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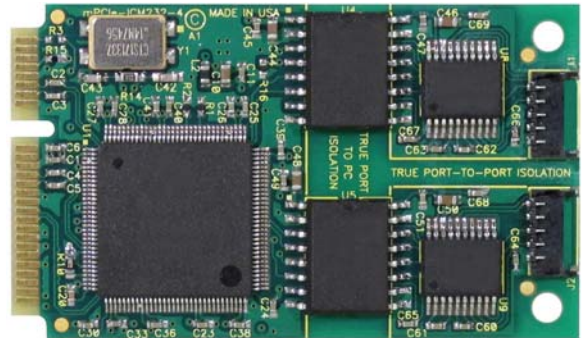
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The idea for Front Panel Designer came from the realization that many engineers designing electronic products face a similar challenge sourcing small runs of custom front panels. Front Panel Express operates with a CAD/CAM system adapted to the production of front panels, which allows Front Panel Designer files to be quickly and efficiently transferred to CNC milling machines. From the customer's perspective, the four-step customization process is as easy as downloading Front Panel Designer, designing the front panel to the required specifications, submitting the order through the integrated order program, and receiving the finished product within the chosen production time.

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## Editorial

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Content Director

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# Catch Up with Today's Leaders

**W**elcome to our annual Leaders issue—an issue dedicated to profiling some of today's industry visionaries, trailblazers, and sources of inspiration across various engineering disciplines. This special issue was created specifically for key trade shows. After all, industry events are where we connect with current, former, and new customers, as well as forging partnerships and sharing ideas. We also win new business, which prompts us to drive our designs and products to reach new heights in performance, cost, and more.

Such communications and connections are extremely crucial these days, as applications, technologies, and products evolve so quickly. Forecasts and plans have to be made on shorter cycles or updated often, as the business environment is extremely dynamic. For project managers and those up the chain, this means that they have to have an overriding longer-range vision, but be ready to adapt it in the near term at any time.

The individuals and companies profiled in this issue chose to share their current visions. Think of this as a time capsule that shows today's driving trends, applications, products, technologies, and design challenges. Right now, for example, the engineering world is putting a lot of focus on areas like 3D printing, automobiles, medical innovations, and the Internet of Things (IoT)—along with its Industrial Internet of Things (IIoT) offshoot. What is the IoT? Think of billions of sensors collecting information and then transmitting it, leading to improvements in manufacturing, smart cities and homes, and much more.

As exciting as the IoT is in terms of opportunities, however, it raises some challenges and concerns. For example, how will we handle so much data? How will we secure it? What infrastructure do we need to support it? The companies leading IoT efforts are already figuring out the answers to some of these questions, and some of their leaders are profiled here. Like them, all of today's leaders face a profound challenge: enabling new technologies, innovations, and approaches in today's rapidly changing market while being sure to carry on a company's legacy and build on its greatness. 

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## 2015 ENGINEERING

# SALARY SURVEY



## It's Not All About the Money


**A**ccording to the nearly 3,000 electrical engineers that participated in *Electronic Design's* 2015 Salary and Opinion Survey, the engineering profession is in a period of transition. On the one hand, companies are still in the process of recovering from the economic recession and risk-averse corporate culture. On the other hand, the Internet of Things (IoT) is slowly maturing into a reality for technology companies and igniting demand—and competition—for engineering expertise.

With priorities shifting out of cost management and into developing new technologies for an IoT ecosystem, the employment outlook for engineers improved slightly over the last year. In general, companies are increasingly motivated to hire experienced engineers and provide slightly higher compensation to keep them. But at the same time, concerns about working conditions, job security, outsourcing, and continuing education have grown more entrenched in the psyche of the typical engineer.

The majority of engineers anticipate that their companies will either maintain or increase hiring next year. But approximately 51% of respondents—a percentage that has been steadily rising over the last five years—noted that their companies were having difficulty finding qualified candidates, especially in embedded and software design. “Extreme specialization in engineering makes job mobility difficult on the technical path,” said one respondent, “and many employers seem to be unwilling to hire or train people who are merely close enough. The glut of engineers seeking work allows employers to be extremely choosy in hiring candidates.”

According to this year's survey, almost two-thirds of engineers think a career in engineering and the potential for salary advancement is as promising as it was five years ago. In terms of total compensation, engineers reported an average compensation of \$108,560, with bonuses and other incentives included, in 2015. (In contrast, the average compensation was \$103,680 in 2010 and \$106,482 in 2014).

Even though many respondents are concerned that compensation is not keeping pace with workflow, almost two-thirds of engineers felt that they were adequately compensated for their work this year. At the same time, in contrast to questions about compensation, the vast majority of engineers reported that they feel satisfied and intellectually challenged in their current positions.

In general, the engineering profession appears to be moving in a positive direction. However, many engineers may have to adjust their opinions slightly to what constitutes a positive employment outlook, especially as the industry becomes more ingrained in the global economy. The U.S. Labor Department Bureau of Labor Statistics (BLS) predicts that electrical and electronics engineers will have around 318,700 jobs in 2022—almost 50,000 more than in 2014, but also about 17,000 fewer jobs than the bureau recorded in 2013. Perhaps most importantly, many engineers remain satisfied with a profession that affords them the opportunity to get paid for indulging in their passions. 

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JAMES MORRA, associate content producer at *Electronic Design*, wrote this report. Data conducted and compiled by Jay McSherry.

(continued on p. 12)

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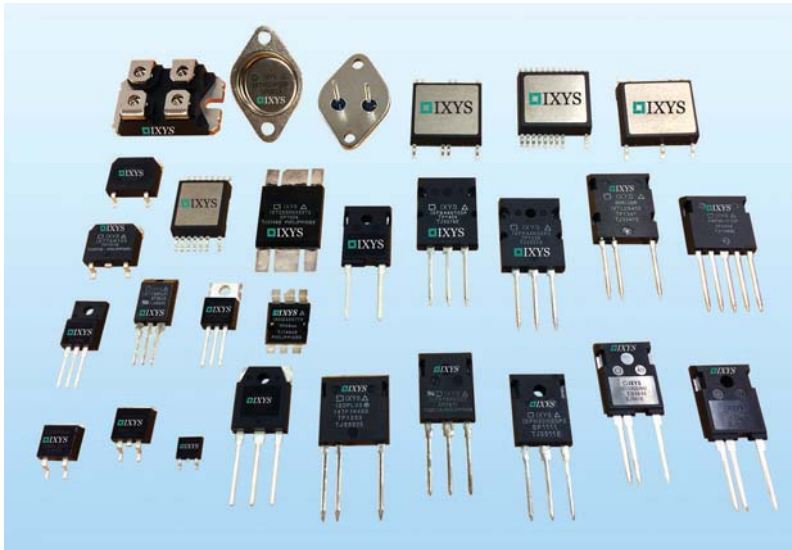
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A complete line of power modules and accessories satisfy a wide variety of avionics, military, high-reliability COTS, and space application requirements. Products include: DC-DC converters from 1 – 250 Watts, point of load converters from 3 – 20 Amps, EMI filters, transient suppressors, inrush current limiters, bus converters and thermal pads.



VPT's VXR Series for rugged military and commercial avionics applications is epoxy encapsulated with dual-sided thermal conduction and features a wide input voltage range (9 to 60 VDC). The patent-pending integral epoxy encapsulated packaging is highly resistant to chemical, solvent, and salt environments and is fully compatible with high-volume manufacturing processes including wave solder, cleaning solvents, high-pressure sprays, and aqueous wash.

VPT also offers a range of DC-DC converters and accessories designed, tested, and proven for the challenging environment of space. The SVR Series products feature maximum levels of radiation hardening with a Total Ionizing Dose (TID) of 100 krad(Si) and SEE of 85 MeV-cm<sup>2</sup>/mg. VPT's SV Series of products for space feature maximum levels of radiation tolerance with a TID of 30 krad(Si) and SEE of 44 MeV-cm<sup>2</sup>/mg. Both families of space products are based on space-proven heritage designs and available qualified to MIL-PRF-38534 Class K.

Global customers of VPT include NASA, Lockheed Martin, Boeing, Raytheon, the United States Air Force, SpaceX, and Thales.

VPT is part of the HEICO Electronic Technologies Group (NYSE:HEI.A) (NYSE:HEI). More information can be found at [www.vptpower.com](http://www.vptpower.com).



# POWER YOUR CRITICAL MISSION

A Full Range of Proven DC-DC Power Converters, EMI Filters and Accessories



## Avionics & Military Features

- ✓ 1-120+ watts
- ✓ MIL-PRF-38534 Class H and Class K
- ✓ 100% hermetic
- ✓ -55°C to +125°C
- ✓ DLA SMDs available

## Hi-Rel COTS Features

- ✓ 5-250 watts
- ✓ Six-sided metal, potted, or fully encapsulated packaging
- ✓ Rugged environmental screening
- ✓ -55°C to +105°C

## Space Series

- ✓ 5-120+ watts
- ✓ Developed for TOR compliance
- ✓ TID: 100 krad (Si)
- ✓ SEE: 85 MeV
- ✓ -55°C to +125°C
- ✓ MIL-PRF-38534 Class H and Class K
- ✓ DLA SMDs available
- ✓ Engineering models typically ship from stock
- ✓ Other radiation levels and custom versions available

# VPT

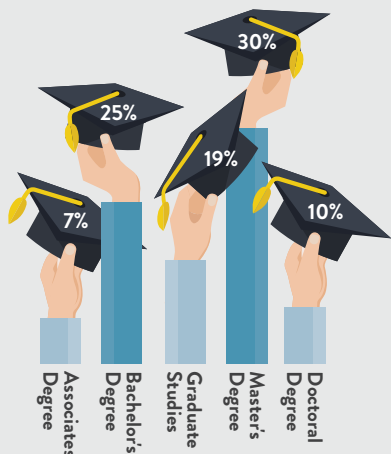
Power Your Critical Mission Today

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



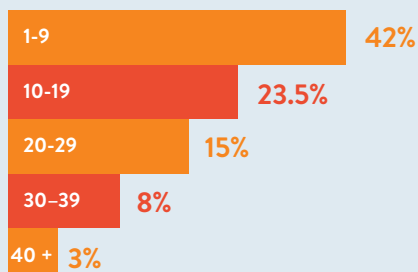
# THE TYPICAL ENGINEER

## Highest education level

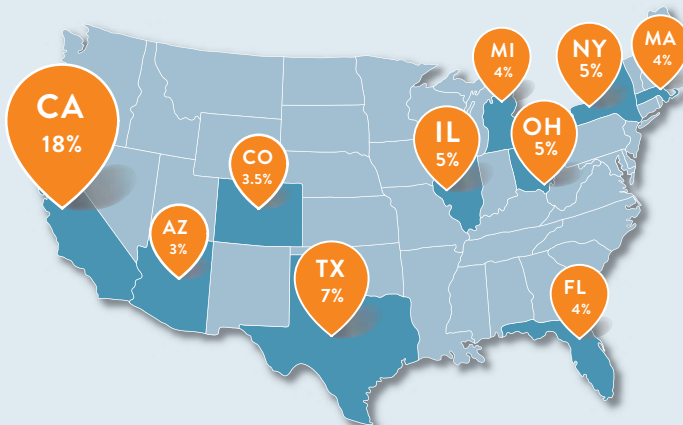


"To remain in the technical path, you have to be a life-long learner. Employers are looking for skills that a college education itself does not provide."

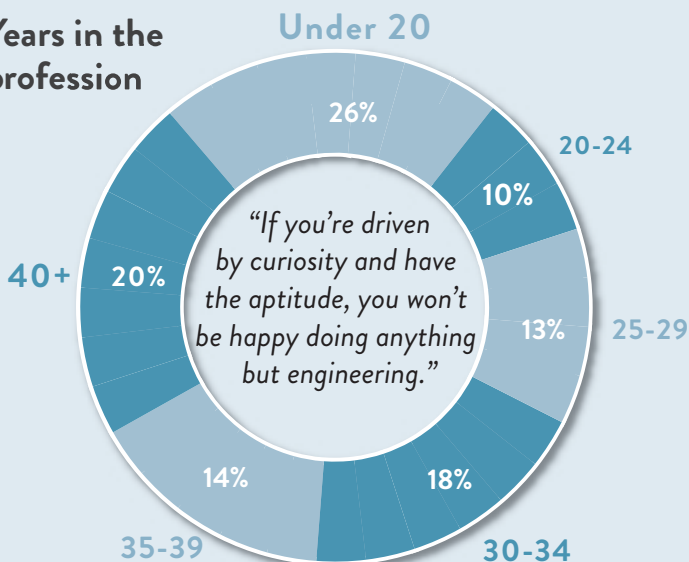
## Years at present company



## Work locations



## Years in the profession



"If you're driven by curiosity and have the aptitude, you won't be happy doing anything but engineering."

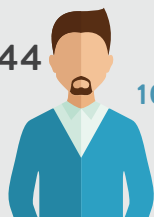
## Age

The typical engineer is growing older and edging closer to retirement age. "Engineers from the baby-boomer generation are retiring faster than engineers are graduating from college," lamented one respondent. Most engineers are of the opinion, however, that retiring engineers have not mitigated the intense competition for engineering expertise. At the same time, "new people are needed," said one respondent, "and a lot of technological opportunities exist."

25-34



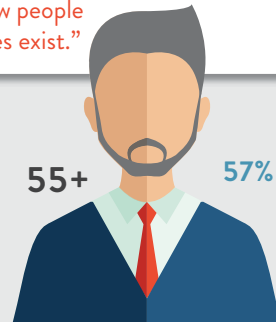
35-44



45-54



55+





## Average Compensation

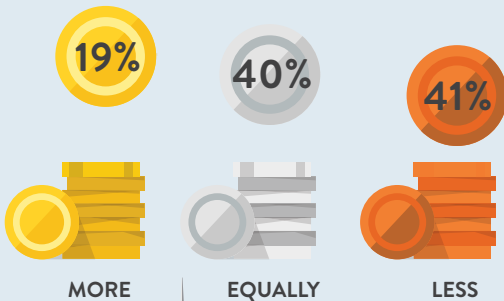
# 108,503

## Average compensation increase



## COMPENSATION

### How competitive is the average engineer's compensation?



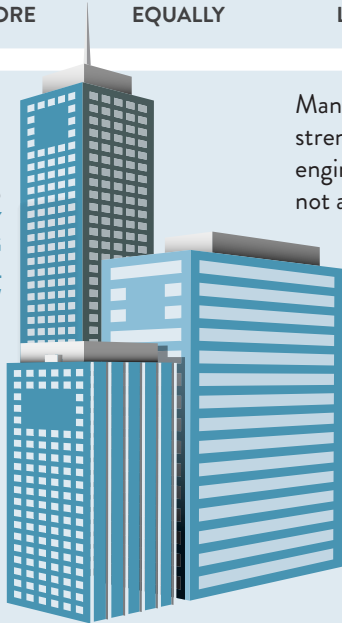
### Average bonus

Cash \$3,880  
 Stocks/options \$2,616  
 Other \$2,500

In general, engineering salaries have not changed significantly in recent years, with many engineers referring to a "glass ceiling" on compensation rates and downward pressure from cost-averse corporations and H-1B workers. While compensation varies widely based on geographic location and job function, the average compensation rate grew more from last year than it has in almost five years.

30%  
 SAY  
 HIRING  
 WILL  
 GROW

11%  
 SAY  
 HIRING  
 WILL  
 REDUCE



Many engineers are optimistic that technological advancements will strengthen demand for their expertise going forward. But many of the same engineers also think that they are increasingly viewed as "commodities" and not as "valued contributors," as one respondent noted.

## EMPLOYMENT OUTLOOK

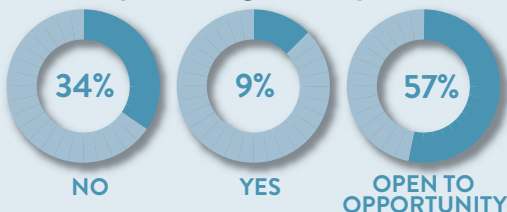
58%  
 SAY  
 HIRING  
 WILL  
 MAINTAIN

Is an engineering career as promising today as it was five years ago?

62%  
 SAY YES

"Things are better now than five years ago with the recession, but overall engineering careers have been on a downward trend for a while, in my opinion."

### Actively seeking a new position



### Is your organization more focused on employee retention this year?





## Ametherm Inc.

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EMAIL | [lori@ametherm.com](mailto:lori@ametherm.com) Carson City, NV 89701  
TEL | 800.808.2434  
FAX | 775.884.0670

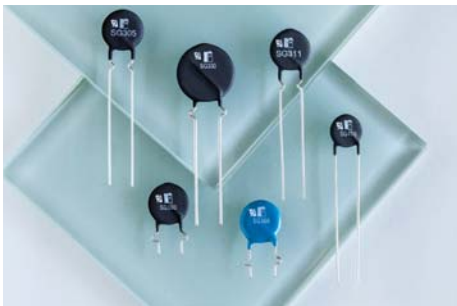
### A GLOBALLY RECOGNIZED INRUSH CURRENT LIMITER MANUFACTURER

is Celebrating 20 years of Success in 2014 while ranking as one of the Top 101 Components of *Electronic Design* Magazine, and receiving Carson City's Business of the Year Award, as well as Recognition of Economic Growth and Job Creation from the NNDA (Northern Nevada Development Authority).

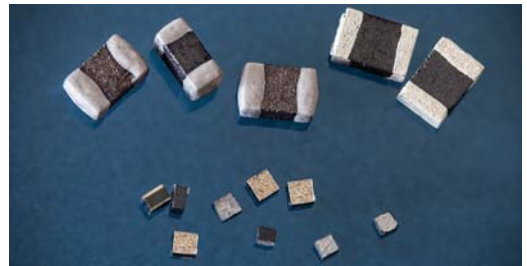
Since 1994, Ametherm has manufactured Inrush Current Limiters that have changed the industry, one innovation at a time. In its time, Ametherm has become known for producing some of the highest-rated circuit protection thermistors in the industry and providing the widest range of inrush current protection available from their Carson City, Nev., HQ for markets such as Power, Medical, Automotive, and Aerospace. Made in the U.S.A., Ametherm products are recognized by Underwriters Laboratories (UL) and the Canadian Standards Association (CSA International) for ensured safety, RoHS-2-certified, and are ISO 9001:2008 certified. The devices are optimized for a wide range of applications, including AC motors, power supplies, motor drives, audio amplifiers, battery chargers, air sensors, HVAC systems, high-speed computers, MRIs, and X-ray machines. At Ametherm, we keep our focus on Customer Service growing steadily as a company—recently acquiring the SG/NTC Chip & Disc line from Measurement Specialties (formerly RTIE) and expanding our facility to more than double our capacity, available to customers all over the U.S. and throughout Europe.

### ABOUT AMETHERM'S RECENTLY ACQUIRED SURGE-GARDS

**SURGE-GARDS ARE OPTIMIZED** for applications like power supplies, motor drives, HVAC motors, transformers, and amplifiers. Surge-Gards



are capable of handling steady-state currents to 36 A and input energy to 250 J. Available in multiple leaded package styles, the components offer resistance at +25 °C (R25) from 0.4 Ω to 220 Ω with tolerances down to ±10%, maximum operating voltage to 265 VRMS, and beta from 3000 °K to 3965 °K.



### NEW CHIP AND DISC THERMISTORS

**AN ALTERNATIVE TO** thermocouples in precision circuits, the NTC chip and disc thermistors deliver high stability and maximum sensitivity for temperature measurement, compensation, and control in applications such as fan motor controls, fluid levels, and temperature sensors. The NTC chip thermistors are available in a variety of compact sizes, while providing fast response times and high-temperature operation to +150 °C.

**AMETHERM**  
Circuit Protection Thermistors



# AMETHERM

## Circuit Protection Thermistors



### GET EXCEPTIONAL CIRCUIT PROTECTION

With the most highly-rated inrush current limiters supporting outputs from 50 to 7,500 watts and continuous currents from .25 to 50 AMPs

Free samples at [www.ametherm.com](http://www.ametherm.com)

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Protect your sensitive electronic components from damaging surge currents that can occur when electrical circuits are switched on. Ametherm's durable, highly-rated inrush current limiters are designed to effectively control damaging surges in a wide range of applications:

- AC motors
- Power supplies
- Motor drives
- Audio drives
- Battery chargers
- Air sensors
- HVAC systems
- High-Speed Computers
- MRIs
- X-ray machines
- Amplifiers



*Surge-Guards/  
Inrush Current  
Limiters*



*NTC Chip and  
Disc Thermistors*



*Probe Assembly*



*High Amp Inrush  
Current Limiters*



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[info@ametherm.com](mailto:info@ametherm.com)

## THE BERGQUIST COMPANY

A HENKEL COMPANY

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EMAIL | [janna.flemmer@henkel.com](mailto:janna.flemmer@henkel.com)

TEL | 800.347.4572

FAX | 952.835.0430

18930 W. 78th Street

Chanhassen, MN 55317

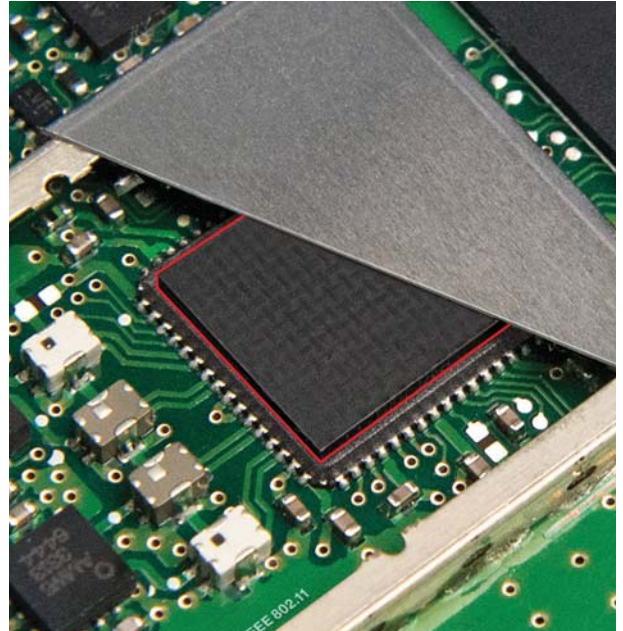
### THE BERGQUIST COMPANY IS NOW A PART OF HENKEL

Henkel's electronics portfolio includes the leading industry brands LOCTITE and TECHNOMELT, renowned for their reliable and high-performance materials. LOCTITE semiconductor and electronics assembly materials, BERGQUIST thermal management products, LOCTITE conductive inks and adhesives, conformal coatings, encapsulants, and solder materials all maintain the lead in the field through continuous, dedicated research and development.

With a global network of research facilities, manufacturing sites and strategic partnerships, Henkel brings customers the local support and global resources they need to ensure quick time-to-market introductions and long-term success. Henkel is directly represented in more than 80 countries, ensuring the delivery of consistent products no matter where you are. Our philosophy guarantees the responsiveness and flexibility of a focused specialist combined with the strength of one of the world's largest specialty chemical corporations.

### A WORLD LEADER IN THERMAL MANAGEMENT MATERIALS

Henkel uses high-quality BERGQUIST thermal management products—like BERGQUIST THERMAL CLAD, BERGQUIST SIL-PAD, and BERGQUIST GAP PAD—to offer technological solutions for electronics.



As a world-leading manufacturer with state-of-the-art facilities, we serve a multitude of industries worldwide including automotive, computer, consumer electronics, lighting/LED, solar, military, motor control, power conversion, telecommunications, and more. We make it our business to know your business. We work closely with our customers to understand their problems and deliver technologically advanced solutions backed by exceptional service. BERGQUIST has developed over 260 materials that provide thermal solutions for a wide variety of applications. Many of our products were originally developed to satisfy a customer request for a specific material designed to perform to their particular specifications. This “can do” attitude and customized technology has earned The Bergquist Company, a Henkel Company, its ISO 9001:2008 certification.



# BERGQUIST



## With Bergquist Liquid Solutions, The Path You Take Is Yours.

### Bergquist Highly Engineered Liquids Give You Complete Flexibility Over The Design And Delivery Of Your Thermal Solutions.

#### **Bergquist's full line of liquid polymers make it easy to customize your material, pattern, volume and speed.**

Bergquist's advanced liquids are specifically designed to support optimized dispensing control with excellent thermal conductivity. Dispensed in a liquid state the material creates virtually zero stress on components. It can be used to interface and conform to the most intricate topographies and multi-level surfaces. They are thixotropic in nature, helping the material to remain in place after dispensing and prior to cure. Unlike pre-cured materials, the liquid approach offers infinite thickness options and eliminates the need for specific pad thicknesses for individual applications.



*Whether automated or hand dispensed, Bergquist liquid materials have natural tack and precisely flow into position for a clean final assembly with little or no stress on components.*



#### **Less stress, reduced application time with minimal waste.**

Either manual, semi-automatic or automated dispensing equipment offers precise placement resulting in effective use of material with minimal waste. Boost your high volume dispensing needs by capitalizing on our expertise. Bergquist can help customers optimize their delivery process through its unique alignment with several experienced dispensing equipment suppliers.

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Call **1.800.347.4572** or visit [www.bergquistcompany.com/liquiddispense](http://www.bergquistcompany.com/liquiddispense)

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Thermal Materials • Thermal Substrates • Fans and Blowers





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EMAIL | [info@calramic.com](mailto:info@calramic.com) FAX | 775.851.3582 Reno, Nv. 89511

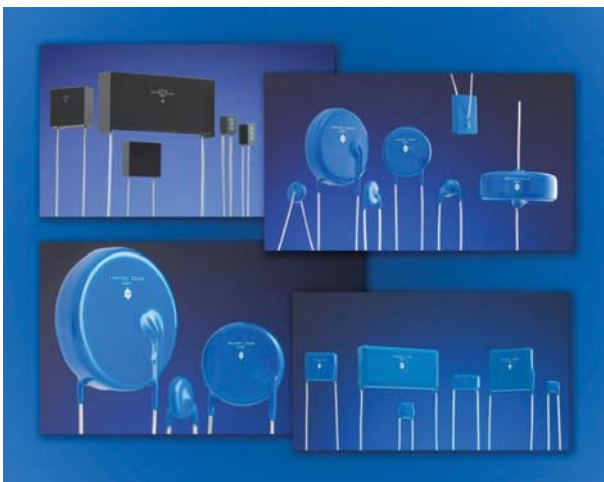
### HIGH-VOLTAGE CERAMIC CAPACITORS FOR VARIOUS APPLICATIONS

**CALRAMIC TECHNOLOGIES LLC** offers a variety of high-voltage ceramic capacitors for multiple applications depending on your needs. We are a U.S.-based fully equipped manufacturing facility with Lean manufacturing strategies to facilitate high-quality ceramic capacitors. We can offer same-day shipping if in stock, and deliveries of 6-8 weeks depending on the product type. Custom products and builds are welcome. Radial-leaded, surface-mount, and disc capacitors for all applications are available. High-quality materials provide superior capacitor reliability and performance. In addition, as an ISO 9001-certified company, stringent manufacturing principles are followed for year-after-year reliability. Applications range from below-ground analytical tools for geothermal/geophysical to above-ground commercial, and military power supplies, medical power supplies, and X-ray systems. High-reliability capacitors are our specialty for various non-repairable applications such as spacecraft and buried systems.

**A VARIETY OF** thru-hole, radial, and axial-leaded products, multilayer, and disc, 500 Vdc to 20,000 kVdc+, over the temperature ranges of  $-55^{\circ}\text{C}$  to  $200^{\circ}\text{C}$ . We offer custom designs and derivatives of sizes and dielectrics. Custom sizes and dielectrics are available. Please contact our factory with your needs.



**SURFACE-MOUNT, BARE** ceramic capacitors are available in a variety of sizes from our catalog for voltage ranges from 500 Vdc to 20,000+ kVdc. Temperature ranges from  $-55^{\circ}\text{C}$  to  $200^{\circ}\text{C}$  are available. Please contact our factory with your needs and requirements.



# High Voltage Multilayer

X7R & NPO

## High Voltage Disc

X5R, X7R, X5U, Z5U | NPO, N750 – N5600

HV Multilayer Radial  
Leaded 500V – 10-KV



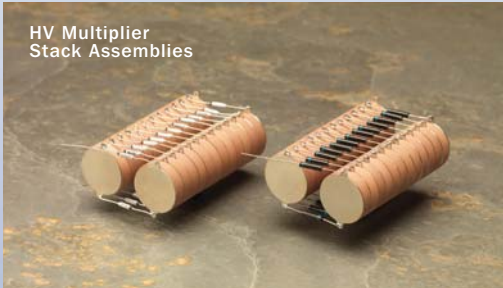
HV Surface Mount  
500V – 10KV



HV Disc Radial Leaded  
3KV – 20KV



HV Multiplier  
Stack Assemblies



### SPACE LEVEL MILITARY COMMERCIAL INDUSTRIAL APPLICATIONS

Power Supplies and  
Test Equipment

X-Ray: Human & Veterinary

Electrostatic Paint Spray

Deep Space Probes

Analytical Equipment

Communication Satellites

TWTA

LOE Geosynchronous

Military Aircraft Based  
Radar Displays

Night Vision Flight Control

Engine Control

Military Based  
Radar Displays

Ground Based  
Surveillance

Night Vision



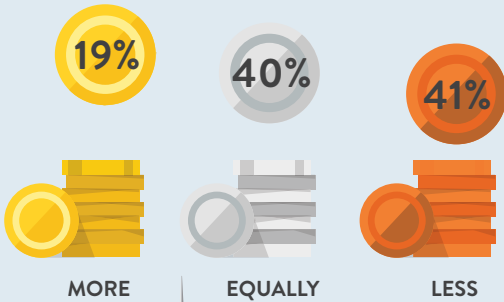
**Average Compensation**  
\$ **108,503**

**Average compensation increase**



## COMPENSATION

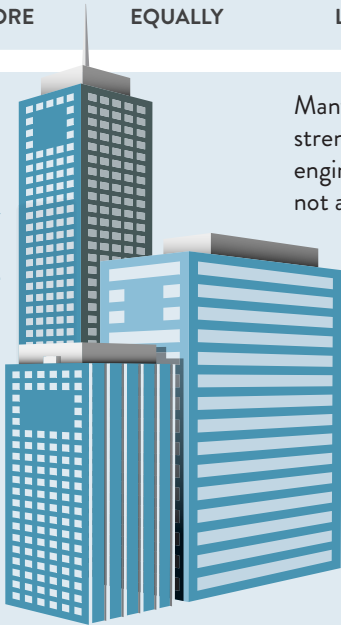
**How competitive is the average engineer's compensation?**



In general, engineering salaries have not changed significantly in recent years, with many engineers referring to a “glass ceiling” on compensation rates and downward pressure from cost-averse corporations and H-1B workers. While compensation varies widely based on geographic location and job function, the average compensation rate grew more from last year than it has in almost five years.

**30%**  
 SAY  
 HIRING  
 WILL  
 GROW

**11%**  
 SAY  
 HIRING  
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 REDUCE



Many engineers are optimistic that technological advancements will strengthen demand for their expertise going forward. But many of the same engineers also think that they are increasingly viewed as “commodities” and not as “valued contributors,” as one respondent noted.

## EMPLOYMENT OUTLOOK

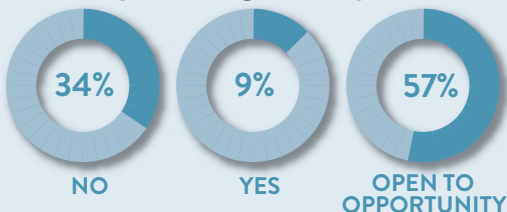
**58%**  
 SAY  
 HIRING  
 WILL  
 MAINTAIN

Is an engineering career as promising today as it was five years ago?

**62%**  
 SAY YES

“Things are better now than five years ago with the recession, but overall engineering careers have been on a downward trend for a while, in my opinion.”

**Actively seeking a new position**



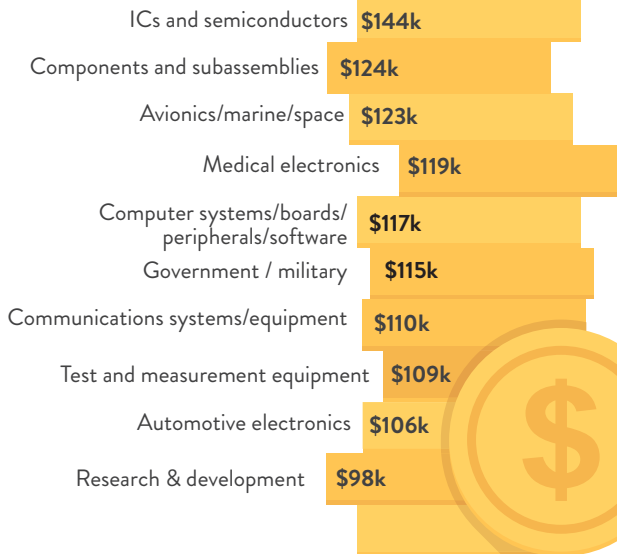
**Is your organization more focused on employee retention this year?**



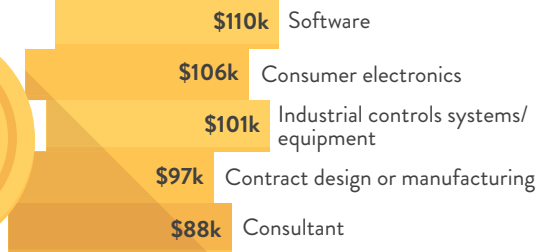
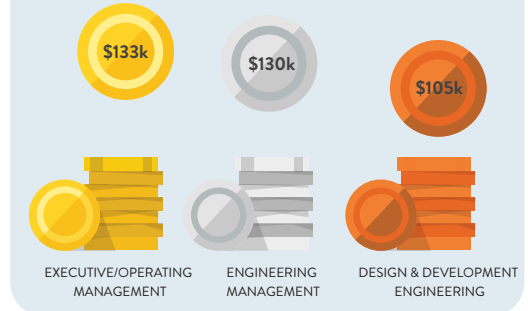


# COMPENSATION BREAKDOWN

## By industry



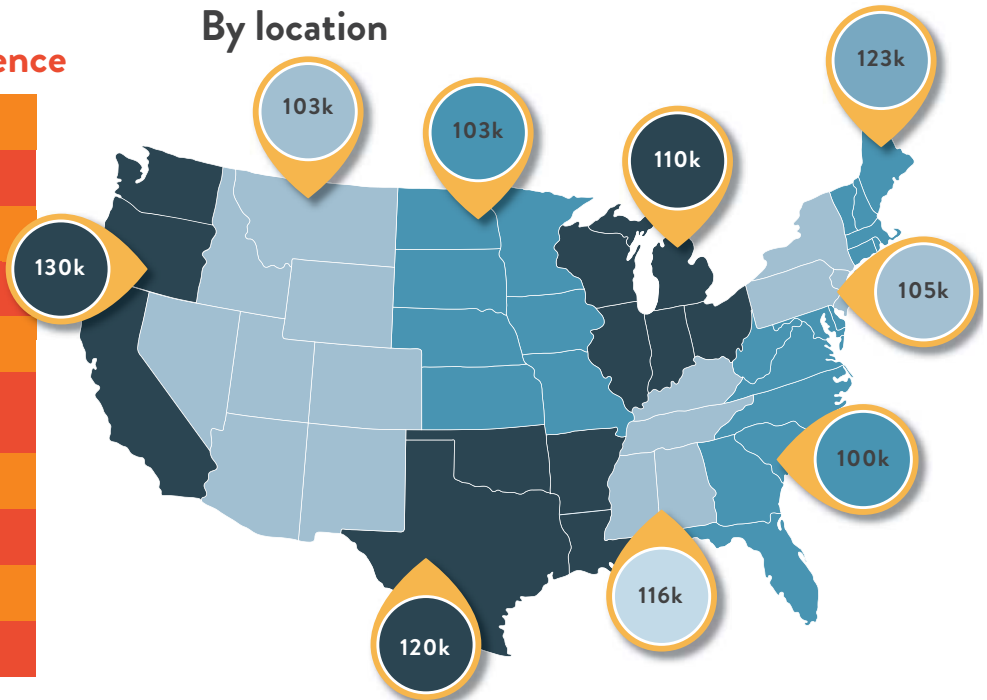
## By job function



## By years of engineering experience

35-39 years	\$123,212
25-29 years	\$116,623
30-34 years	\$115,780
20-24 years	\$112,053
15-19 years	\$105,917
40 years or more	\$105,766
10-14 years	\$90,093
5-9 years	\$84,754
1-4 years	\$68,100
Less than 1 year	\$60,389

## By location



(continued on p. 26)

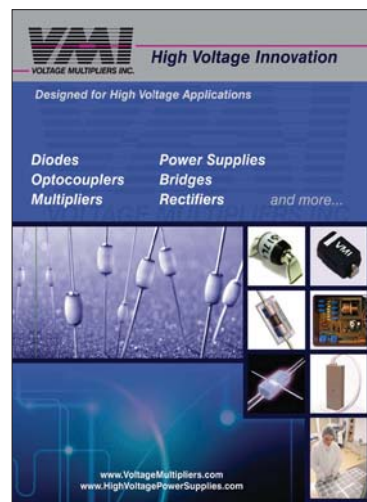
## VOLTAGE MULTIPLIERS INC.

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EMAIL | [kspano@voltagemultipliers.com](mailto:kspano@voltagemultipliers.com) Visalia, CA 93291 USA  
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### VOLTAGE MULTIPLIERS INC. — YOUR HIGH-VOLTAGE EXPERTS!

Look no further for high-voltage components. Voltage Multipliers Inc. manufactures a full line of high-voltage diodes and assemblies ranging from discrete components to complex power supplies.

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- Rectifiers—2kV to 40kV and 500mA to 2.2A in 100ns to 3000ns reverse recovery times.
- Optocouplers—2.5kV to 25kV optocouplers featuring different gains and long-term gain stability in several package styles.
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- Power Supplies—125kV 250W for portable X-ray applications, CRT displays, and HeNe lasers.



### VMI IS YOUR SOLUTION FOR HIGH-VOLTAGE PROBLEMS

**OUR TRACK RECORD** speaks for itself. We work hard to find solutions to our customers' toughest high-voltage problems. We pride ourselves on exemplary customer service and our ability to work with our customers, every step of the way. From project conception through high-volume production, our engineers are in the arena with you. You won't find better engineering or customer service.

Electrical specifications aside, custom power-supply options include multiple or single outputs, custom housings, precision outputs, signal input and output monitoring, and more. Your imagination is the limit!

VMI was established in 1980, 35 years ago. Originally, we manufactured high-voltage multipliers for applications like cockpit CRT displays and analog oscilloscopes. Times have changed, and so have we. When a worldwide shortage of high-voltage diodes occurred—parts that were critical to our products—we responded by developing in-house capabilities. We've continued to grow since then. Our area of high-voltage expertise now includes high-voltage assembly and power supply designs.

CalRamic LLC, VMI's sister company, manufactures high-voltage ceramic capacitors.

#### We know high voltage.

VMI is ISO9001:2008 certified. We've earned DSCC's award of Lab Suitability, and we're a member IPC.





# High Voltage Innovation

*Designed for High Voltage Applications*

**Diodes**

**Optocouplers**

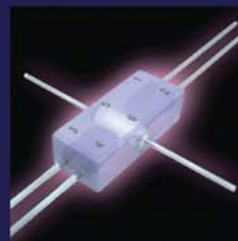
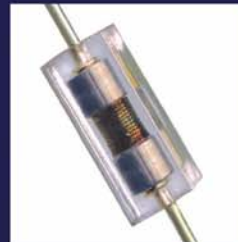
**Multipliers**

**Power Supplies**

**Bridges**

**Rectifiers**

*and more...*



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TEL | 800.275.4899

20050 SW 112th Avenue  
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### A GLOBAL PARTNER DEDICATED TO YOUR SUCCESS

CUI is a technology company focused on the development and distribution of electronic components. At the leading edge of power supply design, we support customers as they strive to improve the energy efficiency and environmental credentials of their application. Our power group is complemented by a portfolio of world-class board-level components, consisting of interconnect, sound, motion control, and thermal products. An unwavering commitment to create collaborative partnerships with customers and a drive to see that their design project is a success has been a hallmark of CUI's sustained growth since its founding in 1989. As a leader in the industry, CUI will continue to invest in the future through new technologies, talented employees, expanded manufacturing capabilities, and a growing global reach.



### YOUR POWER EXPERT

**AS A LEADER** in the power supply industry, we realize that power is playing an increasingly critical role in your designs. We also know that it can be difficult to stay current on the latest power trends and regulations. To keep you one step ahead, we seek to integrate cutting-edge technologies and design techniques in our ac-dc and dc-dc power modules ranging from 1 W to 12,000 W. Combined with robust custom power engineering capabilities, our mission is to be the trusted power expert for your most demanding applications, now and in the future.



### FOCUSING ON EFFICIENCY

**TO HELP OUR CUSTOMERS** stay ahead of the continuously evolving global regulations, we have set out to push the Level VI energy efficiency initiative across our entire power portfolio. By continually monitoring the latest energy efficiency regulations, we ensure that not only our products, but our customers' products are in compliance in each region where they are sold.



# The power to \_\_\_\_\_.



## HEAL



## DELIVER



## CONNECT



## BUILD

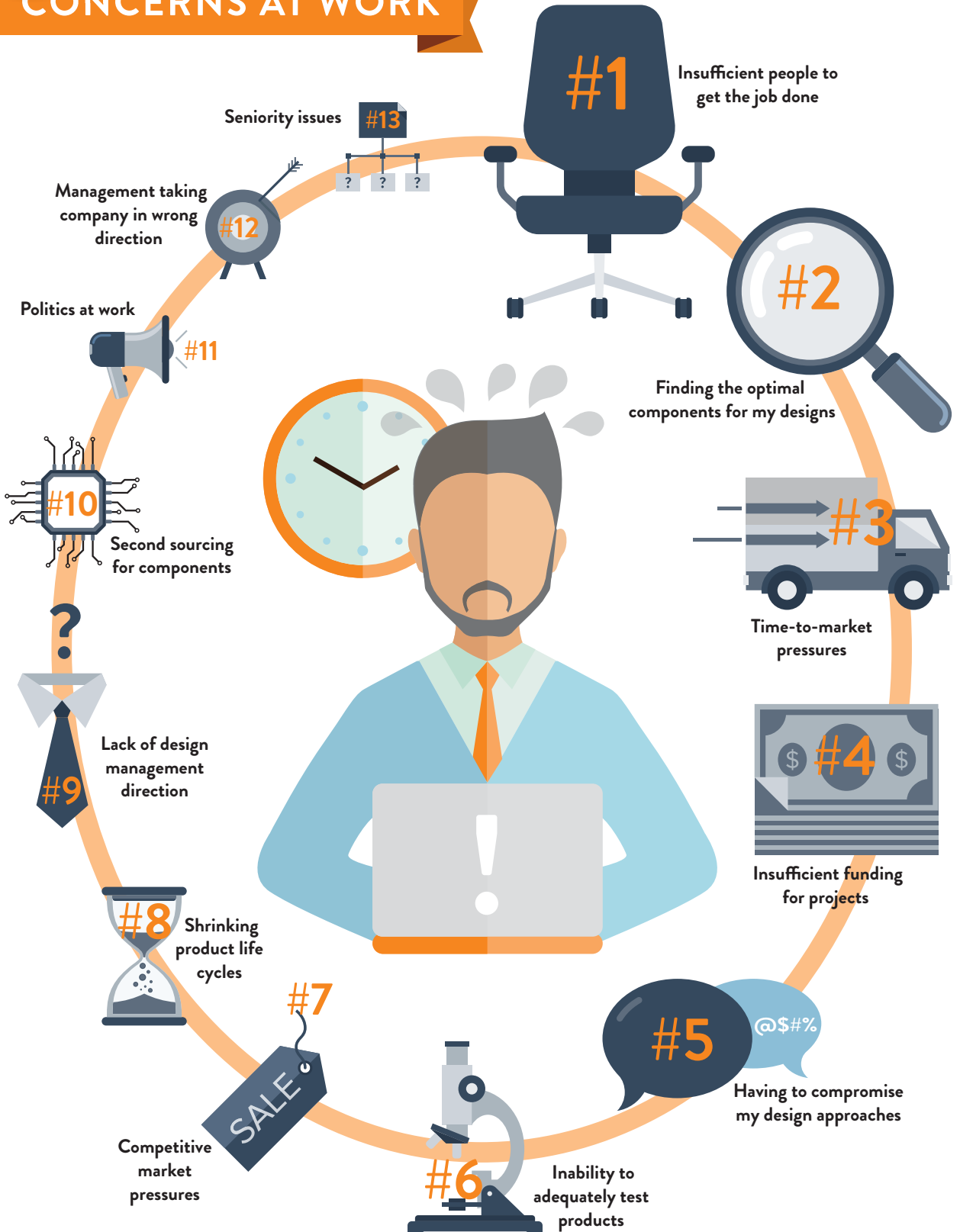
## The power of things.

Technology is transforming the world around us at a rapid pace. While you are designing the products that will save lives and bring global communities together, we are developing the power systems to support your most demanding applications. Our power expertise and collaborative approach are in place to support you while you shape the future of technology.



[www.cui.com/power-of-things](http://www.cui.com/power-of-things)

# CONCERNS AT WORK





# JOB SATISFACTION



The majority of engineers work for long hours under significant pressure from employers, but rarely view their compensation as the spoils of war. On the contrary, most engineers are satisfied with their personal circumstances, feel sufficiently challenged in their current position, and believe they are adequately compensated. “Engineering is a career where you get out of it exactly what you put into it,” opined one respondent.

The average engineer works **54 hrs/week** at the office and at home and other locations

Reasons engineers would leave the profession	
No further chance for advancement	16%
Do something less stressful	22%
Do something more fulfilling	23%
Curious about other opportunities	31%
Start a business	22%
Switch to teaching	12%
Ready to retire	19%

**64%**

Feel adequately compensated



Feel compensation should increase on average by

**21%**

Job Satisfaction	
Extremely satisfied	21%
Very satisfied	32%
Satisfied	35%
Not very satisfied	10%
Not at all satisfied	2%
Have considered leaving the profession	34%

“Engineering has lost a lot of its passion as evidenced by the lack of commitment engineers are making to their employers, due to the lack of commitment from the employers themselves.”

## Most important factors in job satisfaction

1. Challenges that accompany the design of new products
2. Researching potential design solutions
3. Opportunity to design products that can benefit society
4. The compensation you receive for the work you do
5. Working in team situations with peers
6. Working independently of others
7. The recognition you get from others for the work you do
8. The pressures associated with solving design problems



### ENGINEERS TALKING FROM THE PULPIT

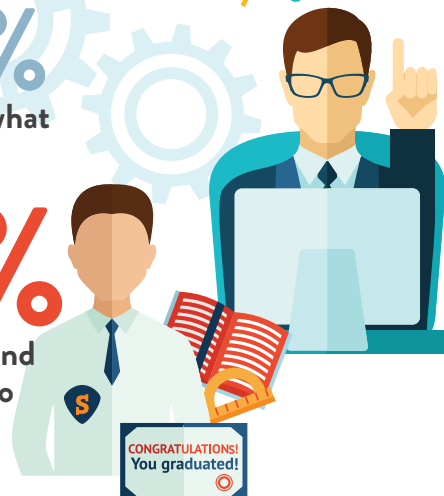
“My career has offered me great flexibility personally and professionally—this is somewhat dependent on the company you work for, but the pay is good, and the challenge of solving tough problems is very rewarding.”

“An engineering profession, if done properly, can keep you mentally sharp, diversifies your skills, and keeps you abreast of technological advancements. Engineers are likely to be well suited to move into many new professions, if their motivations drift in other directions.”

**58%** feel sufficiently challenged

**32%** feel somewhat challenged

**89%** would recommend the profession to a young person



(continued on p. 34)



## PEARSON ELECTRONICS

WEB | [pearsonelectronics.com](http://pearsonelectronics.com)

TEL | +1.650.494.6444

### A TRUE LEADER IN THE ELECTRONICS INDUSTRY

**PEARSON ELECTRONICS IS** the original and leading manufacturer for precision current-monitoring transformers used for accurate AC current measurements. The company was founded in 1955 by Dr. Paul Pearson, inventor and patent holder, of the precision wide-band current transformer. The Pearson design plus careful workmanship and quality control produce current monitors with excellent frequency response and amplitude accuracy. Originally developed for measuring pulse-currents, Pearson Current Monitors™ are now also widely used to measure more complicated transients and periodic signals from a few Hertz to well into the megahertz region.

Pearson precision wide-band current transformers can measure pulse, harmonic, transient, sine-wave, EMI and other complex current wave shapes. The current range is from micro-amps to mega-amps and we manufacture both toroid and clamp-on current transformers. We stock a large variety of models for immediate delivery and design and manufacture for both OEM and custom requirements. Pearson Electronics also specializes in the design of High Voltage Pulse Transformers that are used with high power microwave tubes and Capacitive Voltage Dividers.

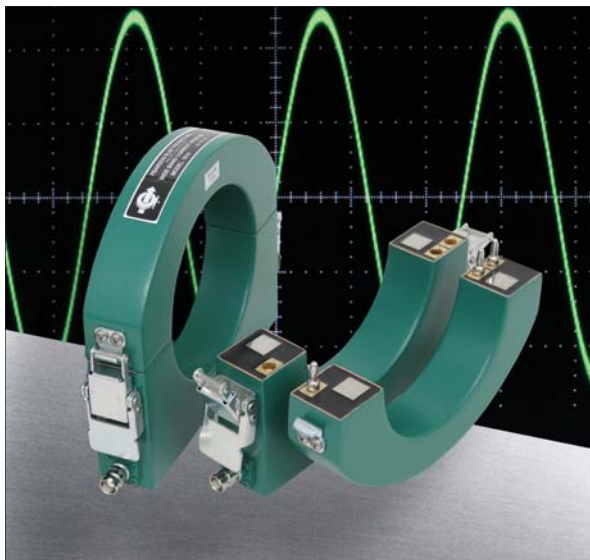
### APPLICATIONS

**WHETHER YOU ARE** interested in observing and measuring submilliamp currents in a charged particle beam or thousands of amps resulting from a fault in a major power feeder, you will find a Pearson Current Monitor to suit your needs. The Power Industry uses Pearson Current Transformers to measure

transients in switching gear and the observation of harmonics and phase relationships on power lines. The testing of circuit breakers for power protection is also a typical application. Pearson Electronics enjoys close relationships with most of the power analyzer manufacturers and provides current transformers for use with their equipment.

Applications in the aerospace industry include measuring pulse currents in modulators for radar equipment, 400 Hz measurements for FAA commercial aviation approval, RF currents in radio transmitters, measuring surge currents and transients for lightning strike analysis, and the appropriate EMI tests to meet EMC standards. The medical equipment industry, particle accelerator community, plasma research, and anyone that needs to have a precise and accurate measurement of AC current could use a Pearson Current Monitor.

The Pearson Electronics Quality System conforms to MIL-I-45208A and AS9003. We offer calibration services traceable to NIST for our current transformer that conforms to ANSI/NCSL Z540-, MIL-STD-45662A and ISO 17025.

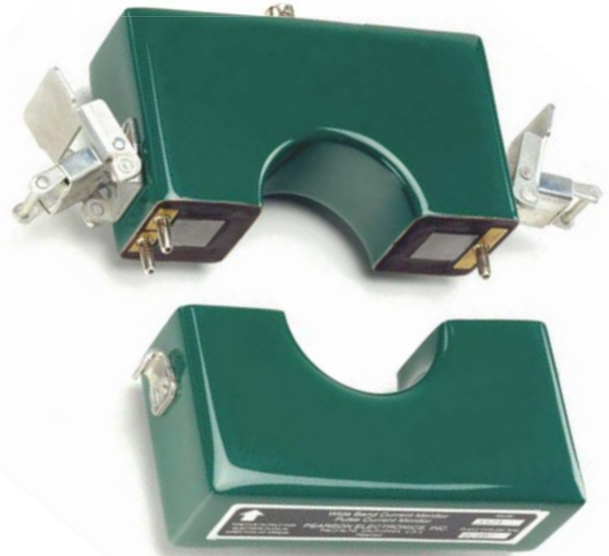


# WIDE-BAND CURRENT PROBES

Precision Wide-Band Current Transformers for accurate and precise measurements of AC currents.

- Pulse, harmonic, transient, sine-wave, EMI, surge, and other complex current wave shapes
- 3dB bandwidth 1Hz - 20MHz
- 1% accuracy across the mid-band
- Frequencies up to 350MHz
- Faithful output of the waveform
- Minimum current of  $80\mu\text{A}$
- Pulse currents up to 1 MA

Since 1955, Pearson Electronics has manufactured and stocked a wide selection of current probes for OEM and Custom Applications, available in Clamp-on and Toroid packages.



**Pearson**  
ELECTRONICS



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

PHONE: +1 (650) 494-6444  
HOURS: 8AM ~ 5PM PACIFIC TIME



## ADLINK TECHNOLOGY

WEB | [adlinktech.com](http://adlinktech.com)

EMAIL | [info@adlinktech.com](mailto:info@adlinktech.com)

TEL | 800.966.5200

FAX | 408.360.0222

5215 Hellyer Avenue, #110  
San Jose, CA 95138

### BUILD YOUR INDUSTRIAL IoT WITH ADLINK TECHNOLOGY

ADLINK Technology is enabling the Internet of Things (IoT) with industry-specific platforms, intelligent gateways, embedded building blocks, and remote device management and cloud-based data acquisition services. ADLINK's products are application-ready for industrial automation, communications, medical, defense, transportation, and infotainment industries. Our product range includes mother-boards, blades, chassis, modules, systems, and platforms based on industry-standard form factors, as well as an extensive line of test & measurement products and smart-touch computers, displays, and handhelds that support the global transition to always-connected systems. Many products are Extreme Rugged, supporting extended temperature ranges, shock, and vibration.

ADLINK is a global company with headquarters in Taiwan and manufacturing in Taiwan and China; R&D and integration in Taiwan, China, the U.S., and Germany; and an extensive network of worldwide sales and support offices. ADLINK is ISO-9001, ISO-14001, ISO-13485, and TL9000 certified and is publicly traded on the TAIEX Taiwan Stock Exchange (stock code: 6166).

#### STANDARDS LEADERS

ADLINK is a Premier Member of the Intel Internet of Things Solutions Alliance and is active in several standards organizations, including PCI Industrial Computer Manufacturers Group (PICMG), PXI Systems Alliance (PXISA), Automated Imaging Association (AIA), Standardization Group for Embedded Technologies (SGeT),



and the European Telecommunications Standards Institute (ETSI) Mobile Edge Computing Committee.

ADLINK focuses on designing robust, reliable, application-ready platforms and products that exceed customer requirements and offer long product lifecycles. We have established five in-house technology labs dedicated to the test and validation of our products and platforms for industrial, connected environments, including: 40/100G Ethernet signal validation; high-speed signal simulation and measurement; mechanical shock & vibration, including Highly Accelerated Life Test (HALT); radio frequency; and thermal/airflow/optical/acoustics.

ADLINK has built a strong partner ecosystem with our processor, software, value-added selling, and distribution partners to simplify the requirements for developing and implementing IoT solutions in order to speed time-to-market. We will continue to build forward together with our partners and customers to turn the promise of the IoT into the reality of a secure, connected world.



**ADLINK**  
TECHNOLOGY INC.



**ADLINK**  
TECHNOLOGY INC.

# Build Your Internet of Things



## Computer-On-Module

## Embedded IoT Gateway Platform



### Express-SL

Basic size COM Express® Type 6 module with 6th gen Intel® Core™ i7/i5/i3 processors



### MXE-200i

Based on Intel® Atom™ processor E3826, featuring industrial grade EMI/EMS compliance and integrated Intel® IoT Gateway

## Industrial Tablet

## Embedded IoT Gateway Platform



### IMT-BT

10.1" industrial mobile tablet with Intel® Celeron® processor N2807 and Windows Embedded 8.1/7



### MXE-100i

Ultra-low power consumption with the Intel® Quark™ SoC X1021, featuring industrial grade EMI/EMS compliance and integrated Intel® IoT Gateway

**ADLINK Technology, Inc.**

Toll Free: +1-800-966-5200 ▶ [info@adlinktech.com](mailto:info@adlinktech.com) ▶ [www.adlinktech.com](http://www.adlinktech.com)





## ALPHA & OMEGA SEMICONDUCTOR

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EMAIL | inquiries@aosmd.com

TEL | 408.830.9742

FAX | 408.830.9757

### AOS: A TOTAL POWER-SEMICONDUCTOR SOLUTION PROVIDER

#### TECHNOLOGY

AOS's goal is to be a leader in Power Semiconductors through delivery of best-in-class products and service to our customers. We have established a well-honed technology engine that includes the cutting-edge capabilities of our in-house world-class wafer fab and packaging facilities. These powerful resources at our R&D team's disposal provide the ideal breeding ground to accelerate the release of new technology.

#### COMPANY

Founded in 2000 with headquarters in the core of Silicon Valley—Sunnyvale, Calif.—Alpha and Omega Semiconductor, or AOS, is a designer, developer, and global supplier of a broad range of power semiconductor products. AOS's products are

aimed at—but not limited to—applications such as portable computers, flat-panel TVs, LED lighting, smartphones, battery packs, consumer and industrial motor controls, and power supplies for TVs, computers, servers, and telecommunications equipment. AOS's goal is to support our customers' success by delivering excellence in design, value, quality, and service. We are committed to building strong partnerships with our customers—from understanding their technology requirements, to delivering solutions to meet their product roadmaps, to providing technical expertise and consulting throughout the process. With an 8-in. in-house wafer fab located in Hillsboro, Ore., two packaging facilities in Shanghai, China, and a global sales and technical support workforce, we are well positioned to deliver the highest level of value, quality, service, and support to our customers.

#### PRODUCTS

AOS's main product categories are power discretes and power ICs. The discrete portfolio consists of a wide voltage range of power MOSFETs and IGBTs—delivering power by switching, transferring, or converting electricity. The Power ICs portfolio uses a multi-chip approach, leveraging AOS IC design know-how, discrete silicon technology, and advanced packaging capabilities.

A collage of six product cards for Alpha & Omega Semiconductor. Each card features a product image, a title, and key specifications. The products shown are: AON6152 (45V Power MOSFET), AOZ1363 (Smart Load Switch), AO4294 (High Efficiency Charger), New 650V M-Series IGBTs, 1200V/1350V E-Series IGBTs, and 5A Smart EZBuck Regulator (AOZ3053).

**Industry's First 45V Power MOSFET with Ultra-Low On-Resistance**  
AON6152

- $R_{DS(ON)}$  (MAX) - 1.15m $\Omega$  @10V
- 1.85m $\Omega$  @4.5V
- DFN6x6 Package

**Smart Load Switch With Rapid Turn-Off Fault Protection Plus Current Monitoring**  
AOZ1363

- Low  $R_{DS(ON)}$  of 23m $\Omega$  in Thermally Enhanced DFN 3mm x 3mm Package

**Leading with New High Efficiency Charger Solution For a faster and more efficient charge**  
AO4294

- 100V device in a SO-8 package
- $R_{DS(ON)}$  12m $\Omega$  @10V

**New 650V M-Series IGBTs The Ultimate Solution for Motor Drive Applications**

- With soft and fast freewheeling diode
- Excellent turn-on performance by low di/dt and high dv/dt
- Fast and soft turn-off switching performance
- SC rating ( $I_{SC}$ ) of >5 $\mu$ s at 400V $_{CE}$ , 15V $_{GE}$  and 150°C
- Available in a variety of packages

**1200V/1350V E-Series IGBTs Optimized for Soft-Switching Applications**  
TO-247

- Lowest turn-off delay time — less than 200ns
- $E_{OFF}$  increase by the temperature (25°C vs. 150°C) — less than 50%
- $I_C$  (100°C) — 20A
- $T_{J(MAX)}$  — 175°C

**5A Smart EZBuck™ Regulator Featuring Adaptable Light Load with Surge Output Current Capability**  
AOZ3053

- Smoke-free function for superior protection
- Over 90% efficiency

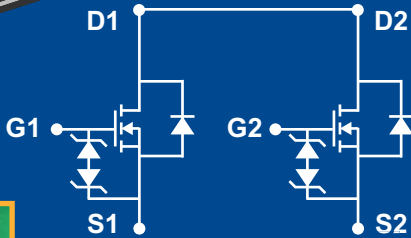


# AlphaDFN™ – *Tiny and Tough*

The Key to the Best in Mobile Battery Performance and Safety



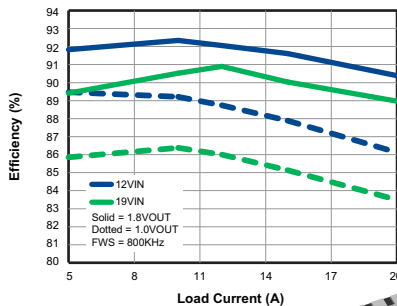
**AOC3864**



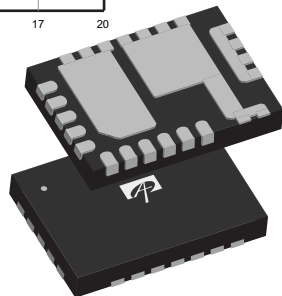
- Robust structure
- Enhances battery protection
- Lowest resistance of 5.7mΩ at 4.5V
- Saves battery life
- Package size 2.7x1.8mm and 0.19mm in height

## DrMOS Power Module

Designed for SuPerformance



**AOZ5029**



- Space saving 3.5x5mm
- Ultra-fast switching
- Parasitic inductance reducing
- Efficiency enhancing
- Ratio of 3:1 thermal pad area vs. discrete solution



**ALPHA & OMEGA**  
SEMICONDUCTOR

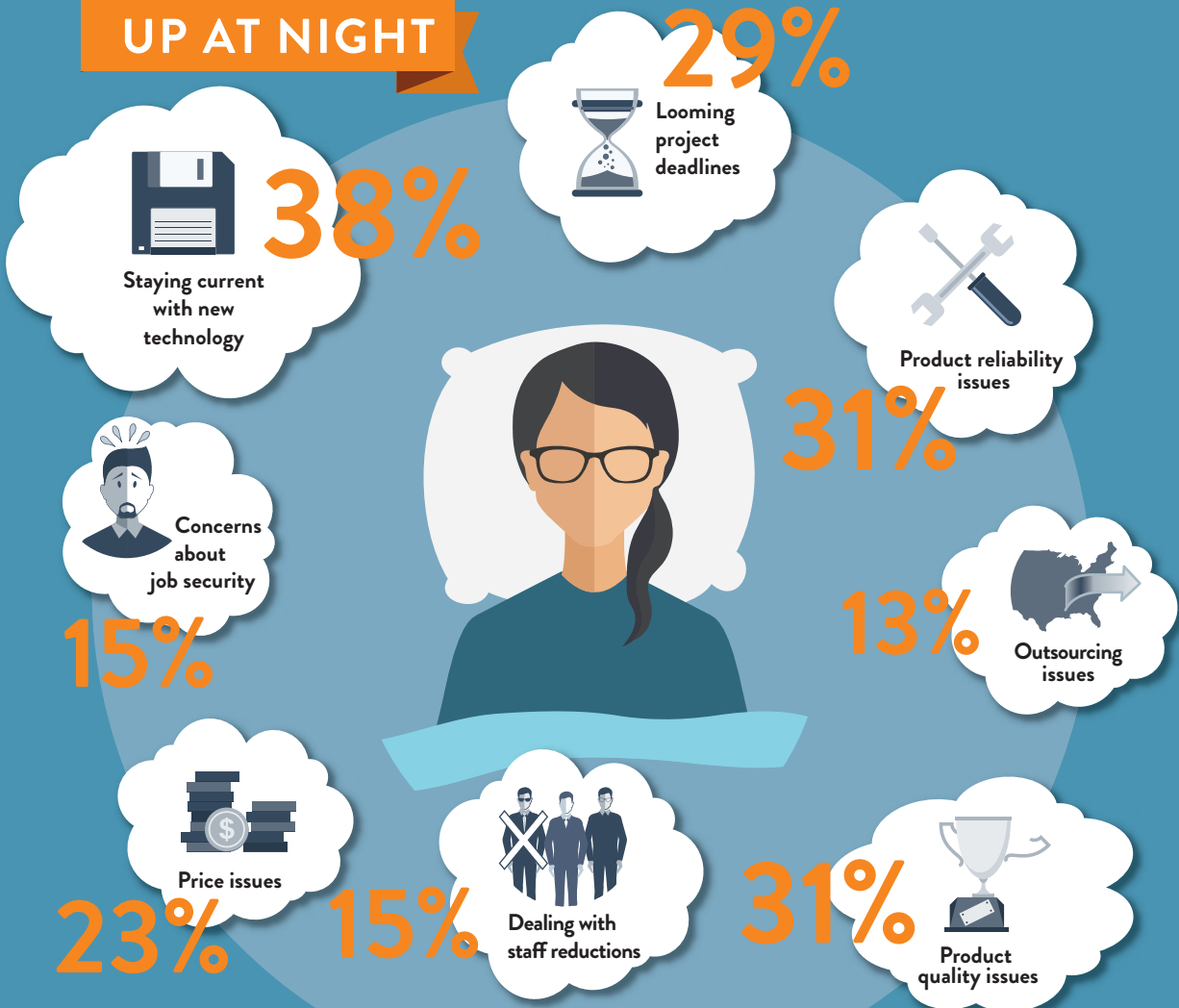
[www.aosmd.com](http://www.aosmd.com)

# ISSUES KEEPING

## ENGINEERS

### UP AT NIGHT

The majority of engineers point to time constraints as the root of their professional concerns, especially as engineering jobs are reduced and the people left behind are forced to assume more responsibilities on shorter deadlines.



### ENGINEERS TALKING IN THEIR SLEEP

“It is impossible to stay current; there is too much information and not enough time. It is not possible to have any knowledge depth on new technologies.”

“What worries me is the rapidly changing expectations of experience. Employers do not want to hire you for a position where you will have to learn new skills.”

“It doesn’t matter how efficient we become if we are not supported to test our products. Testing is an afterthought, and quality is long-gone.”

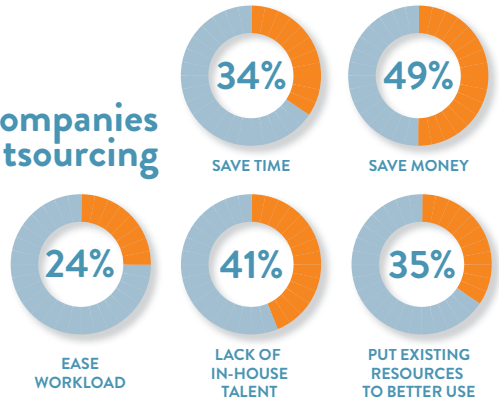
“Unfortunately, the prevailing reason for outsourcing is purely economical, not technical, which jeopardizes the quality of products.”

# THE NECESSARY EVIL OF OUTSOURCING

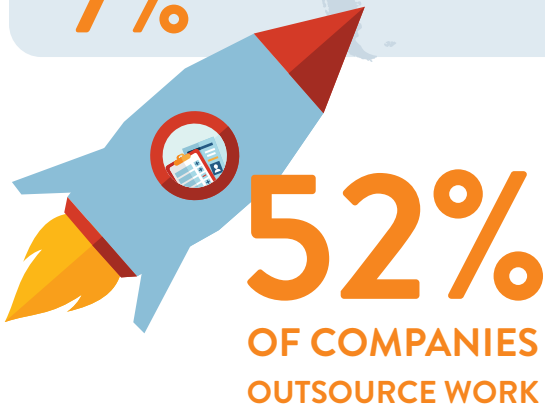
## OPINIONS ON OUTSOURCING

FEWER ENGINEERING JOBS AVAILABLE	42%
LOWER EMPLOYEE MORALE	41%
FEWER OPPORTUNITIES FOR ADVANCEMENT	35%
NEW HIRES AT REDUCED SALARIES	34%
SKILLS VALUED LESS	30%
SALARY REDUCTIONS FOR EMPLOYEES	24%
OPPORTUNITY FOR MORE INNOVATIVE PROJECTS	23%
IMPORTANT ASPECT TO BUSINESS GROWTH	16%
SKILLS VALUED MORE	14%
NEW HIRES TO SUPPORT OUTSOURCING EFFORTS	12%

## Reasons companies are outsourcing



## Where jobs are going

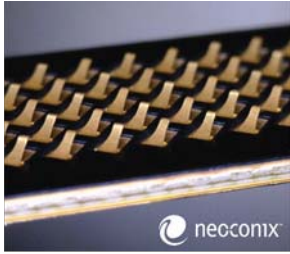


## JOBS BEING OUTSOURCED

SOFTWARE ENGINEERING/DEVELOPMENT	52%
MANUFACTURING/ASSEMBLY	48%
DESIGN	38%
SOFTWARE VERIFICATION/TEST	22%
R&D	21%
CAD/CAE	21%
DESIGN VERIFICATION	16%
DRAFTING	12%
PCB LAYOUT	12%
FINAL TEST	17%

(continued on p. 42)





## NEOCONIX INC.

WEB | [www.neoconix.com](http://www.neoconix.com)

EMAIL | [info@neoconix.com](mailto:info@neoconix.com)

TEL | 408.530.9393

2355-C Paragon Drive  
San Jose, CA 95131

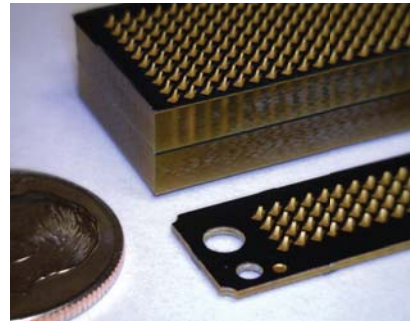
### PCBEAM™ CONNECTOR SOLUTIONS DRIVE INNOVATION AND SPEED

Neoconix Inc. is a premier supplier of fine-pitch, ultra-low-profile electrical connectors with the advanced capability to deliver high-speed signals with ultra-flexible power connections. By providing exceptional dimensional control at fine feature sizes, Neoconix PCBeam interposer technology is the perfect solution for leading-edge, board-to-board, flex-to-board, and LGA socket applications up to 10,000 pins.

Neoconix innovative solutions utilize advanced printed circuit board (PCB) manufacturing processing techniques to enable high-performance, low-cost connectors significantly faster than typical connector development lead-times. The photolithography-based design offers maximum customization and quick turn capability with minimal tooling costs. Our products include a wide range of standard configurations or they can be customized to fit your specific requirements with prototypes available in as little as two weeks and high-volume production in less than two months. With over 60 patents to date, Neoconix products and technology are driving innovation in many markets, including mobile electronics, telecommunications, computing, military applications, medical, and automated test equipment.

#### DEPENDABLE SUPPLIER

**NEOCONIX INC.** is headquartered in San Jose, Calif., with mass-production facilities in Shenzhen, China, and engineering offices in Taiwan. As a subsidiary and technical partner of Unimicron Technology Corp., Neoconix also offers advanced integrated solutions such as FPC plus connector assemblies or PCBs with embedded contacts. Neoconix can offer customers significant cost savings, expert design support, and very high-volume manufacturing capacity.



#### KEY BENEFITS

- High-speed (28 Gbps) and power connections (5-10A)
- Ultra-thin (<0.3mm) profile for the smallest footprint
- Fully integrated solutions: FPC + connector assemblies
- Rapidly customizable solutions with low-cost tooling
- Fast time to market: 2-week prototype and 2-month production-ramp capability
- High-volume manufacturing capacity (>5M units/month)
- Global support and design expertise



# GET » TECHNOLOGY

## PCBeam™

**High Speed**  
**Wearable**

**Ultra-Thin**

**Scalable**

**Design Versatility**

**Mobile**

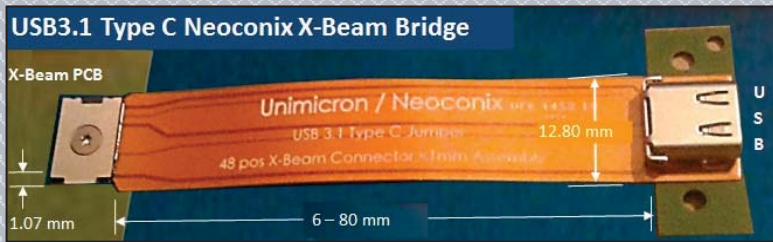
**Custom**

**Rugged**

**FPC Integration**

# CONNECTED

### Flexible Printed Circuit (FPC) Assemblies



#### USB 3.1 Type C Jumper Solution

- USB 3.1 Speed: 5-10 Gbps
- High current: 5 Amps
- Jumper length: 50-150mm
- 1mm Total thickness:  
Connector + FPC+ Screw Head

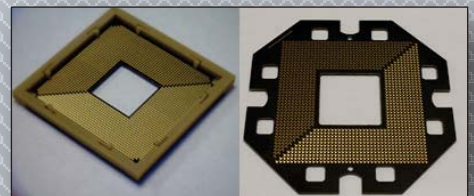
#### High Speed



#### Mobile Devices



#### Custom Sockets



#### SPH1 Connector Series

- High speed to 28Gbps
- Power connections: 1-10A
- Thickness: 0.5 - 3.0 mm
- Pitch: 0.8, 1.0, 1.27mm

#### LPM Connector Series

- Small footprint: High density  
0.74mm pitch area array
- Low profile: 0.28mm thickness
- Power connections: 1-5A
- High speed signals: 5-10Gbps

#### Design Versatility

- Any size or shape: <10,000 pins
- Any thickness: 0.4-3.0mm
- Any pitch: 0.74, 0.8, 1.0, 1.27mm  
or custom pitch
- LGA/LGA & LGA/BGA options



neoconix™

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## RICHARDSON ELECTRONICS, LTD.

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TEL | 800.348.5580  
FAX | 630.208.2550

40W267 Keslinger Road  
LaFox, IL 60147-0393

### INTRODUCING OUR POWER & MICROWAVE TECHNOLOGIES GROUP

For nearly 70 years, Richardson Electronics has been your industry-leading global provider of engineered solutions, power grids, and microwave tubes. With the launch of the Power & Microwave Technologies group, we continue this legacy and complement it with new solid-state technologies. As a manufacturer with design capabilities and an authorized distributor, our strategy is to provide specialized technical expertise and engineered solutions based on our core engineering and manufacturing capabilities. We provide solutions and add value through design-in support, systems integration, prototype design and manufacturing, testing, logistics, and aftermarket technical service and repair—all through our existing global infrastructure.

Our portfolio includes the latest innovations from the world's leading suppliers of devices based on GaN, SiC, SOI, SiGe, GaAs, CMOS, and other power and microwave technologies.

#### DISRUPTIVE TECHNOLOGIES

Our technology partners' disruptive technologies drive customer solutions over a wide range of applications in the alternative energy, aviation, broadcast, communications, industrial, marine, medical, military, and scientific markets.



Within that, we can offer solutions and global design support for everything from military and commercial radar to emerging ultracapacitor, phased array, cellular systems, navigation, SATCOM, automotive, M2M, and IoT applications.

By providing new, disruptive technologies that enable higher power, greater efficiency, and higher integration, we are helping engineers solve the design and applications challenges they face. We are assembling technology partners with complementary lines that allow for a one-stop solution, and we couple this with our highly technical support and global infrastructure to expedite the design-in cycle.

Our specialized technical expertise and “engineered solutions” are based on our core engineering and manufacturing capabilities. We maximize block-diagram selling opportunities to expedite the design cycle and meet today's faster time-to-market demands, and we continue to invest in field engineering throughout the world and to add resources at our design and manufacturing sites.

Richardson Electronics' Power & Microwave Technologies group focuses on what we do best: identify and design disruptive technologies, introduce new products on a global basis, develop solutions for our customers, and provide exceptional worldwide support.



 **Richardson  
Electronics**  
POWER & MICROWAVE  
TECHNOLOGIES





## DISRUPTIVE TECHNOLOGIES TO GLOBAL MARKETS

More than just another distributor.

Our manufacturers' disruptive technologies drive customer solutions over a wide range of applications in the alternative energy, aviation, broadcast, communications, industrial, marine, medical, military, and scientific markets. Get started at [rellpower.com](http://rellpower.com).



800.348.5580 / 630.208.2200

RELLPOWER@RELL.COM

RELLPOWER.COM

## ZIERICK MANUFACTURING CORP.

WEB | [www.zierick.com](http://www.zierick.com)  
EMAIL | [Contactus@zierick.com](mailto:Contactus@zierick.com)  
TEL | 914.666.2911

### BOARD-TO-BOARD AND BOARD-TO-WIRE INTERCONNECT SOLUTIONS

**ZIERICK MANUFACTURING CORP.** has been in business for over 95 years and is a leading source of solutions to complex interconnection requirements and problems for Markets including—Solid-State Lighting, Industrial Controls, Automotive, Appliance, HVAC, and Medical. From standard products to our custom solutions, Zierick has invented and produced technologies that have become the industry standard and which continue to shape the industry in the future.

Zierick is capable of providing solutions from product design to the production floor, with our line of terminal applicators for both surface-mount and thru-hole applications.

Our U.S.-based Team is available to offer solutions and provide assistance from Product Design to Volume Production.



### PRODUCT OVERVIEW

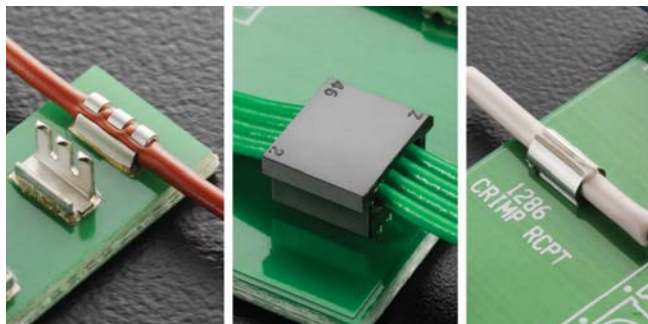
**BOARD-TO-BOARD AND BOARD-TO-WIRE** Interconnect solutions in addition to Electronic Hardware: Pins, Quick Disconnects (tabs), Insulation Displacement Connectors, Board Stacking Connectors, Edge Connectors, Coaxial Connectors, Jumpers, Wire Grippers, Sockets, Headers and Auto Fuse Clips.

Our Applicator Group can provide a variety of automated solutions to reduce labor costs associated with terminal placement. We offer benchtop and automated assembly equipment to insert thru-hole terminals as well as surface-mount specialty feeders for placing continuous strip and bulk parts. We also provide presses and hand tools for wire insertion and termination.

If our catalog products don't meet your specific design needs, we can provide custom solutions for you.

Zierick is ISO 9001:2008 registered as well as RoHS and REACH compliant.

Need help? Contact Zierick today at 914.666.2911; [contactus@zierick.com](mailto:contactus@zierick.com); or [www.zierick.com](http://www.zierick.com).

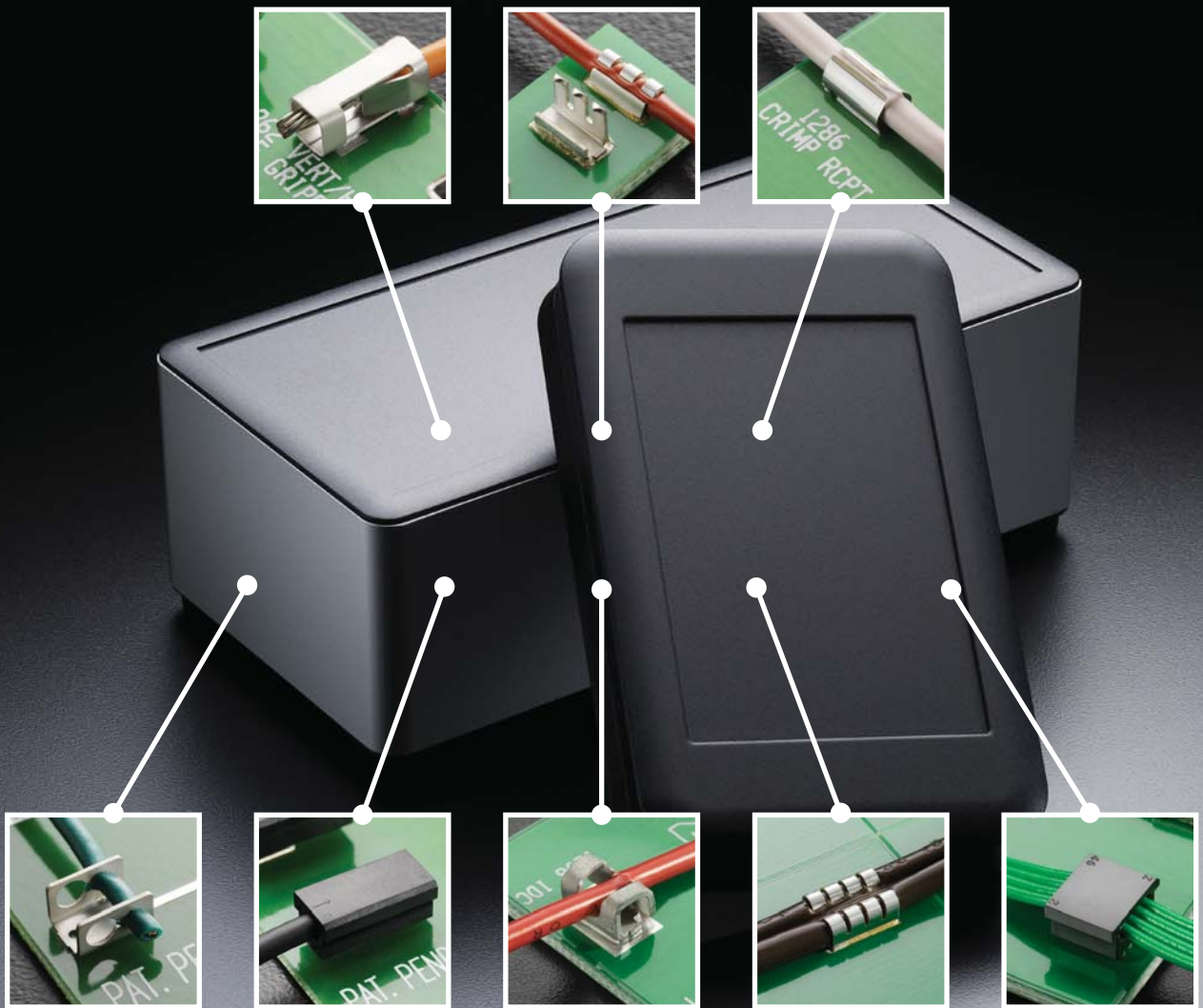


**ZIERICK**  
ENGINEERED INTERCONNECTION SOLUTIONS

# ARE YOU WIRED IN?

Zierick Manufacturing specializes in Wire-to-Board and Board-to-Board applications. Offering standard solutions for wire gauges from 14 to 30; whether the wires have insulation on, stripped and tinned or have a terminal applied.

Our US-based experts can also offer custom stamping solutions while all facets of manufacturing are done in our ISO Certified New York facility.





# CONTINUING

# EDUCATION



Staying current with new and emerging technologies remains a central issue among engineers, especially as it becomes more important in the eyes of employers. Heavy workloads, productivity pressures, and inadequate support from short-sighted management are among the main obstacles to continuing education, according to survey results. “The biggest challenge,” said one respondent, “is to convince the management that staying current is an investment in the future that might not pay off immediately.”

#1 obstacle to staying current with information:

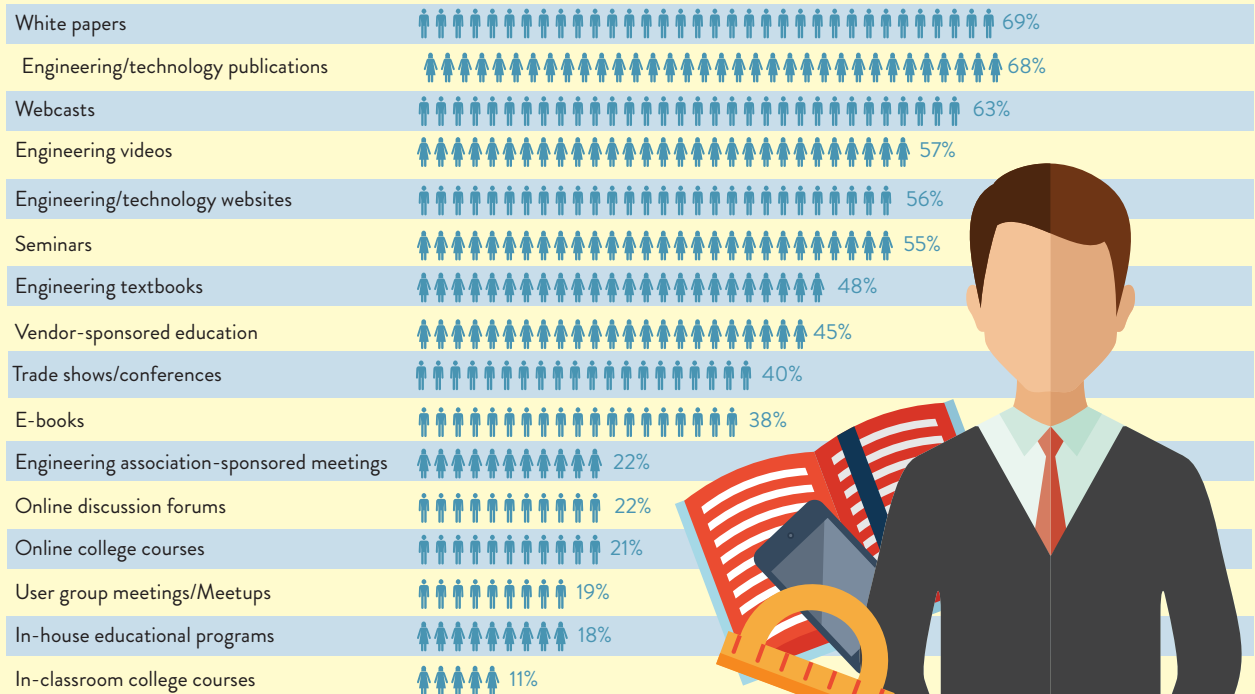


## Finding the time.

### For which of these forms of education does your company reimburse costs to engineers?

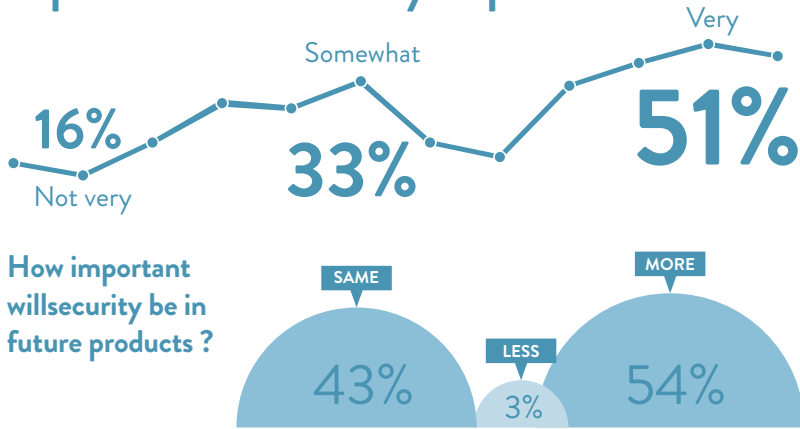
Trade shows/conferences	55%
Seminars	54%
College tuition	38%
Engineering textbooks	35%
Engineering association dues	27%
Certifications	26%
Publication subscriptions	26%
Online training	25%

## How engineers are keeping up



# PREPARING FOR THE INTERNET OF THINGS

## Importance of security in products



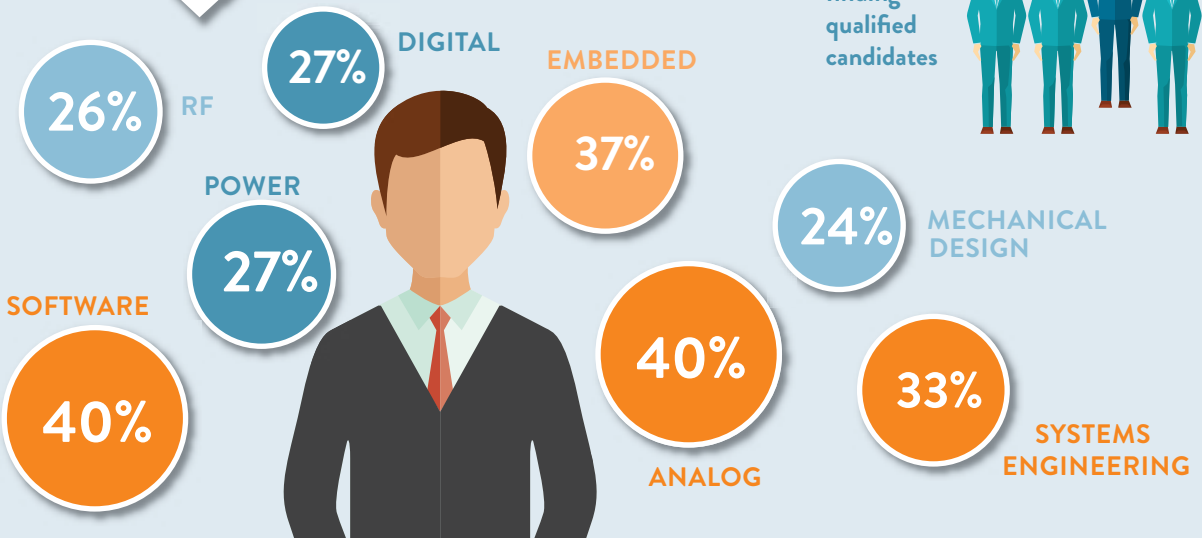
## Companies that will produce connected products



The **Internet of Things** is expected to change the way in which individuals interact with technology and engineering companies design their products. Many companies are preparing for this paradigm shift with strategic acquisitions of analog and mixed-signal chipsets, in addition to Wi-Fi technologies. These maneuvers are being reflected in the engineering specialties that are currently in high demand. . . .

51%

of organizations have difficulty finding qualified candidates



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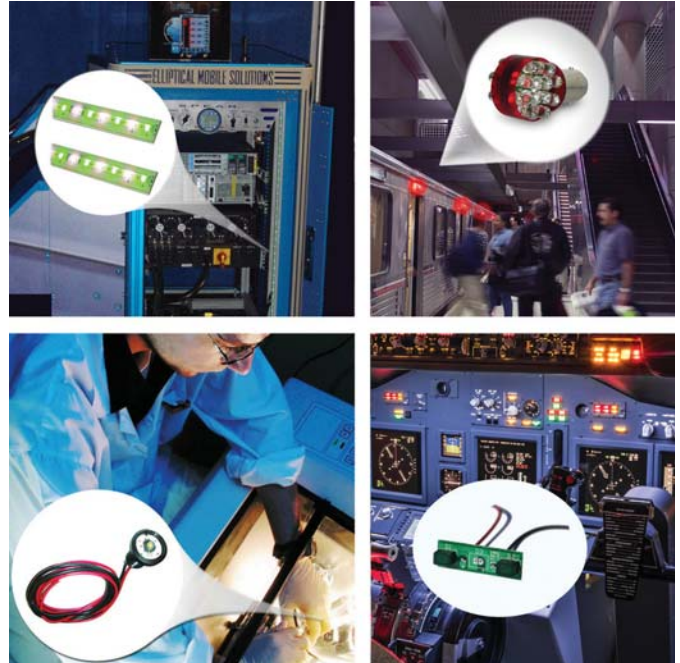
DDP offers innovative OEM and end-user electro-optical design solutions for a wide range of applications. Our design engineers deliver efficient designs and functional prototypes quickly so you can evaluate form-fit and function of our solution to ensure it meets your needs.

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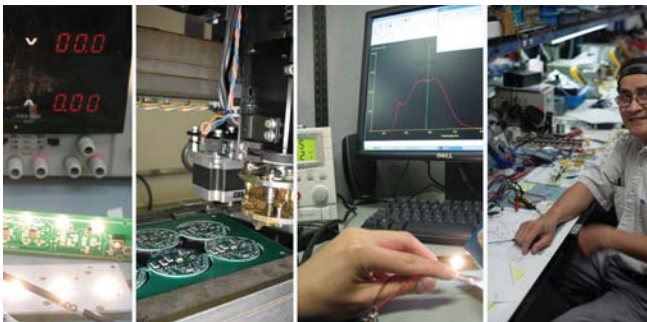
Our policy is to design, manufacture, and market products that consistently meet our customers' needs while striving to exceed their expectations. The focus is to enhance customer satisfaction through continuous improvement of our products and services.

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- To offer the best value to our customers

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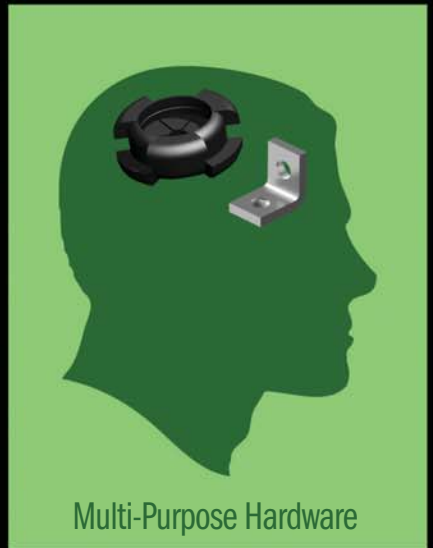
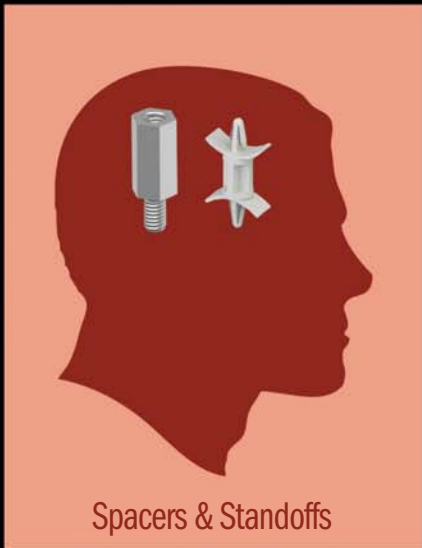
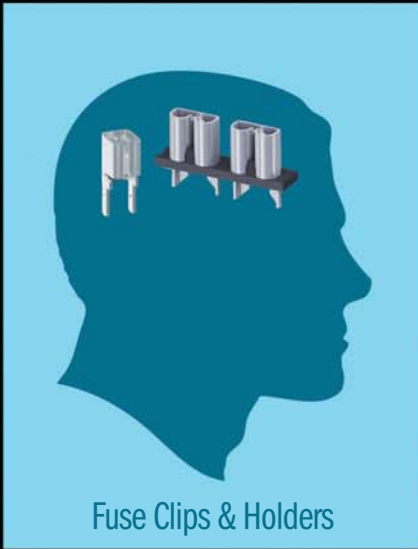
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# THE INTERNET OF THINGS IS HERE

IoT means different things to many people, but it is all about connectivity

Everyone has their own idea of what the Internet of Things (IoT) is, but one thing we can all agree on is this: It is here to stay whether we like it or not. The challenge will be living with the plethora of devices that will be connected in some fashion.

The smartphone provides the ultimate mobile hook into the cloud/Internet. It is considered an IoT device because it not only provides a way to view information from the cloud, but is also a major source of information about the phone's owner. The phone has a collection of sensors that can provide details about location, movement, and use and quite, and quite a bit of that is going to the cloud where "big data" analysis is putting it to use.

This information is often used to provide targeted advertisements and this only gets more effective, or invasive depending on your perspective, as the

surrounding electronic landscape gets populated with even more IoT devices. These devices may not be connected to each other directly, but often the data they generate is correlated via big data analysis.

## THE IoT CAR

Automotive solutions highlight integrated IoT growth with the amount of sensor information growing by leaps and bounds. Even tire-pressure sensors are part of the mix (see "Tire-Pressure Monitoring Pumps Up Performance" on elec-

2. Ford's F-150 can be equipped with wireless systems that check when devices are loaded into the vehicle automating inventory tracking.



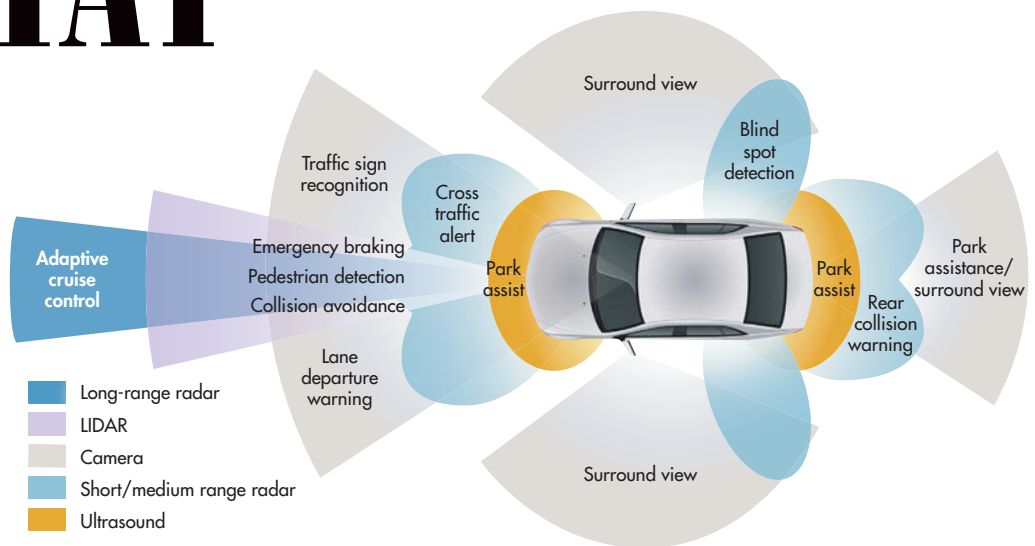
# TO STAY

tronicdesign.com). These wireless sensors, which are found on all new vehicles, can pinpoint a leak or let a driver know if the tire pressure is too low.

An Advanced Driver Assistance System (ADAS) utilizes an array of sensors generating immense amounts of information that can be processed and sent to the cloud (Fig. 1). The sensors include ultrasound and surround-view cameras for locating nearby obstacles for parking-assist operations. Short-, medium-, and long-range radar can be used for features like adaptive cruise control and emergency braking. Cameras can be used for traffic sign recognition. GPS provides location information, while hooks into the speedometer can provide information for tracking traffic patterns.

Of course, this information can also be used for other purposes, such as locating the nearest gas station or a store with a sale on a driver's favorite purchases. There are even dongles from insurance companies that plug in to capture braking and acceleration data among other information.

Telematics, ADAS, and engine control are only part of the story when it comes to the connected vehicle. That ever-present display is providing more information to the driver, and the system is often hooked into more IoT devices like smartphones. They already provide navigation, multimedia



1. An Advanced Driver Assistance System (ADAS) utilizes an array of sensors generating immense amounts of information that can be processed and sent to the cloud. (Courtesy of Texas Instruments)

capabilities, and smartphone connectivity as well as controlling and monitoring the entire car. That alone makes the automotive platform a significant IoT environment but that is just the beginning.

Trucks such as Ford's F-150 (Fig. 2) can link with a host of IoT devices, such as tools that can allow a user or company to track when devices are loaded in the vehicle. Such a system can track when vehicles are used at a job site employing the same wireless location approach used for key fobs that unlock a car door when the user with the fob is outside the door and pulling on the handle.

Automotive platforms are just one example of how IoT systems can work. The home is another environment where the technology is proliferating. Even light bulbs like Sengled's Pulse Solo (see "IoT Is Here Whether You Like It or Not" on [electronicdesign.com](http://electronicdesign.com)). The Pulse Solo is an LED lightbulb with a built-

(continued on p. 56)



## Electrocube Inc.

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**LINEAR INTEGRATED SYSTEMS INC.** would like to take a moment to remember its founder, leader, and continued inspiration, John H. Hall. In a career that spanned over 60 years, Hall developed technology included in over 20 fundamental patents, including pioneering work in low-power CMOS integrated-circuit technology.

Hall served in the U.S. Navy in the late 1950s, working in electronics development and testing. He graduated from the University of Cincinnati in 1961 and soon applied his chemical engineering education in the nascent semiconductor industry.

In 1962, Hall began a series of projects with semiconductor pioneer Dr. Jean Hoerni, which led to Hoerni asking Hall to work for him at Union Carbide. Hall worked as Union Carbide's director of IC Development from 1962 to 1967, and his years there included innovations that were to lead the semiconductor industry. These include: the first application of thin-film technology; the first dual transistor on a single chip; and the invention of dielectric isolation technology.

In 1968, Hoerni asked Hall to join him in the formation of a new company, Intersil. As co-founder of Intersil,



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Hall headed R&D and achieved a breakthrough in coating silicon oxide gates with phosphorous glass, resulting in the first practical metal oxide semiconductor (MOS) processes. Hall's Intersil team also developed the first N-Channel memory chip at a time when most companies overlooked its potential.

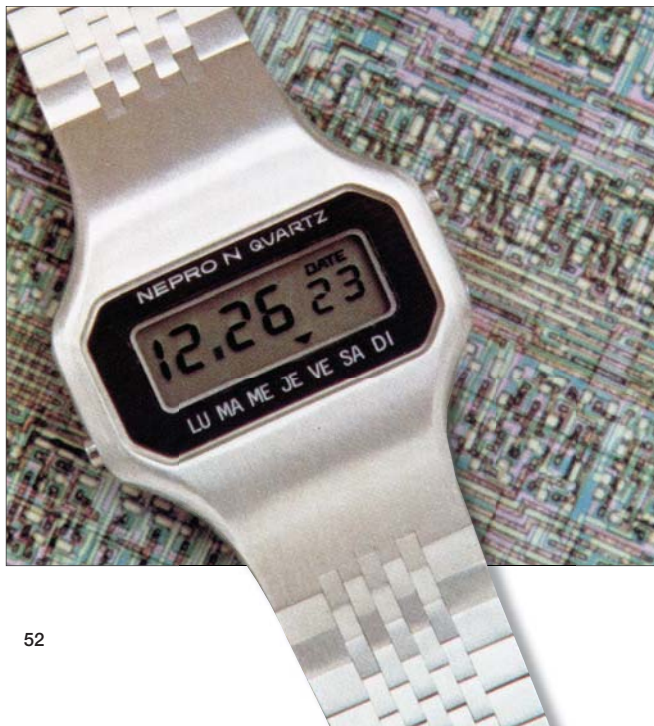
Hall's work in thin film resistors and CMOS technology formed the basis of Intersil's electronic watch development for Seiko, which was chosen over a competing bid from RCA. Hall's development was the first successful

quartz crystal watch, running on a one-volt battery that would last over a year.

Following the sale of Intersil in 1968, Hall declined Hoerni's offer to join him in a new venture and opted to go out on his own with the backing of Seiko. Hall went to Japan to be the principal architect of Seiko's—and Japan's—first CMOS fabrication facility in 1970.

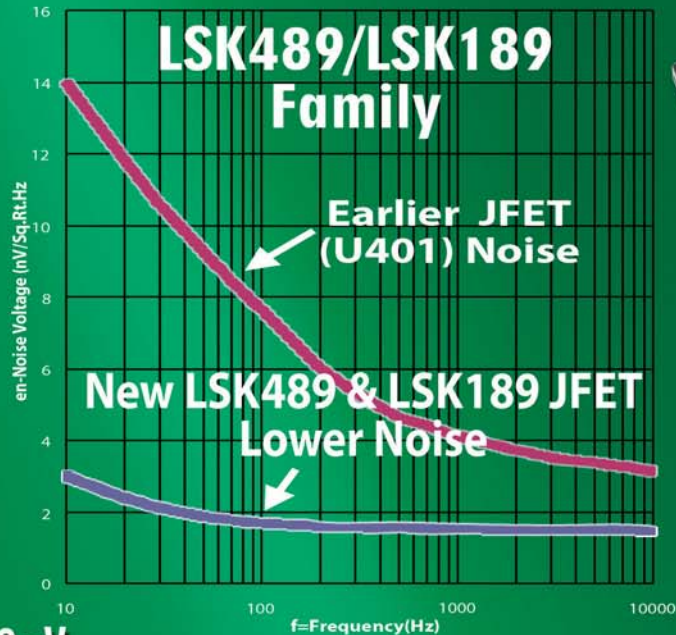
In 1971, Hall founded Micro Power Systems and for the next 15 years produced a string of commercial and technical successes. In 1987, Hall founded Linear Integrated Systems Inc. to create new, higher-performance discrete semiconductors in addition to producing components he developed at Union Carbide, Intersil, and Micro Power Systems.

Linear Integrated Systems honors John Hall's memory by continuing to develop and produce some of the world's best small-signal discrete semiconductors.





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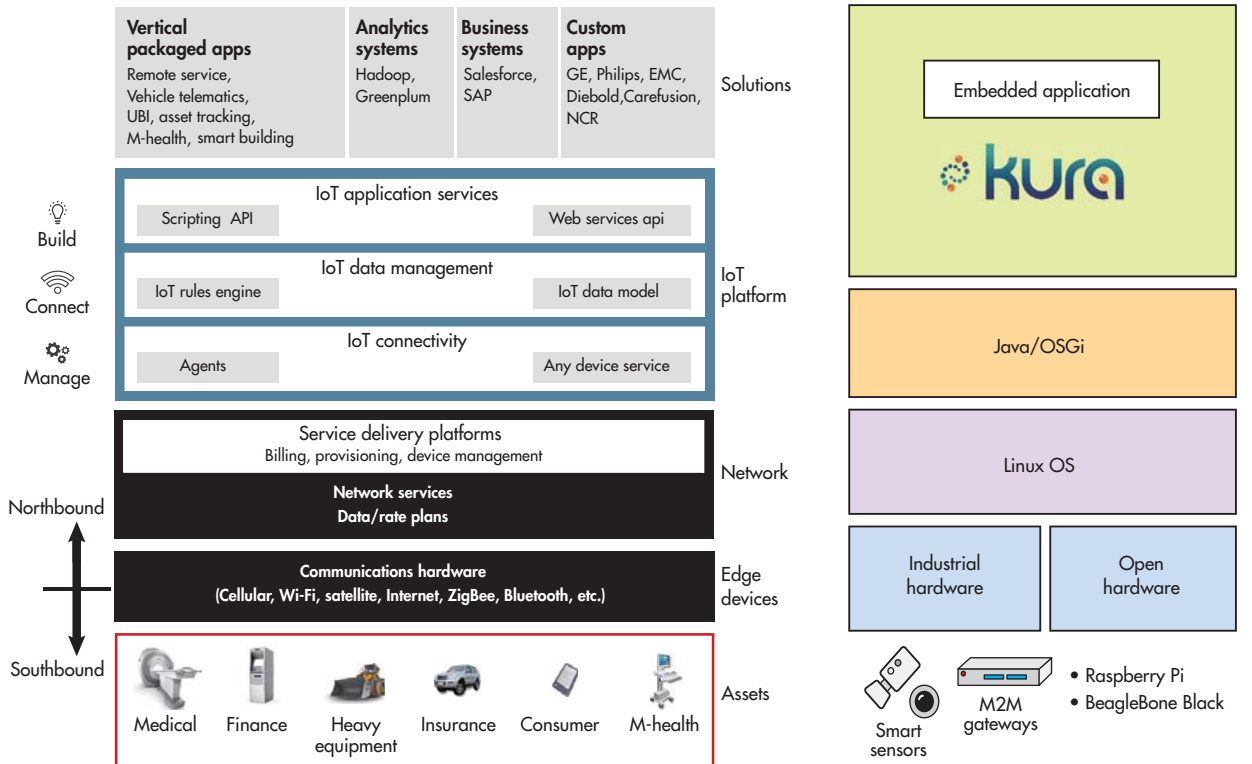
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3. Wind River’s Edge Management System is designed to address the array of services needed to deploy and manage sophisticated IoT environments.

4. Kura is an open-source IoT framework built on Java and OSGi.

in, wireless amplifier and speaker system. A smartphone can stream audio to the Pulse Solo using Bluetooth.

The view of IoT thus far glosses over the communication and security challenges. Many devices will connect directly to the Internet, but others will communicate locally or through gateways. The use of standard protocols like TCP/IP allows traffic to move across standard routing systems, while it is the higher-level protocols that allow the interchange of data. This level is where there are fewer standards.

**IoT COMMUNICATION FRAMEWORKS**

The lack of high-level standards has not prevented a vast array of IoT frameworks from emerging. Wind River’s Edge Management System (EMS), for example, is designed to address the array of services needed to deploy and manage sophisticated IoT environments (Fig. 3). It targets IoT devices such as those used in medical applications. An agent runs on the device. This supports the various services from control and monitoring to provisioning and remote updates.

To simplify programming, the system supports a rule system and data model that maps a consistent interface onto the agent. Developers dealing with data from, and control of, IoT devices can utilize this vendor-specific API to handle the remote agents. Details of communication, connectiv-

ity, and security are able to be ignored when dealing with the content. Of course, the system deals with these details and others can address this management using other tools within the framework.

Wind River’s EMS is only one of many solutions available to developers. In general, the frameworks have a similar architecture with an agent that runs on the device. The frameworks and their protocols are built on top of communication standards such as TCP/IP, allowing the frameworks to take advantage of standard communication interfaces like WiFi and Bluetooth.

EMS is integrated with Wind River’s application development support. It’s able to handle end-to-end security strategies that are customizable, and is designed to take on large-scale IoT deployments.

Gateways that can provide additional services are typically defined within the framework. They can usually run applications that provide translation, correlation, and local management and are often firewalls between a network of IoT devices and the cloud.

It is possible to create an IoT device without utilizing a framework, but it takes a significant amount of work to match the range of services provided by a framework. Keep in mind that these frameworks do not just involve moving



data from the IoT device to the cloud. Distribution of data, security, and a host of other details need to be managed as well. For example, some frameworks provide a publish/subscribe infrastructure that allows data to be shared with any number of devices within the environment. These may be peers, gateways, or servers running applications that also run on the framework. Data generated by IoT devices may wind up in SQL databases in the cloud or big data databases. In general, the agents on the IoT devices do not have to deal with details of where the data it generates is going.

There are open-source solutions in this space and some vendors are basing their frameworks on them. Note that this is not the same thing as having an IoT framework that is built on open-source or standard APIs. Those are typically interfaces and protocols that provide the communication between nodes within an IoT framework and almost all IoT frameworks use these. The open-source IoT frameworks open the APIs used within the framework.

Kura is an open-source IoT framework hosted by the Eclipse Foundation (see “Developers Discuss IoT Security and Platforms Trends” on [electronicdesign.com](http://electronicdesign.com)). Kura is built on a Java/OSGi framework (Fig. 4). It uses MQTT to exchange data. MQTT can run over protocols like TCP/IP. Kura agents and gateways can run on low-end platforms like Raspberry Pi or the Beaglebone Black.


There are complementary projects to Kura like Mihini, a high-level, Lua API for machine-to-machine (M2M) applications. (The term “M2M” is gradually being overtaken by IoT.) Mihini is designed for microcontrollers with a few megabytes of storage, so it does not necessarily target the very low end of the IoT spectrum.

## FUSING SENSORS

Sensor fusion is often associated with IoT devices that provide additional context-related data by combining information from other local sensors. This fused data essentially implements a virtual sensor. Platforms such as smartphones often have sufficient resources to utilize sensor data directly using native applications. Other platforms may just move this information up the food chain. The virtual sensor information is often much more compact in terms of data compared to the sensor data that is used to generate it. For example, a virtual sensor that indicates where the device is and how it is moving can prove useful. Some sensor fusion technology can currently indicate whether the device is moving on a train or in a car.

Sensor fusion hubs are a popular means of integrating sensor hardware. The microcontrollers in the hub handle the integration of data, providing it and virtual sensor information to the local host. In many cases, these can be viewed as IoT devices.

The idea of analyzing data from multiple sources is not restricted to sensor fusion hubs. The approach is applicable to combining data from IoT devices as well. Analysis of big data is simply the other end of the spectrum.

Hardware and software make IoT possible, but many of the costs of using these devices will remain hidden from users. Not all connectivity is free. Most data will not be under the direct control of users. Security of these systems is another area of concern because they greatly increase the attack surface of a user’s electronic environment. There are also some concerns about the legitimate, or at least legal, use of this information. There are many opportunities and advantages of IoT as well. In any case, the Internet of Things is here to stay, whether we like it or not. 

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### AN INTERNET OF THINGS PRODUCTS AND SERVICES PROVIDER

Linx Technologies makes wireless simple by developing and manufacturing wireless products that are easy for engineers of all skill levels to use. The company's RF modules, remote controls, antennas, evaluation kits, and master development systems feature straightforward hardware configuration and clear documentation. Linx products make it simple to integrate wireless features without the hassle and expense of engineering RF functionality from scratch.

Linx strives to make every engineer a hero in record time by minimizing risk, delays, and technical challenges for design engineers to implement wireless in their products. Unlike other module producers, every aspect of our product and design experience is specifically crafted to achieve Wireless Made Simple.

With the addition of Smartlinx, an Internet of Things (IoT) solution, Linx offers solutions from wireless componentry and electronics to cloud services, data management, and user-interface solutions. With this, customers can remotely connect and control, record, store, analyze, and visualize their information. Linx's flexible Smartlinx IoT platform offers custom Web and smart-device application tailored for customer applications. Performance made affordable.



### ADDED CAPABILITIES TO PROVIDE COMPLETE IoT SOLUTIONS

**AS A HIGHLY** customizable end-to-end Internet of Things (IoT) solution, Smartlinx takes care of everything a design engineer needs to connect their product to the Internet and unlock myriad capabilities, conveniences, and value-added services. Smartlinx is the Internet of Things Made Simple.



### LOW-COST, HIGH-PERFORMANCE RF MODULES

**DESIGNED WITH COST** and high performance in mind from the start, Linx introduces the Hummingbird and Raven Platforms. At below \$10 in volume, Hummingbird is the lowest-cost complete wideband transceiver with microcontroller modules on the market today. The new Raven Series is a low-power module that has multiple interface support, including 80.15.4, 6LoWPAN, and Thread.





If only RF could be so easy.

**Linx**  
TECHNOLOGIES

**Wireless made simple®**

RF Modules • Remote Controls • Antennas • RF Connectors • Custom Designs

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



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### GLOBAL LEADER FOR CURRENT AND VOLTAGE TRANSDUCER SOLUTIONS

LEM is the market leader in providing innovative, high-quality solutions for measuring electrical parameters. Its core products—current and voltage transducers—are used in a broad range of applications in drives & welding, renewable energies & power supplies, traction, high precision, conventional and green cars businesses. LEM's strategy is to leverage the intrinsic strengths of its core business, and to develop opportunities in existing and new markets with new applications. LEM is a mid-size, global company. It has production plants in Beijing (China), Geneva (Switzerland), Sofia (Bulgaria), and Machida (Japan). With its regional sales offices close to its clients' locations, the company offers seamless service around the globe.

In today's world, efficiency of industrial applications is of increasing importance in order to save energy and money. Industrial applications are controlled by power electronics requiring optimal and accurate regulation of electronic parameters such as current, voltage, and power. LEM uses innovative technologies to ensure the high degree of reliability and safety that customers require. With a portfolio of more than 2,500 current and voltage transducers, LEM offers a comprehensive range of accurate, reliable, and galvanically isolated devices to measure current from 0.1 A to 20,000 A and voltage from 10V to 6,400V, across a range of technologies. LEM transducers are CE marked in recognition of their electromagnetic compatibility and compliance with EMC standards.



#### TYPICAL APPLICATIONS INCLUDE:

- AC variable speed drives
- Servo motor drives
- Static converter for DC drives
- Battery-supplied applications
- Uninterruptible power supplies (UPS)
- Switched-mode power supplies (SMPS)
- Power supplies for welding, medical, mobile telecom, etc.
- Pumps & fans control/monitoring
- Induction cooking
- Gas co-generator
- Elevators
- Forklifts
- Air conditioning and ventilation equipment
- Various converters (solar, wind generators)
- Grid power control



# HO Series

Programmable, Over-Current Pin,  
Current Transducers



## Achieving the Challenging Target of Accuracy and Performance

### LEM SOLUTIONS ARE THE SMART CHOICE FOR HIGH PRECISION APPLICATIONS.

LEM's HO current transducer series integrate Open Loop ASIC technology into every unit, allowing highly precise current measurement. Incorporated with the HO series wide range of circuit configurations that can be used to simplify designs while reducing parts stock holdings, these transducers have excellent linearity, low residual noise, and a high frequency response. Offering both programmable and pre-programmed models, the HO series product family features multi-range measurement capabilities according to primary connection configurations.

- Three programmable ranges: 8 ARMS, 15 ARMS, 25 ARMS
- Programmable response time (from 2 to 6  $\mu$ s)
- Small current measurements from 2.67 to 25 ARMS nominal thanks to multirange configuration
- DC, AC and pulse currents measurements with galvanic isolation
- 5 year warranty



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