 3D products for manufacturing purposes. This introduction is a flagship option of Digi-Key's additive manufacturing services portfolio, and we look forward to continuing to expand our offerings to include many suppliers to serve the needs of the additive manufacturing market."

Jabil's senior director of digital manufacturing, Rush LaSelle, added: "Jabil has a long relationship with Digi-Key and their 3D printing and additive manufacturing tool service is an important step in making Jabil's advanced digital manufacturing capabilities available to a broader set of users. We will be continuously enhancing the tool through the Jabil digital manufacturing platform with powerful and innovative features to offer increased value and greater agility to Jabil and Digi-Key customers."

[www.digikey.com](http://www.digikey.com)

## Custom capacitors for automotive, military and aerospace

Knowles Precision Devices has introduced a new customizable capacitor assembly for automotive, military and aerospace applications. This approach offers customers a combination of capability and durability, while helping maximize board space. The capacitor assemblies use the vertical space above the circuit board to achieve high capacitance and high voltage in a smaller area.

The assemblies are customizable in height and shape. They are built using large diameter pins that are low loss and ultra-stable dielectric. The pins are mechanically decoupled from ceramic elements, which allows the assembly to withstand severe mechanical shock, vibration and temperature variation.

Knowles Precision Devices' senior applications engineer, Steve Hopwood, said: "This custom approach to large capacitor assembly enables us to better accommodate the specific needs of our customers when they have a project that requires high capacitance and proven durability in a tight space."

"By utilizing the vertical space above the board, we can replace multi-chip assemblies where large arrays of multilayer ceramic capacitors are placed in parallel on a circuit board."

[knowlescapacitors.com](http://knowlescapacitors.com)

## Boost to switch portfolio

Sager Electronics has added Electroswitch's CW Industries-Oslo product brand to its portfolio. CW Industries-Oslo designs and manufactures switches for industrial, medical, automotive and consumer applications.

Electroswitch's sales manager, Trey Ayscue, said: "We're pleased to expand our switch product portfolio with Sager Electronics. Electroswitch offers full service design and application engineering, without the burden of non-recurring engineering costs, high minimum order quantities or long lead times. Building on our solid relationship with Sager, we look forward to developing new switch customers with Oslo's product offering."

Sager Electronics' supplier marketing and product manager, Pamela Berigan, added: "We're excited to enhance our partnership with Electroswitch. Oslo's products significantly expand our product offering in switches, including rocker, pushbutton, slide and keylock switches. Their products, combined with Electroswitch's in-house design and customization capabilities, aligns with Sager's commitment to provide effective product solutions for our customers."

[www.sager.com](http://www.sager.com)



# It's The Human Component that sets TTI Apart

Sure, we warehouse more than 850,000 part numbers, but it's the Human Component that gives TTI an advantage others can't touch.

TTI Specialists add product knowledge, purchasing assistance, industry trends, design expertise, supply chain updates, the newest technology and more.

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# Keeping production lines moving

Avnet's VP of Operations and Supply Chain, Richard Diaz, explains how the company is leveraging 100-years' experience to help customers navigate risk

**Q** Lead times and component availability are key concerns for ESNA's readers. What is Avnet's strategy for managing lead times and ensuring OEMs and EMS keep their production lines running?

Some of Avnet's strengths in this area are our breadth, market knowledge, world class line-card and the critical position we hold in the global supply chain. Leveraging these strengths, coupled with close collaboration with our customers and suppliers to extend forecast visibility and order horizons is key. Also, assessing overall BoM risk and identifying opportunities to mitigate risk through supply chain and design chain strategies is key for improved near/long term success. Additionally, leveraging our broad market position and knowledge for increased insight into long-term market/consumer trends and visibility across the supply chain also helps mitigate risk and reduce uncertainty.

**Q** How has Avnet adapted to clients' requirements over the last 18-months?

We're seeing more and more existing/new customers and suppliers coming to us for help in this challenging market, including many Tier 1 household names. They're primarily seeking demand planning and logistics consulting. In addition, we're helping more customers with the redesign of products to

further reduce risk/supply issues where it makes sense.

**Q** How has component pricing changed over the last 20-years and do you see costs rising over the next few years?

Historically, component prices tend to decrease in price over time and as new components come onto the market. I don't think we'll ever see the kind of price decreases we've had in the past. Cost of raw materials is up across the board and we'll see that continue to be reflected in component pricing going forward.

**Q** Finally, what advice would you offer ESNA's 72,000 readers to maintain robust supply chains moving forwards?

Avnet helps our customers and suppliers focus on two key factors to help navigate current challenges and ensure overall supply chain success: transparency and agility. Over the last year plus, the critical nature of supply chain strategy has been realized from back office all the way to front of house.

On the transparency side, we help customers by starting with the understanding that everything we are seeing—as well as the ongoing semiconductor shortages—is not just a reaction to global shutdowns. There were numerous factors that have brought us to where we are today, and we provide a thorough understanding of

what those factors are: from megatrends and significant component content increases, to factory shutdowns and manufacturing holds to geopolitical policies and potential impacts.

Previously, after an event happened, the disruption would settle and many went back to what worked: the low cost and efficient supply chain model that had been designed and worked well. But that's where agility becomes crucial. At Avnet we lean on our 100-years of experience to help navigate those risks by identifying patterns and new technologies that can help ease the impact of supply chain disruption. This goes back to our critical position at the center of the value chain—which inherently enables us to offer supply chain and design chain strategic counsel and risk management support for our customers and suppliers alike.

[www.avnet.com](http://www.avnet.com)



Avnet's Vice President of Operations and Supply Chain **Richard Diaz**



**Avnet helps our customers and suppliers focus on two key factors to help navigate current challenges and ensure overall supply chain success: transparency and agility**

A central graphic featuring a dark blue diamond shape with a white border. Inside the diamond, the number '20' is written in a large, green, sans-serif font. The zero in '20' contains a white stylized 'F' logo. Below the '20', the word 'ANNIVERSARY' is written in a smaller, green, sans-serif font, and below that, the years '2001 - 2021' are written in an even smaller, white, sans-serif font. The background of the entire page is a dark blue gradient with a complex pattern of white circuit lines radiating from the center diamond.

20  
ANNIVERSARY  
2001 - 2021

TIME FLIES WHEN YOU'RE SOLVING  
SUPPLY CHAIN SHOCKS.

Fusion Worldwide is celebrating our 20th anniversary. We'd like to thank our customers and partners for helping make our business successful. Here's to the next 20 years.

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[www.fusionww.com](http://www.fusionww.com)



# Why manufacturers need to rethink supply chain practices

*Tanaka Precious Metals' vice president, William Crockett, argues that manufacturers need to pivot their supply chain management in the face of chip shortages*

We're 18 months into the Covid-19 pandemic and almost no part of the semiconductor supply chain has returned to any semblance of 'normal'. In fact, the supply chain remains in crisis mode—and it's hurting manufacturers desperate to deliver goods and products.

Manufacturers that need semiconductors are dealing with what seems like endless problems. Factories in Malaysia—a critical hub for semiconductor production—aren't operating at full capacity due to government-mandated factory closures and the Singapore-Malaysia border closure. Price increases for chips in short supply are forcing manufacturers to hike operational and product costs. Dozens of container ships backed-up off Southern California ports are creating supply chain bottlenecks.

With the chip shortage expected to continue until at least 2022 and semiconductor lead times recently climbing to a staggering 20.2 weeks, manufacturers need to retool their supply chain practices and the way they source precious metals to push production forward.

Issues are a given for the current semiconductor supply chain, but adjustments can be made to ensure business continuity. The following are two practices which can be implemented to make semiconductors supply chains more agile.

Firstly, consider dual sourcing. Relying on a single source for materials and equipment can be a critical blow to operations during this chip shortage. If a supplier needs to shut a factory due to rising Covid-19 cases or has too many back orders to fill, customers may be forced to halt their operations completely.

To ensure continued operations, dual source with another supplier. Even if a buyer only sources a small percentage of materials from a second partner, they have another supplier available in case of emergency. Also partner with suppliers that provide proactive communication about their operations—buyers should be receiving a scheduled status update every two weeks and real-time updates for any delays or emergencies.

Secondly, find partners with onshore and offshore distribution. Most conversation about the chip shortage has focused on manufacturing delays for current products. However, the lack of materials also hinders research and development efforts. With a supplier that operates completely offshore, you run a greater risk of shipping delays. Without even a small amount of materials, you can't test chip designs for new products, which can set back timelines.

To continue R&D efforts, consider partnering with suppliers that operate onshore

and offshore distribution. Although a supplier may not possess most of its material stock onshore near your locations (eg there's a smaller supply of precious metals in North America v Asia), you can still use this source for IC tape-outs and prototype assembly. Ensuring new products are tested and ready for production can set a company apart from competitors that are solely focused on current supply chain production.

The light at the end of the chip shortage tunnel is still far away. Supply chains will be indefinitely unpredictable, making agility crucial to continue operations as a manufacturer. To succeed in this difficult period, set up for business continuity through dual sourcing and use onshore distribution to continue R&D projects.

[tanaka-preciousmetals.com](http://tanaka-preciousmetals.com)



Tanaka Precious Metals' vice president, William Crockett



**We're 18 months into the Covid-19 pandemic and almost no part of the semiconductor supply chain has returned to any semblance of 'normal'**



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# Distributors expand warehouse facilities, enhance web capabilities

*Electronics distributors are enlarging distribution facilities or building new ones to attract new customers and better serve existing ones*



James Carbone

Many electronics distributors are adding warehouse space, investing in automation equipment and enhancing their website capabilities to make it easier for buyers and engineers to find and purchase components. While there are allocations or long lead times for a wide range of semiconductors, passives and connectors, distributors say shortages won't last forever. The extra warehouse capacity will be needed as more electronics is used in more products.

Many distributors are expanding existing warehouse facilities and equipping facilities with a range of equipment designed to maximize existing space and improve efficiency. Some are using vertical carousels for parts stored vertically rather than horizontal. Others are using cube storage automation which use robots to retrieve components. Some distributors have built new distribution centers. For instance, Farnell, an Avnet company, has a new distribution center in Leeds, England. "The facility will enable us to hold more inventory, offer date-and-lot capabilities and 2D bar code labelling as well as improved shipping for our customers," said Chris Breslin, president of Farnell.

One distributor that has invested in warehouse expansion is TTI. "Some of our most recent investments have included an expansion of our Americas distribution center," said Don Akery, president, TTI Americas. "We added an additional 165,000 square feet, bringing the

operating square footage to 1 million," he said.

The distributor has also invested in a new technology called iPack, which is an automated carton packaging system that minimizes freight, operating, and consumables costs of parcel shipments by rightsizing the pack and optimizing productivity. "In addition to lowering freight costs and reducing the carbon footprint of shipping, rightsizing each parcel eliminates the need for void fill and additional packaging materials," said Akery.

#### Investing in robots

TTI has also invested in AutoStore Robotic Solution, an automated storage and retrieval system (ASRS) that uses warehouse robots. "This allows 24/7 order fulfillment within a cubic layout so dense that it will quadruple storage capacity and unlock the true potential of storage floor space," he said.

Such investment is needed to support TTI's growing customer base. "We have increased our customer base an average of 10 per cent annually over the last five years. In addition, the need to increase warehousing space is also driven by the increased volumes and breadth of products/ technologies that TTI's sells to existing customers, he said. Akery added a key part of TTI's growth strategy is to sell "all of our technologies to every customer." Two of the fastest growing technologies are discrete semiconductors and circuit protection.



**"We have over \$1.3 billion of inventory on order which will need to go somewhere"**

**Mark Burr-Lonnon, senior vice president global service and sales for Mouser commenting on Mouser's warehouse expansion**

Akery said as a specialty distributor, TTI carries the broadest and deepest inventory of its supplier partners. "Our line card is also designed to support our target customer segments. We have made strategic additions to the line card to grow our strength in industrial, military, commercial aerospace and transportation/automotive market segments," he said.

TTI is also investing in its website and digital tools.

A focus for TTI over the past 18 months has been in its Application Program Interface (API) solutions for customers. "We are connecting directly with our customers' computer systems, machine-to-machine, sharing

critical information real-time," said Akery. Such information about part descriptions, lead times, current inventory levels and pricing are available through the APIs 24/7 which makes the customers' job easier, according to Akery.

High-service distributor Mouser Electronics has invested about \$25 million over the last 18 months in warehouse automation, including AutoStore and i-Pack machines, which measures the height of the products and reduces the size of the box the parts will be shipped in. The automated systems result in more efficient operations and allow products to be retrieved and shipped to customers quicker, said Mark Burr-Lonnon, senior vice



president global service and sales for Mouser.

#### More warehouse space needed

The company also increased its warehouse space by about 200,000 square feet over the past two years. Mouser has made the investments because demand for components has increased and it has added new suppliers, products and customers.

Because of shortages, Mouser's inventory has declined from about \$850 million to \$760 billion, says Burr-Lonnon. However, "we have over \$1.3 billion of inventory on order which will need to go somewhere," he said. The extra capacity will eventually be needed although many parts have 20-,30- or 50-plus week lead times, said Burr-Lonnon.

Adding additional warehouse space is necessary because suppliers rely on Mouser to have inventory available for engineers designing new products, said Hayne Shumate, senior vice president of Internet business for Mouser.

"That is part of the value we provide," he said. Mouser has also taken steps to make sure that a volume customer does not buy all of the inventory of a part. "In this market we have actually had to invest in not selling stuff. We need to preserve inventory so it will be available for 100

engineers instead of the parts going to one guy," he said.

Another key investment has been to improve Mouser's website search capability to make it easier for engineers to find parts.

"We have changed our search technology," said Shumate.

"We are adding several key technologies including signals, machine learning and artificial intelligence. Our search engine for products now knows everything that everyone has looked for on our website and on some other websites, what they put in their carts and what they purchased," said Shumate.

Mouser has also invested in high-definition photography of products. Search engines such as Google and Bing "will not favor your pages unless you have high-definition photographs." "So, we actually have microscopes to take photos of products. That's not for the benefit of our customers. That is part of our marketing to make sure the search engines love us," he said.

#### Making strategic investments

High-service distributor Digi-Key has also made strategic investments to "expand warehouse capacity, localize customer experience both digitally and from a support standpoint, scale our website and web services and expand into

new markets," said Dave Doherty, president of the distributor.

Doherty said the biggest capital investment Digi-Key has made in recent years is in warehouse infrastructure. Its new Product Distribution Center is close to quadrupling the footprint of what the distributor has. "It'll give us 2.2 million square feet and allow us to serve close to three times the number of packages that we support today, out of a single site location," said Doherty.

He said all the new space is needed. "Today, we currently offer 12.6 million parts from 2,000 suppliers, and in the past 18 months alone, we have added 800 new suppliers and 2.4 million parts," he said. In addition to its core stock, Digi-Key has 1.1 million parts from 847 suppliers through the Digi-Key Marketplace, "augmenting the types of products that we don't currently offer in our existing model," said Doherty.

Digi-Key is also investing in its operations around the globe, and in particular, India which is a growing market for the distributor. "We are in the process of creating a local entity in India, which will allow us to do business more locally there, supporting the Rupee as a currency and providing more localized customer support," said Doherty.

He said the distributor hopes to open a customer service center there in order to support the growing number of engineers and OEM technology companies that are emerging in India.



**"Our new Product Distribution Center is close to quadrupling the footprint of what we currently have in Thief River Falls"**

Dave Doherty, president,  
Digi-Key Electronics

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# Supply chain perfect storm

*Lansdale Semiconductor's president, R Dale Lillard, reminds readers that in today's uncertain world, JIT manufacturing will need re-tooling to provide sufficient redundancy*

Since the 1980s manufacturers have enjoyed years of just-in-time manufacturing using outside suppliers. This let them reduce inventories and shorten cycle times for improved quality. They also discontinued vertical integration of their supply chain leaving them vulnerable to different supplier priorities which can be driven by political upheavals, environmental disasters and pandemics.

When the coronavirus emerged in March of 2020, it caused a perfect storm: shutting businesses, causing labor shortages and slowing transportation of goods. This led to supply shortages and long lead times. Many manufacturers have faced significant delays in buying materials for production. The most dramatic is the auto industry, which is reported to lose \$210 billion in sales in 2021 because of the IC supply slowdown.

Even without the pandemic, commercial life cycles can be two to three-years where automotive life cycle can exceed 10-years for production and maintenance support. Although the automotive industry has experienced supply issues when their products' technology lagged the rapid changes of advanced commercial products, the extent of this problem is something new.

Semiconductor companies' shift in production from automotive ICs to home computer products were well publicized. When demand changes rapidly, as it did in 2020, suppliers review their wafer production line run rates and modify them to improve sales per square inch of wafers produced. This can force unpredicted obsolescence and long cycle time delays as they optimize production for current product demand. The pandemic has caused a shift in wafer fabrication processes that is not easily reversed, leading to the possibility of permanent changes in availability for some products.

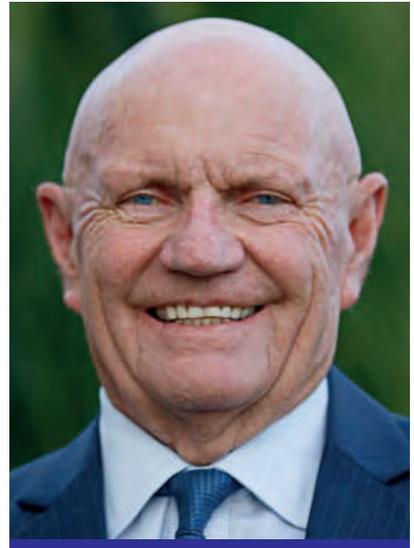
IC life cycles are driven by the wafer fabrication foundry process. Foundry equipment is expensive (new fabs cost \$5 to \$10 B) and their processes become difficult to modify. When market driven semiconductor technology advancements demand newer equipment and processes, the switch can make it difficult to produce older products. In many cases, the fab uses existing floor space and personnel for the newer equipment, forcing them to remove older equipment and shut down the older process. If older products are not compatible with new equipment, they become obsolete.

Pandemic induced supply chain problems have caused many semiconductor customers to spend time interrogating their suppliers about product life cycle, cycle times and overall lead times. The belief is that manufacturers can warn them of potential problems. However, suppliers cannot always accurately predict potential problems due to uncertainties within their own supply channels.

I'm sure most companies consider how to reduce supply shortfalls. It is a good time to increase inventories where possible, lengthen supply contracts and switch to suppliers who are closer and have good environments. The automotive industry used to have its own semiconductor manufacturing capability and may need to restart some closed foundries to ensure supply.

Nothing lasts forever. In an uncertain world, just-in-time manufacturing needs to be re-tooled to provide enough redundancy to cope with events that stress the supply chain, such as new technologies and a worldwide pandemic.

[www.lansdale.com](http://www.lansdale.com)



Lansdale Semiconductor's president, R Dale Lillard



Automotive life cycle can exceed 10-years for production and maintenance support

# Shortages: a good problem to have

*ECIA president and CEO, David Loftus, reminds buyers that the current shortage problems, which will subside, are less damaging than the pandemic's original dire predictions*

Supply chain professionals' searing memory of 2021 will be their efforts dealing with shortages. The frantic exercise to secure components and overcome shipping bottlenecks has been the everyday, often 18-hours per day, headache for millions worldwide.

These shortages are actually a good problem to have. Think back to the pandemic's early days. Those dark clouds, dire predictions of recession and potential collapse, now seem a distant bad dream.

Through Q2 2020, most production lines were shuttered, workers idled and fear of a hidden assassin gripped the world. However, as essential businesses ramped output and other companies resumed production, we realized the world was not imploding. Governments injected trillions into shaky economies and by Q3 2020, most businesses were catching up for lost time.

Recovery efforts are causing the biggest headaches. The components market ran like clockwork for 50-years, with boom-bust cycles every four to five-years. Late 2019, the market was climbing out of the last down cycle. Most businesses had drawn down inventories. Just as demand ramped, Covid slammed on the brakes.

A rush of new orders has driven extended lead-times and escalating raw materials prices. Semiconductors will grow 24 per cent year-over-year to a record \$550B. Dozens of new fabs are being constructed or planned, with hundreds of billions of dollars in new capex. However, the new variable is nationalism. China, the EU and US are each dangling tens of billions of dollars in incentives for companies to build fabs within their specific borders. With 5G, IoT and EVs driving opportunities, it is hoped these investments will catch up and keep pace with demand without overbuilding.

Excess capacity can present equal challenges. Fabs are extremely expensive to build, from \$2B to \$20B. While many wish for extra capacity, 'be careful what you ask for'. If supply overshoots, prices will rise to cover excess, under-utilized machinery.

Lastly, most buyers are reviewing their supply chains and improving their forecasting. Direct customers are reengaging with the channel to cushion supply disruptions. Most companies are reevaluating their forecasting methodologies and inventory policies to avoid future lines-down situations due to a few missing components.

While the current crises are painful and disruptive, it could have been worse. The market will stabilize (personal prediction is mid 2022), we'll gladly resume some normalcy and hopefully learn some important lessons to protect our businesses going forward.



ECIA president and CEO, David Loftus

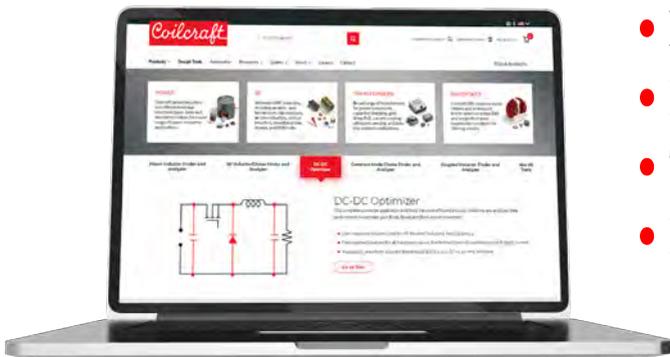


**The frantic exercise to secure components and overcome shipping bottlenecks has been the everyday, often 18-hours per day, headache for millions worldwide**

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# Car sector in crisis

*Company Debt director, Simon Renshaw, reflects on how semiconductor shortages are impacting the automotive industry and causing a ripple across associated sectors*

A global microchip shortage is having a huge impact on the motor manufacturing sector, with many leading brands experiencing production delays. For example, in the UK, new car registrations for July were the lowest since 1998, down 29.5 per cent year-on-year, according to trade body SMMT.

SMMT CEO, Mike Hawes, said: “The automotive sector continues to battle against shortages of semiconductors and staff, which is throttling our ability to translate a strengthening economic outlook into a full recovery. The next few weeks will see changes to self-isolation policies which will hopefully help those companies across the industry dealing with staff absences, but the semiconductor shortage is likely to remain an issue until at least the rest of the year.”

The world’s biggest semiconductor producer, Taiwan’s TSMC has said the shortages will extend into 2022, while analyst IHS Markit estimates that the shortage will cost the

industry \$60billion in lost sales this year.

The following highlights four reasons for the global shortage of microchips.

**Pandemic:** From early 2020, factories producing microchips were forced to close, particularly in Asia where most are based. Although they are now reopened, there is a backlog of orders. During lockdowns, home working and gaming rose and microchips were bought up in vast amounts by electronics manufacturers. Even rising numbers of crypto-currency miners who use high-end chips impacted availability. New car sales fell during the pandemic, but rising demand is now affected because there are insufficient components.

**Political:** Actions by the Trump administration led to a reduction in microchips from China as the US blocked technology transfers and imposed tariffs.

**Natural catastrophes:** Production of microchips

requires water and Taiwan is affected by drought, with TSMC bringing water in trucks. Other producers have faced disasters, with a major fire halting production at Japan’s Renesas facility and freezing conditions stopping manufacturing in Texas.

Other reasons impacting supply hold-ups range from the container ship blocking the Suez Canal to Brexit.

Microchips are largely manufactured in Asia, including Taiwan, China, Japan, the Philippines, Thailand, Vietnam and Malaysia, although the know-how largely comes from the US. The US is keen to manufacture more microchips at home and is engaging with TSMC to build a plant in Phoenix, Arizona costing up to \$12B.

In March, the European Commission set out a plan to grow its share of the global microchip market to 20 per cent by 2030. The German car sector is lobbying hard for this as the most important producer in the EU’s economy.



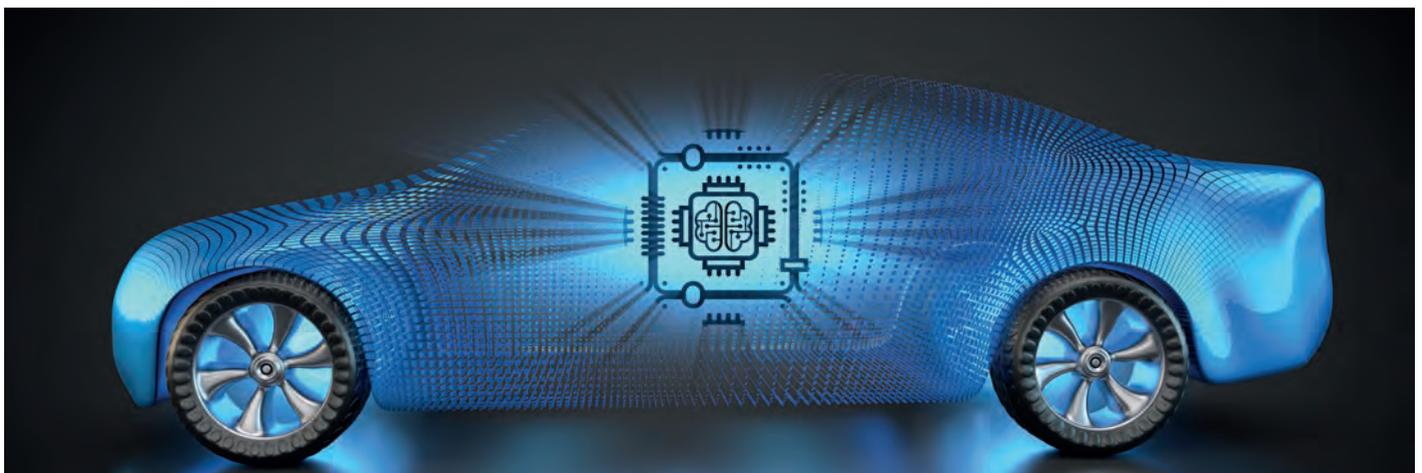
**A global microchip shortage is having a huge impact on the motor manufacturing sector, with many leading brands experiencing production delays**

This would put the UK in a potentially weaker position. There is also concern about Newport Wafer Fab, a UK microchip manufacturer in South Wales, which has been purchased by China’s Nexperia. There has been anger that the business, which had received state funding, was allowed to be sold off. The following summarises how the microchip shortage is impacting some motor brands.

Toyota said it would cut worldwide vehicle production by 40 per cent in September. It had planned to make almost 900,000 cars but will now produce 540,000 vehicles.

Jaguar LandRover is thought to be one of the worst affected because its luxury cars contain more microchips. It has

*Continues on page 18 →*





# ELECTRONIC COMPONENTS SHORTAGE? WE CAN HELP.

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predicted a 50 per cent fall in sales for the next quarter and told leasing companies that lead times for some of its models are now over a year.

Daimler said Mercedes-Benz production has reduced at three plants in Germany and temporarily halted in Hungary because of the microchip shortage.

BMW-owned Mini paused production for several days in April because of the microchip shortage.

Volkswagen has not released any details other than saying it expects this quarter to be 'very volatile and tight' because of the microchip shortage.

Ford temporarily closed its Kansas City assembly plant, halting pick-up truck manufacture and its plant in Turkey also closed.

Stellantis, which includes Vauxhall, Citroen, Peugeot, Jeep and Chrysler, will cut production by 1.4 million during 2021 and to date, some eight of its 44 global plants have been affected by the temporary closure.

Company Debt director, Simon Renshaw, said: "It's a concern that the fall in vehicle sales is holding back economic recovery. The situation is extremely serious and will have knock-on effects on smaller companies involved in the supply chain, such

as dealerships and leasing companies. It has also raised the issue of 'microchip security' and highlighted the need for innovation—Tesla, through proprietary software development, has been less impacted, for example.

"But, microchips are not all about the motor market and Goldman Sachs analysis found that the shortage affects some 169 other industries.

"What is more, a shortage of technology is also preventing some employees from returning to their offices. Although we are seeing the supply situation improving, I expect to see the fallout from this microchip crisis continue, well into next year."

[www.companydebt.com](http://www.companydebt.com)



**The world's biggest semiconductor producer, Taiwan's TSMC has said the shortages will extend into 2022**

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# Buying into the latest technologies

*Mouser explains how its focus on stocking the latest technologies offers a cascade of benefits for product design, purchasing, manufacturing and support*

Few things are more frustrating than a delay caused by obsolete components. That's why distributors like Mouser Electronics are working hard to identify products not recommended for new designs (NRND).

Identifying product lifecycle and NRND products are two examples of value-added services beyond simple component supply. Mouser offers suggestions for component alternatives, plus the risk level for those potential replacements. In addition, it provides easy, quick access to technical data and application resources such as product datasheets, application design notes, white papers, videos and other solution-based content.

Mouser's customers can subscribe to receive product notifications online and the company offers real-time product availability through its website and customer

service representatives, providing the accurate product information to make confident buying decisions. Mouser is working with its 1,100-plus manufacturer partners to provide quick and straightforward access to the industry's newest components. Using the most advanced technology to develop cost-efficient prototypes helps limit costly redesigns, manufacturing delays or even project terminations. It also leads to a design edge by delivering more product features and capabilities, as well as longer lifecycles.

As a global authorized distributor, Mouser launches more new products than any other global distributor, with its website updated many times per day. To answer buyer's questions, Mouser's customer service and technical support staff are available weekdays from 7am to 8pm (CST) to assist with price quotes; order placement/status; real-time product

availability; technical support and more. For added service, buyers may also order and communicate with Mouser representatives via phone, email, fax and live chat.

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# Sensors v switches: which choice is best?

*TTI technical marketing manager, Brian Wellhouse, explains why new sensor capabilities could change the conversation around component selection*

In many cases, today's sensors provide greater reliability, higher throughput and greater granularity than ever before. These advancements raise a question: Can sensors replace switches?

The answer is 'it depends'. Sensors can provide more opportunities for customization of set points, plus data customers can use to better understand processes and ensure reliable service. We can find examples of

sensors providing a more capable replacement in select applications in the industrial, transportation and defense sectors.

In industrial use cases—for example, monitoring machine health or diagnostics in warehouses, distribution centers or manufacturing facilities—sensors can already help prevent downtime by providing more granular data about machine operations. Those insights allow for better

scheduled maintenance and safer, more efficient operation, ideally leading to less costly downtime and greater worker safety.

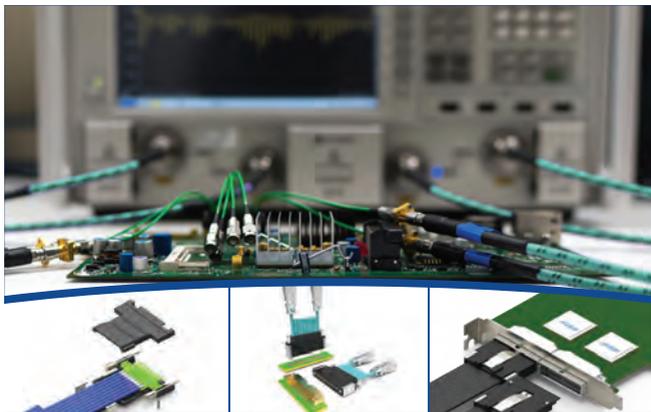
The next step is a sensing and switching network that allows systems to act on sensor data, not just sounding an alarm but using the sensor to switch off a machine or halt a line when data goes outside defined boundaries. For safety and compliance purposes, we will probably always have manual emergency-stop switches and controls on industrial machines. However, sensor-driven safety capabilities may be able to react to dangerous conditions quicker than human operators.

Wireless sensors can be used in outdoor applications with appropriate sealing options. Low-power sensors can run for years, even decades, on built-in batteries. Moreover, new sensors can interface with industrial Internet of Things (IIoT) monitoring systems.

Machine learning capabilities integrated with smart devices can help users anticipate when something goes wrong, based on pressure, temperature, vibration or other indicators going out of bounds. Also, sensor-based switching may allow a single package for multiple



TTI technical marketing manager, **Brian Wellhouse**



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**In many cases, today's sensors provide greater reliability, higher throughput and greater granularity than ever before**

inputs—for instance, temperature and pressure monitoring in one unit.

It is easy to see how today's sensors open-up opportunities for new functionality and interactions between device/user and device/environment.

Traditional electromechanical switches aren't going to disappear. They are tried-and-true technology with low failure rates and are often inexpensive. The mechanical properties of a switch cannot be fully replicated by sensors alone.

As switching will always be a common device function, the question for design engineers comes down to: what is the best choice for the design and application?

Some applications simply need a set point or limit such as a position, temperature or pressure. A switch that opens or closes at that set point is enough to fit the application. However, a sensor can provide continuous feedback on that position, temperature or pressure. Given the option, sensor data may provide a functional advantage with an acceptable cost difference.

In other applications, a design's physical characteristics may give sensors an advantage. Consider the switches onboard a commercial aircraft indicating whether the landing gear is up or down. A sensor at the main junction can give absolute position throughout the landing gear's travel, whereas a traditional switch might only indicate open/closed.

A sensor package may also withstand the repeated usage, temperature changes and pressure changes of flight, takeoff and landing better than a mechanical switch, giving the sensor an additional lifecycle advantage.

Other harsh environment characteristics work in favor of switches, which can be protected better against some situations. A door switch on a military vehicle may be better suited to an application with heavy vibrations and exposure to dust that could interfere with a basic sensor's accuracy during operation.

In other applications, from smart home/smart city devices to next generation transportation, sensors may provide enough advantages, because of the data they provide, to make them the ideal choice.

With many new sensors available alongside a proven array of switches and e-mechs, OEMs can trust their distributor partner to provide technical guidance and help find the best components to fit the application at hand.

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Harsh environment characteristics work in favor of switches, which can be protected better against some situations

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John Denslinger is a former executive VP Murata, president SyChip Wireless, and president/CEO ECIA, the industry's trade association. His career spans 40 years in electronics

# Battery and chip investment tsunami

*John Denslinger explores how downstream demand and the corresponding upstream response is driving levels of investment that were expected but are stunning in their enormity*

Investment • By John Denslinger

**T**he magnitude of investment reported over the last few months foretells a cost and market share race among two ultra-critical, technology-driving components: Li-ion batteries and semiconductors. Triggered partly by pandemic consequences, demand from downstream manufacturers across all market segments exploded, challenging the best supply lines. That situation set the upstream response: a global investment tsunami in new production capacity and all-out research.

One can't help think the investment might also be linked to another factor as well: brand survival and the need to invest or perish. Batteries, for example, occupy the position as the most expensive component in EVs at a cost of \$7,000 to \$20,000 according to Beroe Inc, a provider of procurement intelligence. Above and beyond the usual avid consumer demand, mandates from governments and environmentalists worldwide greatly accelerated adoption timelines forcing critical investment in EV battery production now. It was expected at some point, but the enormity is stunning. The price tag to build a Li-ion battery facility is somewhere above \$2B depending on number of lines and gigawatt hours (GWh) of installed capacity. Given the range variation, installed GWh capacity seems a better metric for comparison. A research paper *Applied Energy, Volume 286, 116499*, dated 15 March 2021, indicates LG Chem will have an installed capacity of 189GWh, CATL at 113GWh and Tesla at 102 GWh at the height of their currently announced investments. Seven other third party suppliers will contribute another 200GWh of available capacity within the same timeframe.

Since that paper was released six months ago, key automakers have moved aggressively forward with plans to build in-house Li-ion battery capacity adding to the already large 3rd party tsunami. Volkswagen announced intent to buy and build additional EV battery facilities in Europe delivering 240GWh capacity before the end of

the decade. Toyota revealed its plan of 200GWh internal battery production by 2030 as well. Assuming an operating factory costs about \$50M/GWh, Volkswagen and Toyota will spend in excess of \$20B in that horizon. GM and Ford said they will build their own battery factories, most likely rivalling installations of VW and Toyota.

With 65 per cent of the Li-ion battery as material cost, research is center stage. Trials continue on lower cost lithium and cobalt substitutes and alternatives like solid-state. Processing operations are being further groomed to optimize battery performance. The cost of the current Li-ion battery pack is around \$140/kWh, but to effectively replace the internal combustion engine (ICE), \$100/kWh level must be achieved. Who can argue the company achieving that goal will have a significant competitive and brand edge?

Now, let's talk chips. They may be small, but future investment seems to dwarf all the EV Li-ion battery investment discussed above. First, TSMC announced \$100B in fab expansion over the next three years. That was followed by Samsung's plans to invest a significant portion of \$205B (also over next three years) in fab and chip manufacturing with \$17B of that amount earmarked for a USA chip manufacturing plant. Intel followed with plans to spend \$95B over the next decade with two new factories in Europe and \$20B more for two new factories in Arizona. This is only the tip of the iceberg with many smaller companies committing to substantial capacity expansions as well.

Collectively, the investment numbers funded solely by private enterprise are staggering. It's a tsunami the industry rarely sees. None the less, supply constraints will continue for some time as there's no magic panacea for growing capacity of either in the short term.



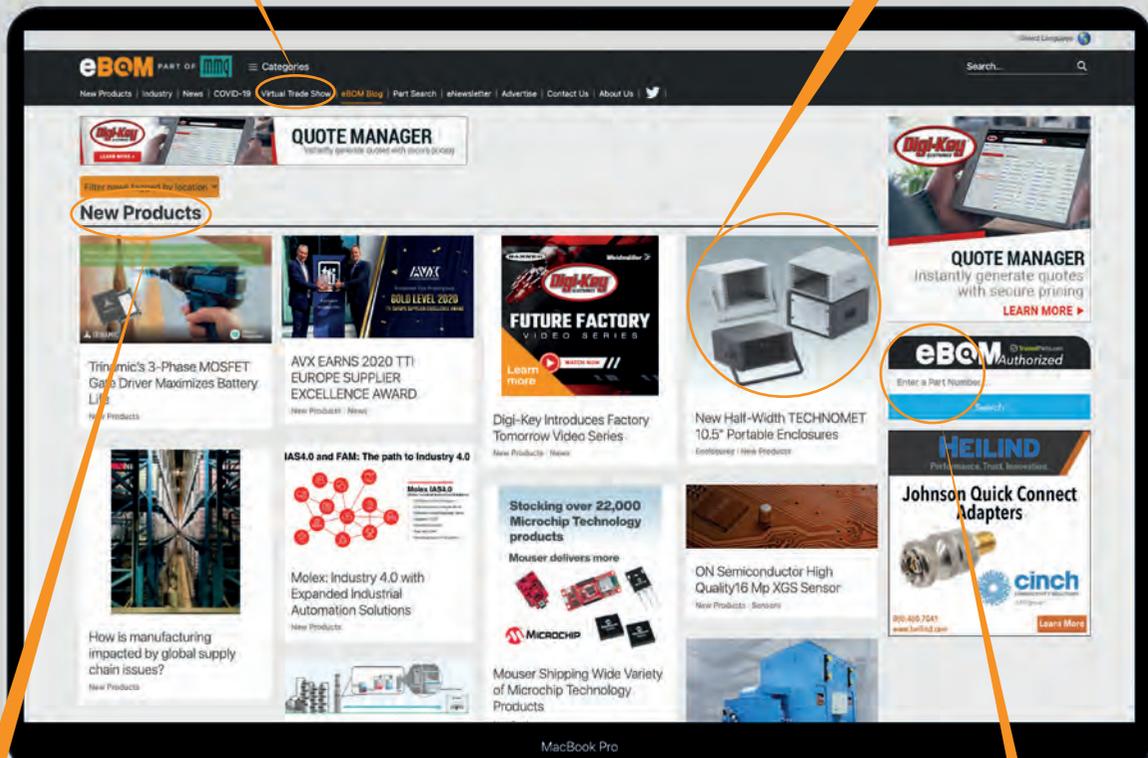
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# Component cost and demand in the 2020s

*TTI SVP business development, president Exponential Technology Group, Michael Knight states that how things have worked in the past are not how things will work going forward*

**Q** How have component prices moved over the last ten years and are you seeing price increases driven by extending lead-times and shortages?

A: Generally, prices have deflated over the past decade. The notion of sales prices in electronics declining over time has become baked into consumer expectations then institutionalized in the purchase price variance metric prevalent through the component specifying and procurement communities.

The level of year-on-year decline is not uniform across all component types. Commodity passives particularly have been squeezed more than non-commodity semiconductors. During the past decade we've seen years the average selling price of chip capacitors and resistors declined more than 10 per cent. This led to manufacturer hesitancy to add capacity, especially for legacy parts. This contributed to the shortages we saw in 2018 and the shortages crippling many supply chains right now.

During 2018 we saw a temporary halt to price decreases, and even increases in challenged components. This was essential to encouraging suppliers to commit to capacity expansion. However, it's now obvious that

new capacity that came online then was only enough to relieve the immediate pressure, not enough to support the explosive growth in demand created by the ramping of 5G, IoT, electric vehicles etc in the current decade.

**Q** It is predicted that component sales over the next five years will double compared to current sales. Does this mean authorized distribution can expect twice the sales and profits?

A: Even in down years for the industry, the number of components manufactured and shipped each year is always greater than the year before. This speaks to how significant price decreases can be. In down years component prices fall faster than shipping quantities rise, and historically the industry has had enough down years to create a bit of a bunker mentality going into the 2020s.

With this in mind, I don't think the idea that the growth in demand for electronic components is going to greatly accelerate through this decade (and probably beyond) has settled into the collective mind of the industry. Rather, we are conditioned to expect a sharp drop after a sharp climb and even now many in the industry are bracing for a drop. This is especially rough on distributors who contend with

multiple levels of competition, which drives a bit of a 'race-to-the-bottom' instinct, especially when quoting pricing.

Of course, any increase in demand is good for the topline of all in the supply chain, but what good news there is on the bottom line is unevenly distributed. The go-forward source of profit improvement in distribution isn't a slam-dunk and what there is probably won't be the result of increasing the gap between component purchase prices and resales. It is more likely to come as the result of essential supply chain and design services that distributors are adding to the components they spec in and sell, and through the increasing digitization of their transactions with OEMs and component suppliers.

**Q** Have shipping, raw material and other costs impacted component prices in recent times?

A: They have. All cost inputs have risen sharply: labor, chemicals, plastics, energy, transportation, packaging materials. This has triggered price increases unlike any we've seen in a long time—maybe ever. Not only have the prices for new orders gone up; open supplier backlog is being repriced, sometimes multiple times, before the product ships. This on top of the expediting going on now has increased



TTI SVP business development, president  
Exponential Technology Group,  
Michael Knight



**Even in down years for the industry, the number of components manufactured and shipped each year is always greater than the year before**

the workload and stress on the entire supply chain. An unintended consequence is that new product development has slowed as resources are diverted to dealing with supply chain issues, which may end up being a safety valve that bleeds off a bit of the pressure that is building.

**Q Can you share your predictions and advice for the North American component supply chain?**

**A:** Supply chain configurations and metrics have largely been unchanged for fifty years. Outsourcing, offshoring and just-in-time have optimized for cost, not resilience. The pandemic, trade wars and climate related disruptions have exposed the brittleness of the electronics supply chain, and the growing demand (despite all the environmental and economic head winds) threatens to break some of those links. I think the obvious first step for all participants is to acknowledge that how things have always worked are not how things will work going forward—waiting this out is not an option.

In the short-term OEMs should open up bills-of-material that are riddled with single sourced parts and invest in alternative sourcing. In some cases, products may need to be redesigned to use components available. OEMs should also expect to make more forward looking and binding commitments than 'normal'. These actions will reduce some of the immediate pressure and incentivize suppliers to add capacity.

In the near term, time, energy and investment should be committed to evolving and modernizing every link in your supply chain. Much easier said than done, but critical to survive and thrive in the accelerating-demand environment for electronics that will be the hallmark of the 2020s.

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# Seven steps to specifying metal enclosures

Manufacturers can specify fully customized aluminum enclosures in very small batches. Read on to discover how

### Step 1: What is the enclosure for?

Consult a specialist enclosure manufacturer early in the design process to discuss the application and explore options which save time, budget and stress. The following summarizes the main options.

Nineteen-inch racks and enclosures comprise standardized floor-standing or desktop mini-racks (typically heights from 3U to 42U) for mounting 19in subracks (84HP), chassis and cases.

Nineteen-inch rack cases are equipment housings for mounting in racks (typically in heights from 1U to 9U).

Then come 10.5in half-width desktop enclosures which are compact standard housings for 10.5in subracks (42HP) and chassis (typically in heights of 3U to 6U).

Desktop and portable instrument enclosures are usually available with or without a bail arm which acts as a desk stand.

Sloping-front desktop enclosures offer an

ergonomically inclined operating front panel for terminals and data entry.

Finally, there are wall-mount enclosures, which can also be mounted on machines.

Note that standard enclosures are designed to be versatile. For example, a sloping-front desktop case can be ideal for wall-mount applications such as access control.

**Step 2: How will components be mounted?**  
This consideration is important for installation and maintenance. PCBs that



**Most designers take the standard customized enclosure route. Choosing the right model is critical. Similar looking cases can offer different advantages. Expert advice pays dividends**



Custom 19in rack enclosures

slide in/out on guide rails are faster to install and remove than boards mounted on pillars. Advanced instrument enclosures such as Metcase's TECHNOMET offer both options.

For 19in rack applications, how will users open the case: via the front, rear, top or base? Will they need access while the case is in the rack?

**Step 3: Standard/customized or bespoke?**

Customizing a standard enclosure is usually quicker and more cost-effective than opting for a bespoke housing. Not always: simple bespoke cases can be cheaper but customized is usually better.

Determined to go bespoke? Ask your enclosure partner about prototyping offers. Combining prototyping with an initial production run can offer exceptional value. Batch sizes can be as low as 10 for larger rack cases or 25 for smaller instrument enclosures.

**Step 4: Which standard model is best?**

Most designers take the standard/customized enclosure route. Choosing the right model is critical. Similar looking cases can offer different advantages. Expert advice pays dividends.

Does the preferred standard model offer all the required features? Is it available in a range of sizes? Can it be manufactured to a custom size in all three dimensions? What are the standard ventilation options? Does the enclosure have earthing studs on every panel?

Bezels are key for two reasons: they enhance aesthetics but add cost; they are diecast, usually limiting custom sizes. However, enclosures without bezels don't have to look prosaic. A flat-front rack is elegant and offers a customizable enclosure at a sensible price. Metcase's COMBIMET rack cases are an example.

**Step 5: Download a 3D model**

Downloading a 3D model of a preferred enclosure helps engineers to spot design opportunities or pitfalls early. Specify apertures for controls/connectors and see exactly how components will look inside.

Presenting your enclosures supplier with a signed-off 3D model shortens the design process and speeds up production. Ask if 3D models are available for every enclosure in the range (as they are for Metcase). You will usually need to register to download



Custom 19in rack mount enclosures

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the design-protected 3D models.

### Step 6: Customizing the standard enclosure

Metcase's VP marketing, Robert Cox, said: "It makes sense to order your enclosures from a single-source supplier so they're fully customized and with all the accessories assembled. Your housings will be PCB ready when they arrive at Goods In so you can send them straight to your production line."

Metcase's customization services include: CNC

machining (punching, forming, milling, drilling and tapping); fixings and inserts (threaded studs for mounting PCBs, connectors and electronics assemblies); custom colors (including 'always in stock' bespoke colors), panels, trims, legends and logos. Digital printing's low set-up costs make customization viable for low-volume orders.

### Step 7: Project timings, how long will it take?

Customized standard enclosures will always be the fastest option because the manufacturer

can concentrate on the customized parts. For bespoke housings, finalizing the design is usually the longest part of the process. A clear specification regarding component location speeds up the process. However, multiple prototypes may be needed, extending timings.

Metcase's project delivery times are typically four to eight weeks for customized standard enclosures and six to ten weeks for bespoke projects.

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**Desktop and portable instrument enclosures are usually available with or without a bail arm which acts as a desk stand**



Custom instrument enclosures

# Washdown enclosures ready to ship

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Typically, a flat-top enclosure would allow standing water to accumulate, creating a breeding ground for bacteria. Waterfall enclosures' 25-degree sloped top prevents liquids accumulating, while its brushed number four finish eases cleaning.

Hammond's sales and marketing manager, Tom Ballou, said: "We often hear about food recalls or quality issues with food that can affect the safety of consumers, so effective cleaning in this environment is an absolute must. Standing water and debris build-up in crevices and on surfaces can be breeding grounds for bacteria. The Waterfall stainless steel enclosures were designed with features to address all of these concerns and still be suitable for other environments."

The enclosure's content is protected by a one-piece foam gasket, while an exaggerated flange trough collar deviates water before it reaches the gasket. All Hammond industrial NEMA 4 or 4x enclosures have a channel allowing water to flow around the gasket. The larger channel on the Waterfall enclosures further protects the gasket, extending its life.

Instead of a standard piano hinge that can trap debris, Waterfall enclosures use a bullet-style hinge for easy hose-down cleaning or rapid removal of the door for more extensive cleaning. The hinge lets the door open 180deg for easy access for maintenance or replacement. Optional stand-off kits are available for cleaning behind enclosures.

An IP69K rating means the enclosures can handle high-pressure (1,450psi) and high-temperature (85°C) water jets, which are important for cleaning in food processing environments. Waterfall enclosures are NSF certified for splash zone areas in food processing plants.

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The larger channel on the Waterfall enclosures further protects the gasket, extending its life

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# Microprocessor revenue rises as demand for PCs and servers remains robust

*However, unit shipments and revenue for MPUs used in PCs will fall in 2022 while server processor growth will continue*



James Carbone

Continuing strong demand and higher prices will result in a 14 per cent revenue increase in the overall microprocessor (MPU) market in 2021 as sales grow to \$103.3 billion this year from \$90.7 billion in 2020, according to market researcher IC insights.

It will be the second straight year for double-digit growth for the global MPU market which includes microprocessors used in computers and embedded applications and application processors used in cell phones. However, growth in 2021 won't be as strong as 2020 when sales grew 16 per cent.

Rob Lineback, senior market research analyst for IC Insights, says the PC MPU segment is "still doing fairly well." The growth rate is slipping a bit from last year when you compare year-to-year, but it is still at record levels," he said.

Lineback added that the recent release of Microsoft's new Windows 11 operating system

may further boost computer demand for the rest of this year and in 2022, which would also boost demand for processors. "If you're Intel, you hang a lot of hopes on that," he said.

In the first half of 2021 MPU sales grew as many office workers continued to work from home and students studied at home. Many people bought new computers. In addition, data center operators invested in new servers to handle increased Internet traffic. Those servers use higher-end MPUs which can cost \$700 or more.

## Server MPU to rise in 2022

Revenue from microprocessors used in personal computers were expected to rise from \$35.5 billion in 2020 to \$38.6 billion in 2021, according to researcher IDC. Sales from processors used in servers were forecast to rise from \$23.2 billion in 2020 to \$24.2 billion in 2021. The researcher says server revenue will continue to grow in 2022 when sales rise 10.5 per cent to \$26.8 billion and unit shipments increase 6.8

per cent. However, revenue from processors used in PCs will dip 2.4 per cent to \$37.7 billion and unit shipments will decline. "I am forecasting a 6.2 per cent decline in unit shipments," said Shane Rau, research vice president, computing semiconductors for IDC. He noted that the decline in units will come after two "very strong years" of unit growth. "There will be a bit of a cooling off after two very intense years," of growth, said Rau. He added that the decline will likely come in the second half of the year.

"It does not mean the PC market is going to really contract. It's just that supply will catch up with demand for CPUs," said Rau. PC MPU revenue will also "subside somewhat in the second half of 2022."

He said prices for PC microprocessors will end 2021 increasing by about 9 per cent to \$96.28. However, PC MPUs, will increase 4 per cent to \$100.19 in 2022 and remain mostly flat

through 2025, according to IDC. Microprocessor revenue in the embedded processor segment will rise 11 per cent in 2021, said IC Insights. Sales of embedded MPUs, which cover a broad range of system applications such as the Internet of Things, automotive, industrial, medical, consumer, telecom, and networking equipment, are expected to reach \$19.7 billion this year with unit shipments growing 12 per cent worldwide, the researcher said.

Overall prices for microprocessors used in personal computers is in the \$100 range, but tags vary depending on the computer segment. For instance, prices for desktop computer MPUs are \$135-140 while for mobile processor tags are \$90-\$95, said Rau. "These are pretty healthy prices compared to five years ago. It's a good time to be a PC processor manufacturer," he said.

## Server MPU tags to rise

The average price for an MPU used in a server in 2021 is about

## By the Numbers



**\$103.3 billion**

The forecast size of the global microprocessor market in 2021. Source: IC Insights



**8.5%**

The compound annual growth rate of server microprocessors through 2025. Source: IDC



**14%**

The expected growth rate for the overall microprocessor market in 2021. Source: IC Insights



**\$135-140**

The average price range of microprocessors used in desktop computers. Source: IDC



**\$24.2 billion**

The forecasted size of the global server microprocessor market in 2021. Source: IDC



**6.2%**

The expected decline of unit shipments of PC microprocessors in 2022. Source: IDC



\$690. However, servers MPU average prices will rise steadily through 2025 when it reaches \$797, according to IDC.

The good news for semiconductor buyers in the computer industry is that microprocessor supply may be tight for some MPUs but it's not as bad as other semiconductor products.

There had been a shortage of some processors used in PCs, but processor makers have caught up with demand. "The ability to meet demand for the x86 processor by Intel and the AMD is holding up well," said Lineback. "They are able to meet demand."

He said Intel had some trouble shipping inexpensive x86 processors to the desktop markets, but the company increased production and now "they have that under control." Lineback added most of the shortages in the semiconductor world are in more mature fabs which don't make MPUs. However, the fear of shortages of MPUs used in servers is causing issues for microprocessor companies. "There is a fear by server OEMs of not being able

to get supply of server MPUs because of past shortages," said Rau.

He said OEMs will order server processors "as early as possible and double order, because they are fearful of not getting their supply," said Rau. The problem is "if everyone does that then you have supply/demand imbalance. Big server companies will get most of what they want but smaller, regional server companies may not get the volume that they want," said Rau.

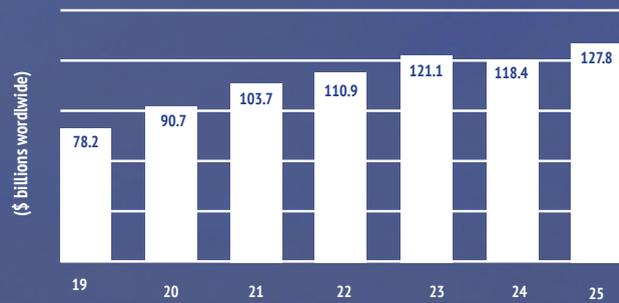
#### MPU growth muted

While the Microsoft's microprocessor market will continue to grow for the next five years, its growth may be muted because of a decision by Apple to switch from x86 microprocessors made by Intel to Apple's home-grown ARM-based M1 chip for its MacBooks and desktop computers. Apple had been using x86 processors since 2007.

"With Apple shifting away from x86 microprocessors to its own homegrown device, the x86 market is going to lose about 10 per cent of its units to application processors," said Alan Priestley,

Strong demand for PCs and servers will boost microprocessor demand for the next five years  
Source: IC Insights

### MPU market to post strong growth



vice president analyst, emerging technologies & trends for Gartner Inc. Gartner categorizes the M1 chip as an application processor. Application processors are used in cell phones.

He said that other PC OEMs that now use x86 microprocessors will start to use application processors in their new Windows PCs, "not in high numbers, but enough to cause another 6 per cent decline in share within the PC market." Gartner's current forecast says about 16 per cent of the PC market will be non-x86 MPUs by 2025, said Priestley.

Apple and others will switch to application processors because they have a higher level of integration than an x86 processor, said Priestley.

An x86 microprocessor has processor elements, a memory controller and PCI interfaces. Apple's M1 processor also includes memory. So separate DIMM modules are not needed. Power management, security, networking functionality are also on the M1 chip, said Priestley.

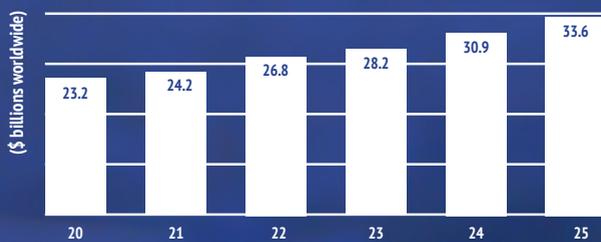
#### More integration, less cost

With a much higher level of integration, fewer components are needed on the printed circuit board of the computer. As a result with a laptop computer, there is more room for a bigger battery which will increase run time of the computer.

"With the M1 processor Apple gets high levels of integration, lower manufacturing costs, bigger batteries, longer battery life," said Priestley. There are also lower component costs on the bill of materials because there are fewer components.

"If you put aside the cost of developing the piece part cost, you only have Apple buying the application processor from the manufacturer which is TSMC," he said. "The piece part cost will be lower for Apple than by commercial products from Intel. If more PC OEMs use application processors, such as QUALCOMM's Snapdragon chip it will likely boost competition between Intel and AMD for share of the x86 market."

### Server revenue pushes upward



Rising demand for servers at data centers will drive server processor revenue past \$33 billion by 2025. Source: IDC

# Semiconductor shortages in automotive will ease in 2022

*Chipmakers are adding production capacity and demand is expected to weaken which will lead to improved supply conditions for semiconductor purchasers*

Electronics purchasers in the auto industry can expect shortages of microcontrollers, MOSFETs and a range of other chips used in automotive systems to continue until the second half of next year and maybe longer.

While integrated device manufacturers (IDMs) and foundries are adding semiconductor production capacity, much but not all of the investment is for chips produced on leading-edge technology nodes, such as 5nm, 7nm and 10nm and on 12-inch wafers.

With a few exceptions, chips produced on such process technology nodes are not used in automotive systems, but in servers, PCs, laptops and smart phones. Most semiconductors produced for use in vehicles are often built on 8-inch wafers using more mature process technology nodes such as, 130, 110, 90 and 65 and 28nm. There are some chips used in automobiles that are built on 5nm nodes.

While chipmakers are increasing capacity to existing fabs, it can take a year or more for capacity to be added. New fabs can take two to three years to be built and equipped and ready for production. In addition, there is limited assembly and test capacity. When new semiconductor capacity comes online, shortages could continue until more assembly and test capacity is also added.

Most buyers, suppliers and analysts say current shortages impacting the auto industry and all other electronics industry segments is the worst they've ever seen. There are many allocations and lead times are long for most semiconductors. Component shortages have resulted in automakers temporarily stopping production of vehicles.

For instance, Toyota said it would produce 60,000-80,000 fewer vehicles in October in North America because of component shortages and ongoing challenges in its supply chain. Ford announced it cut back production of its popular F-150 pickup in September because of a lack of chips. Nissan said it plans to make fewer vehicles in 2021 as it did in 2020 because of the semiconductor shortage.

## Unprecedented shortages

"We've never seen anything like this before," said Dave Valletta, executive vice president of global sales and marketing for Vishay Intertechnology, which supplies MOSFETs and other components to the auto industry. "We've had times of shortages in the automotive industry before, but never like this."

Many of Vishay's MOSFETs are on allocation. "In some cases, we're forecasting out to the end of 2022 and into 2023," said Valletta. "It is really severe. We are adding

capacity as quickly as we can but it takes time," he said.

Next year Vishay will have a double-digit increase in capacity, Valletta said. But "it's nowhere near enough to cover demand," he said.

Vishay makes MOSFETs internally but also outsources some production to foundries. The company is trying to outsource more to foundries but "we are running into the same problem as everyone: foundries are completely booked."

Vishay also supplies diodes and optoelectronics to the auto industry. Diode supply is tight but it is not "quite as restricted as MOSFETs," said Valletta. "Diode supply is more manageable. Optoelectronics are in pretty good shape in terms of support for automotive programs," he said

Guarav Gupta, vice president analyst at researcher Gartner Inc., said microcontrollers, power management ICs, discretes, analog ICs, MOSFETs and display drivers used by the auto industry were in short supply at the beginning of the fourth quarter. The shortages will not end anytime soon," he said.

"Our prediction right now is we will see a better balance of demand and supply in the second half of 2022. When I say there will be a better balance, it probably won't be true for all devices



**We've had times of shortages in the automotive industry before, but never like this**

**Dave Valletta**, executive vice president - worldwide sales for Vishay Intertechnology



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or all applications or all industry verticals,” said Gupta. “But overall, you will see a much better environment” for semiconductor supply, he said.

#### More capacity coming

He said there are several reasons why supply will improve for semiconductor buyers next year. One is the addition of more chip capacity. Foundries and integrated device manufacturers have invested in increasing production capacity.

TSMC, UMC, Vanguard SMIC, Bosch and Infineon, which make semiconductors for the auto industry, have new fabs coming online. “Some of that capacity will come online by the end of this year or early next year but most of it will start coming online towards the end of 2022,” he said.

In some cases, new capacity has already been added. C. C. Wei, vice chairman of foundry TSMC, said the chipmaker has increased production of microcontrollers by about 30 per cent in the first half of 2021 compared to the first half of 2020.

“For the full year, we expect to increase output for MCUs by close to 60 per cent over the 2020 level which also represents about a 30 per cent increase over the 2018 pre-pandemic level,” he said. As a result, he expects that the automotive component shortage will be

reduced for TSMC customers starting this quarter.” Overall TSMC’s capital spending this year will be \$30 billion, a 74 per cent increase from 2020.

Other semiconductor companies are also building new fabs, and increasing capital spending. For instance, Infineon’s capital expenditures this year will increase 59 per cent, according to IC Insights.

Infineon has just opened a new \$1.86 billion 300mm fab in Austria that will build power semiconductors for the industry in other segments.

The fab, which had been under construction for the past three years, began producing chips in September, the company said. At first chips produced at the fab will primarily be used to meet demand from the automotive industry, data centers and renewable energy generation of solar and wind power. The fab will enable Infineon to serve the growing market for power semiconductors by those business segments.

Bosch has begun production of a new 300mm fab in Dresden Germany which will also produce chips for the auto industry and other industries.

#### Chip demand to weaken

Another reason that supply conditions will improve is semiconductor demand

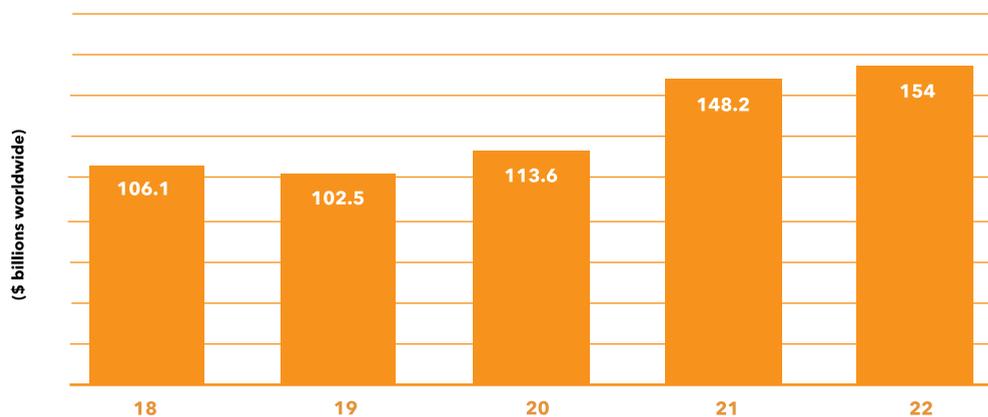
## Chip capacity rise as chipmakers increase capital spending

The good news for semiconductor buyers who are working overtime trying to source parts that are on allocation is that chipmakers are building new fabs to boost semiconductor supply. The bad news is that most of the capacity from the new fabs won’t come online until 2023.

Most chip makers have increased their capital spending to add more capacity at existing fabs and some are building new production facilities. Worldwide semiconductor capital spending was expected to increase 30 per cent in 2021 to \$148.2 billion from \$113.6 billion in 2020, when expenditures grew 11 percent from \$102.5 billion in 2019, according to researcher IC Insights. In 2022 capex will grow another 5 per cent.

Much of that investment will be for new fabs. By the end of this year, chipmakers will have started construction on 19 new high-volume fabs and plan to break ground on another 10 in 2022 to meet growing demand, according to industry association SEMI. Equipment spending for new fabs will be more than \$140 billion over the

### Semiconductor capital spending rises sharply



Source: IC Insights

Chipmakers will add more production capacity as their capital expenditures rise to nearly \$155 billion.

is weakening in certain segments such as consumer electronics, according to Gupta. “Softness in demand will also help ease the chip shortage,” he said. Shortages may also ease because some foundries are looking for long-term, non-cancelable orders because of panic buying from some buyers who are double and triple ordering parts, according to Gupta. TSMC chairman Mark Liu recently said his company was trying to figure out which companies really needed chips and which ones were hoarding. The foundry was delaying orders to customers that may be stockpiling semiconductors.

While semiconductor manufacturers are adding capacity to address chip shortages, there are other issues that may impede those efforts. One headwind in eliminating shortages is a lack of an assembly and testing capacity and shortages of lead frames and other materials needed for packaging, according to Nina Turner, research manager, semiconductor applications forecaster. She noted a lot of assembly and test for semiconductors is done in China. Recent power outages in China have contributed to semiconductor supply delays.

“Because of higher coal prices, China has decided they want to enact new policies to reduce energy consumption,” said Turner. They are doing power outages and not prioritizing manufacturing,” she said. As a result, production of assembly and test materials needed for semiconductors is

slow, further exacerbating tight supply.

In the longer term, while chipmakers are adding capacity, it may not be enough because demand for chips is expected to grow robustly in the auto industry and other segments .

In automotive, more electric vehicles and hybrids will be built, replacing internal combustion vehicles. Electric vehicles typically have many more semiconductors than traditional vehicles. For instance, an internal combustion car has about \$620 worth of semiconductors, a hybrid has about \$800 of chips and electric vehicle semiconductor content totals \$1,200 on average, according to IC Insights. EVs require more microcontrollers, power management ICs, IGBTs, small signal transistors, rectifiers, and diodes. More silicon carbide and gallium nitride chips will be used in electric vehicles.

In addition, more vehicles will be equipped with driver assistance systems features such as lane change warning, automatic braking in an emergency and collision avoidance. Such systems are mainly used in higher-end vehicles but will migrate to lower-cost vehicles over the next five years. Driver assistance systems require a wide range of semiconductors and will further boost chip demand.

next few years which should help reduce semiconductor shortages, according to Ajit Manocha, SEMI president and CEO. The new fab capacity will help address demand for chips from emerging applications including autonomous vehicles, artificial intelligence and high-performance computing.

China and Taiwan will build eight new fabs each; six will be constructed in the Americas; three each in Europe and the Middle East and two each in Japan and Korea, the association said.

Fifteen of the new fabs being built in 2021 will produce 300mm wafers. In 2022, seven more 300mm fabs will be built. Over the next two years, seven fabs will be built that will produce 100mm, 150mm and 200mm wafers, according to SEMI. Much of that capacity will be used for chips used by the auto industry and other segments that don't require the most advanced semiconductors.

The 29 fabs could produce as many as 2.6 million wafers per month (in 200mm equivalents). About 15 of the new fabs will be foundries and will produce 30,000-220,000 wafer per month. Four of the new fabs will produce memory chips.

Many of the fabs won't start production until 2023, although some could begin installing equipment as early as the first half of 2021, said SEMI. Much of the production will be for integrated circuits and not discrete semiconductors. “There isn't anything I can see that will quickly improve availability of MOSFETs, diodes, and other discretes,” said Rob Lineback, senior market analyst for IC Insights. “The MOSFET business is still very tight overall and automotive is very much plagued by short supplies and prices are rising,” he said. The average selling price of a discrete in 2021 will rise 5.2 per cent compared to .2 per cent in 2020, he said.

Improvements in chip supply are “much further down the road,” said Lineback. He added it might take a market slowdown in demand for new cars and trucks before supply catches up with demand. Chipmakers currently are slow to add capacity during an upturn because when demand cools off it results in oversupply and lower prices.



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PUI Audio	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
Schneider Electric	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
Sensata	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
TE Connectivity	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
Tedyne Relays	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
<b>ENCLOSURES</b>											
Bud	ECCO	773-767-2200	www.eccoconnectors.com	Y	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Bud Industries	Mouser Electronics	800-346-6873	www.mouser.com	Y	1,325	N/A	\$0	80.00%	50	1,000+	Y
Hammond Manufacturing	Mouser Electronics	800-346-6873	www.mouser.com	Y	2,839	N/A	\$0	82%	50	1,000+	Y
METCASE Enclosures	OKW Enclosures, Inc.	(800) 965-9872	www.metcaseusa.com		322	N/A	\$0	N/A	10	20	Y
New Age Enclosures	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
OKW Gehäusesysteme GmbH	OKW Enclosures, Inc.	(800) 965-9872	www.okwenclosures.com		2,450	N/A	\$0	N/A	10	20	Y
ROLEC Gehäuse-Systeme GmbH	ROLEC Enclosures Inc	(888) 658-5774	www.rolec-usa.com		1,960	N/A	\$0	N/A	4	6	Y
<b>FREQUENCY MANAGEMENT</b>											
Abracon Corporation	Mouser Electronics	800-346-6873	www.mouser.com	Y	1,780	N/A	\$0	100%	50	1,000+	Y
CTS Electronic Components	Mouser Electronics	800-346-6873	www.mouser.com	Y	3,889	N/A	\$0	100%	50	1,000+	Y
ECS Inc	Mouser Electronics	800-346-6873	www.mouser.com	Y	2,070	N/A	\$0	100%	50	1,000+	Y
Epson Toyocom	Mouser Electronics	800-346-6873	www.mouser.com	Y	178	N/A	\$0	100%	50	1,000+	Y
IQD Frequency Products	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
Kyocera	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
Silicon Labs	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
<b>ICs &amp; SEMICONDUCTORS</b>											
Analog Devices, Inc	Mouser Electronics	800-346-6873	www.mouser.com	Y	18,749	N/A	\$0	95%	50	1,000+	Y
Broadcom Limited	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
Central Semiconductor	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
Central Semiconductor Corp.	Future Electronics	(800) 675-1619	www.futureelectronics.com	Y	N/A	N/A	N/A	N/A	N/A	N/A	Y
Cree, Inc.	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
Cypress Semiconductor Corp	Mouser Electronics	800-346-6873	www.mouser.com	Y	1,325	N/A	\$0	81.00%	50	1,000+	Y
Digi International	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
Diodes Incorporated	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
FTDI	Mouser Electronics	800-346-6873	www.mouser.com	Y	94	N/A	\$0	100%	50	1,000+	Y
IDT (Integrated Device Technology)	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
Infineon	Mouser Electronics	800-346-6873	www.mouser.com	Y	1,580	N/A	\$0	63%	50	1,000+	Y
Intel	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
ISSI	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
IXYS	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
Lattice	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
MACOM	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
Maxim Integrated	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
Microchip	Mouser Electronics	800-346-6873	www.mouser.com	Y	5,800	N/A	\$0	100%	50	1,000+	Y
Microsemi	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
Monolithic Power Systems (MPS)	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
Nexperia	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
NXP	Mouser Electronics	800-346-6873	www.mouser.com	Y	7,205	N/A	\$0	100%	50	1,000+	Y
ON Semiconductor	Mouser Electronics	800-346-6873	www.mouser.com	Y	7,486	N/A	\$0	96%	50	1,000+	Y
Power Integrations	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
Qorvo	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
Renesas Electronics	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
ROHM Semiconductor	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
SanDisk	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
Silicon Laboratories Inc	Mouser Electronics	800-346-6873	www.mouser.com	Y	1,141	N/A	\$0	100.00%	50	1,000+	Y
Skyworks	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
ST Microelectronics	Mouser Electronics	800-346-6873	www.mouser.com	Y	8,145	N/A	\$0	96.00%	50	1,000+	Y
Swissbit	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
Texas Instruments	Mouser Electronics	800-346-6873	www.mouser.com	Y	29,676	N/A	\$0	94%	50	1,000+	Y
Toshiba	Mouser Electronics	800-346-6873	www.mouser.com	Y	800	N/A	N/A	N/A	N/A	N/A	Y
Vishay	Mouser Electronics	800-346-6873	www.mouser.com	Y	53,781	N/A	\$0	77%	50	1,000+	Y

Manufacturer	Distributor	Telephone	Website	Franchised Distributor (Y/N/A)	No. of Lines for Principle	Stock Value for Principle	Minimum Order Value	% Lead Free for Principle Range	No. of Technical Support Staff	Total No. of Staff	Pack and Hold
<b>INTERCONNECTION</b>											
3M	Mouser Electronics	800-346-6873	www.mouser.com	Y	23,235	N/A	\$0	46.00%	50	1,000+	Y
Aero Conesys	ECCO	773-767-2200	www.eccoconnectors.com	Y	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Amphenol	ECCO	773-767-2200	www.eccoconnectors.com	Y	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Amphenol	Mouser Electronics	800-346-6873	www.mouser.com	Y	165,853	N/A	\$0	31%	50	1,000+	Y
Anderson Power Products	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
Active (Delphi)	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
Bel Magnetic Solutions	Bel Fuse	+1 858 676 9650	belfuse.com/magnetic-solutions	Y	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Cinch	ECCO	773-767-2200	www.eccoconnectors.com	Y	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Cinch Connectivity/Bel	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
Cinch Connectivity Solutions	Bel Fuse	+1 507 833 8822	+1 507 833 8822	Y	N/A	N/A	N/A	N/A	N/A	N/A	N/A
ERNI Electronics	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
FCI	Mouser Electronics	800-346-6873	www.mouser.com	Y	3,394	N/A	\$0	73.00%	50	1,000+	Y
Glenair	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
Harting	Mouser Electronics	800-346-6873	www.mouser.com	Y	2,160	N/A	\$0	51.00%	50	1,000+	Y
Harwin	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
Hirose Electric	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
ITT Cannon	ECCO	773-767-2200	www.eccoconnectors.com	Y	N/A	N/A	N/A	N/A	N/A	N/A	N/A
ITT Cannon	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
JAE Electronics	Mouser Electronics	800-346-6873	www.mouser.com	Y	6,02	N/A	\$0	100%	N/A	N/A	Y
JST	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
LEMO	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
Mill-Max	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
Molex	Mouser Electronics	800-346-6873	www.mouser.com	Y	85,634	N/A	\$0	89%	50	1,000+	Y
Neutrik	Mouser Electronics	800-346-6873	www.mouser.com	Y	1,563	N/A	\$0	100%	50	1,000+	Y
NorComp	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
Phoenix Contact	Mouser Electronics	800-346-6873	www.mouser.com	Y	30,044	N/A	\$0	77.00%	50	1,000+	Y
Radiall	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
Souriau	Mouser Electronics	800-346-6873	www.mouser.com	Y	10,744	N/A	\$0	27%	50	1,000+	Y
Stewart Connector	Bel Fuse	+ 1 717 235 7512	belfuse.com/stewart-connector	Y	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Switchcraft Corporation	Mouser Electronics	800-346-6873	www.mouser.com	Y	300	N/A	\$0	55%	50	1,000+	Y
TE Connectivity	Mouser Electronics	800-346-6873	www.mouser.com	Y	123,613	N/A	\$0	69%	50	1,000+	Y
<b>OBSCULENCE / HARD TO FIND</b>											
	Lansdale	602-438-0123	lansdale.com	Y							
	Lantek Corp.	973-579-8100	www.lantekcorp.com	M	186,000	\$22M	\$0	75.00%	5	62	Y
	Rochester Electronics	978-462-9332	www.rocelec.com	Y		N/A	\$250		10	400+	Y
<b>OPTO ELECTRONICS</b>											
Broadcom	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
Cree	Mouser Electronics	800-346-6873	www.mouser.com	Y	582	N/A	\$0	99.00%	50	1,000+	Y
Finisar	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
Osram Opto Semiconductors	Mouser Electronics	800-346-6873	www.mouser.com	Y	1,927	N/A	\$0	99%	50	1,000+	Y
ROHM Semiconductor	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
Vishay	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
<b>PASSIVES</b>											
ABRACON	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
AVX	Mouser Electronics	800-346-6873	www.mouser.com	Y	42,454	N/A	\$0	72%	50	1,000+	Y
Bourns	Mouser Electronics	800-346-6873	www.mouser.com	Y	38	N/A	\$0	78%	50	1,000+	Y
Cornell Dubilier	Mouser Electronics	800-346-6873	www.mouser.com	Y	24,145	N/A	\$0	71%	50	1,000+	Y
Coilcraft	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
EPCOS	Mouser Electronics	800-346-6873	www.mouser.com	Y	26,533	N/A	\$0	98.00%	50	1,000+	Y
Fair-Rite	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
Kemet	Mouser Electronics	800-346-6873	www.mouser.com	Y	77,568	N/A	\$0	66%	50	1,000+	Y
KOA Speer	Mouser Electronics	800-346-6873	www.mouser.com	Y	34,078	N/A	\$0	58%	50	1,000+	Y
Murata	Mouser Electronics	800-346-6873	www.mouser.com	Y	33,780	N/A	\$0	99%	50	1,000+	Y
Nichicon	Mouser Electronics	800-346-6873	www.mouser.com	Y	20,389	N/A	\$0	84.00%	50	1,000+	Y
Ohmite	Mouser Electronics	800-346-6873	www.mouser.com	Y	14,293	N/A	\$0	55.00%	50	1,000+	Y
Panasonic Electronic Components	Mouser Electronics	800-346-6873	www.mouser.com	Y	14,948	N/A	\$0	100.00%	50	1,000+	Y
Signal Transformer	Bel Fuse	+1 516 239 5777	belfuse.com/signal	Y	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Taiyo Yuden	Mouser Electronics	800-346-6873	www.mouser.com	Y	4,620	N/A	\$0	98.00%	50	1,000+	Y

# Buyers' Guide

Manufacturer	Distributor	Telephone	Website	Franchised Distributor (Y/N/M)	No. of Lines for Principle	Stock Value for Principle	Minimum Order Value	% Lead Free for Principle Range	No. of Technical Support Staff	Total No. of Staff	Pack and Hold
<b>PASSIVES (Continued)</b>											
TDK	Mouser Electronics	800-346-6873	www.mouser.com	Y	6,663	N/A	\$0	100.00%	50	1,000+	Y
TT Electronics	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
United Chemi-Con (UCC)	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
Vishay	Mouser Electronics	800-346-6873	www.mouser.com	Y	102,917	N/A	\$0	64.00%	50	1,000+	Y
Würth	Mouser Electronics	800-346-6873	www.mouser.com	Y	934	N/A	\$0	99.00%	50	1,000+	Y
Yageo Corporation	Mouser Electronics	800-346-6873	www.mouser.com	Y	18,246	N/A	\$0	100.00%	50	1,000+	Y
<b>POWER &amp; BATTERIES</b>											
Artesyn Embedded Technologies	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
Bel Power Solutions	Bel Fuse	Power & Batteries	belfuse.com/power-solutions	Y	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Cincon	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
Cosel	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
CUI Inc.	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
Delta Electronics	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
MEAN WELL	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
Mornsun		+1-978-567-9610/+1-978-293-3923	www.mornsunamerica.com		N/A	N/A	\$0	100%	N/A	2000+	Y
Phihong	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
Phoenix Contact	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
RECOM	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
Schaffner	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
Texas Instruments	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
TDK Lambda	Mouser Electronics	800-346-6873	www.mouser.com	Y	405	N/A	\$0	80.00%	N/A	N/A	Y
TRACO Power	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
Vicor	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
TRACO Power	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
<b>REED SWITCHES</b>											
HSI Sensing	HSI Sensing	405-224-4046	www.hsisensing.com	M	75	N/A	\$200	100.00%	15	275	N
<b>SENSORS</b>											
ams	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
Analog Devices Inc.	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
Bosch	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
Honeywell Sensing and Control	Mouser Electronics	800-346-6873	www.mouser.com	Y	12,059	N/A	\$0	64.00%	50	1,000+	Y
Littelfuse	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
Maxim Integrated	Mouser Electronics	800-346-6873	www.mouser.com	Y	1,379	N/A	\$0	45.00%	50	1,000+	Y
Melexis	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
Microchip	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
NXP	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
ON Semiconductor	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
Omron	Mouser Electronics	800-346-6873	www.mouser.com	Y	4,915	N/A	\$0	59.00%	50	1,000+	Y
Sensirion	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
STMicroelectronics	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
TDK	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
TE Connectivity	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
Texas Instruments	Mouser Electronics	800-346-6873	www.mouser.com	Y	914	N/A	\$0	65.00%	50	1,000+	Y
<b>SWITCHES &amp; KEYBOARDS</b>											
OTTO	ECCO	773-767-2200	www.eccoconnectors.com	Y	N/A	N/A	N/A	N/A	N/A	N/A	N/A
<b>TEST &amp; MEASUREMENT</b>											
B&K Precision	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
Fluke	Mouser Electronics	800-346-6873	www.mouser.com	Y	1,008	N/A	\$0	94.00%	50	1,000+	Y
Keysight	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
Lascar Electronics		814-835-0621	www.lascarelectronics.com	Y	130	\$602,000	\$0	100%	10	175	Y
Tektronix	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
Teledyne LeCroy	Mouser Electronics	800-346-6873	www.mouser.com	Y	194	N/A	\$0	96.00%	50	1,000+	Y

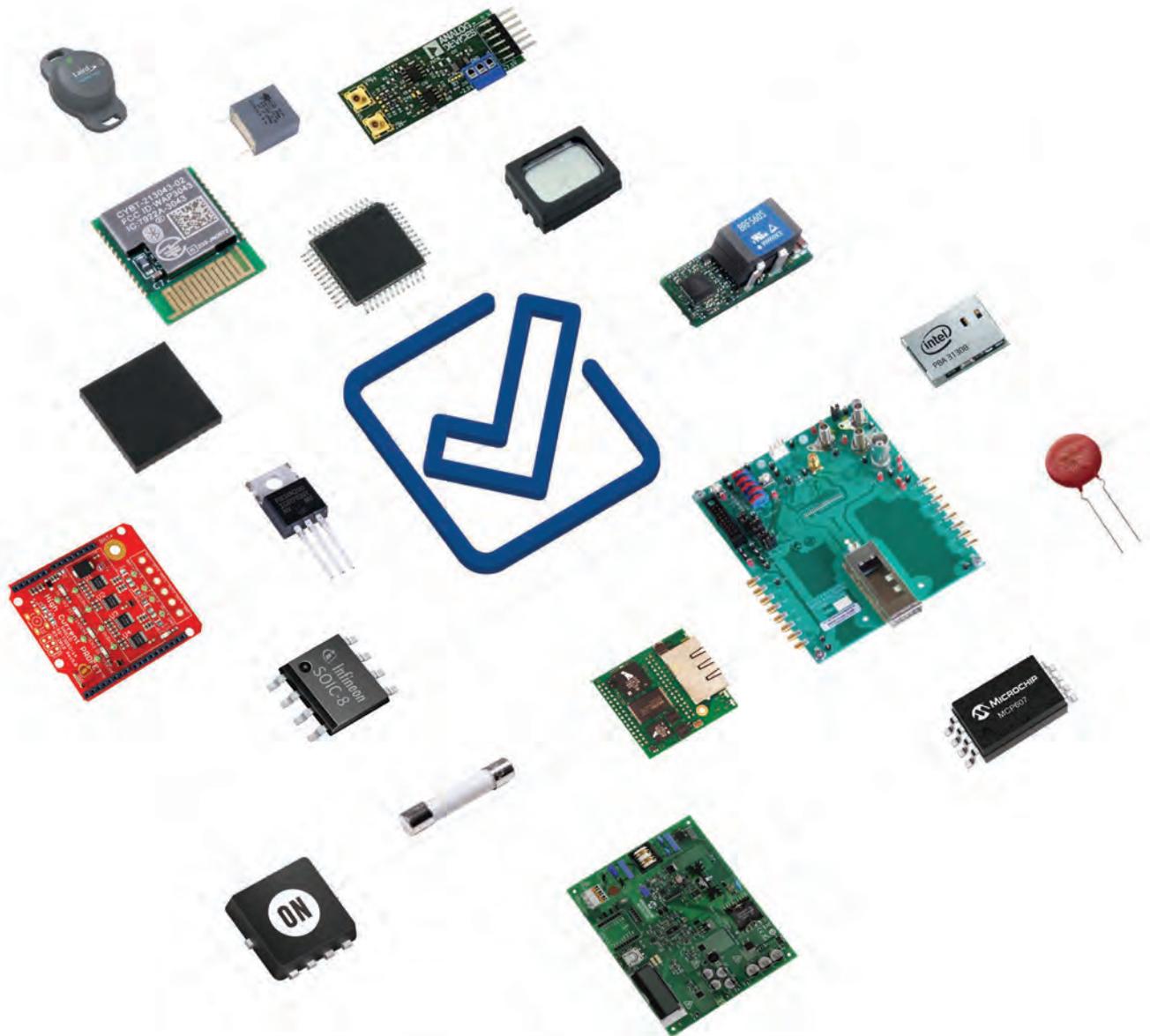
## Contract Manufacturers Buyers' Guide

Manufacturer	Telephone	Website	Turnover	Location	Employees	Number of Surface Mount Lines	Approvals	BGA Capacity	Lead-Free Manufacturer	Prototyping	Design Capability	Full Turnkey	Cables and Harnessing
Pektron	1-248-677-4838	www.pektron.com	\$66m	Michigan & UK	350	8	ISO9001, ISO14001, TS16949, BEAB, VCA, TUV, UL	Y	Y	Y	Y	Y	Y

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# We thank our Partners for the continued support throughout 2020 & 2021



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Rutronik keeps growing in North America! Join the team and become part of Rutronik in USA! We are expanding our team, come join us in the following positions:



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Midwest, East Coast, West Coast, Florida, Texas

## Field Application Engineer

Midwest, East Coast, West Coast, Florida, Texas

## Internal Sales Assistant

Texas, Florida

## Material Manager

Texas, Florida