APPLIANCE & HVAC

REPORT Reaching Design Engineers at the OEM Level

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中国节能协会热泵专业委员会
Heat Pump Committee of China Energy Conservation Association

China Heat Pump Forum
August 6-8, 2024

Shanghai Fuyue Hotel
Songjiang District, Shanghai, China

CHPF: A Global Forum on Heat Pumps Presented by the China Heat Pump Alliance








The China Heat Pump Forum and the China Heat Pump Industry Annual Conference will take place from August 6th to 8th at the Shanghai Fuyue Hotel. Widely recognized as the foremost event for discourse on the future of heat pumps, the CHPF is not only for China but for the whole world.

> **This forum has consistently led the charge in promoting heat pump technologies and energizing the growth of the heat pump industry.**
>
> **Hengyi "Cooper" Zhao,**
> Co-Chair of the CHPA

The CHPF draws more than 1500 participants annually from China, Europe, the United States, Japan and South Korea as well as other countries.

Delegates represent leading heat pump producers as well as suppliers of essential parts and components, along with hundreds of engineers and professionals who seek to keep up-to-date with the myriad changes in the heat pump industry. For hands-on experiences of the new technologies, an ample number of heat pump technologies and components will be on display at dozens of booths of the floor exhibit.

The conference schedule is as follows:

August 6: All-day registration

August 6, Afternoon: Board Meeting for the CHPA

August 6, Evening: Welcome dinner

August 7: Full-day meeting and banquets

August 8: Full-day meeting and departure

This annual event encourages team spirit and networking through a friendly soccer game, enhancing communication among attendees. The dinner events offer a relaxed environment for socializing and entertainment, including activities such as lotteries and performances. Each participant receives a special souvenir, adding a personal touch to the forum.



For more information or to register for this event, please contact tina.lee@chpa.org.cn directly.

Registration is available up to August 6.

https://microgroove.net/china-heat-pump-forum

About the China Heat Pump Alliance

China Heat Pump Alliance (CHPA), a secondary professional committee under the China Energy Conservation Association, was established in 2009. CHPA has more than 500 enterprise members, representing more than 80 percent of China's heat pump product R&D, production, and manufacturing capacity. CHPA is currently the largest and most influential heat pump association in China's heat pump field. CHPA has a close relationship with all parties in the heat pump industry, especially heat pump manufacturers, research institutions, and government agencies, and acts as a bridge between policymakers and manufacturers in terms of policy and standard formulation.

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A MILESTONE REACHED…

Please go back and take a look at our front cover. Most of our covers have an eye-catching pic that references a technical article in the issue. But this time we did something different.

The front cover in turn has pics of all 20 of our front covers, including this one. One from 2019 when we were started, four each in 2020, 2021, 2022 and 2023 and three so far this year. That makes 20. As a quarterly brand, this means we have been publishing now five consecutive years. Most new publications don't attain that level of success so we are letting you the OEM design engineers know about it.

And we are thanking you. Because without your attention (open rates consistently in the 15% range and enewsletters double that) we couldn't attract an audience of advertisers that finances our operations. So thanks for the first five years and let's all find out what the next five will bring us!

In other news…

Have Appliances Become More Expensive Recently?

Focusing on the Appliance market I read an article in the Washington Post discussing this subject. Quoting Zonda Media ''Americans need to buy new appliances more often then they did 15 years ago.'' And Zonda also says we spend 34% more than we did 15 years ago. Does that sound terrible to you? A 34% increase over 15 years? A quick calculation tells me that is merely 2% per year compounded growth. So I think Zomba is talking about a non-existent problem.

Still I wanted to investigate further. I did my own homework to see if this article was correct. Here is what I found for the last (almost) 30 years:

Between 1997 and 2024: Appliances experienced an average inflation rate of -0.58% per year. In other words, appliances costing $200 in the year 1997 would cost $170.80 in 2024 for an equivalent purchase. Compared to the overall inflation rate of 2.48% per year during this period inflation for appliances was lower...big time (source: US Bureau of Labor Statistics)

Think of it…all the prices people complain about…healthcare and higher education especially, and appliance prices have dropped according to the BLS. So they are contracting Zonda.

I believe is was Twain who wrote ''There are lies, damned lies and statistics''. The above illustrates his point.

We recently exhibited at the Electrical Wire Processing Technology Expo (EWPTE) in Milwaukee. Excellent results. There were 213 exhibitors, up an impressive 15% from 2023. The attendee count was about 3,000. We came away with some very solid leads, happy to say. Plus, while we are a digital pub we always do print for tradeshows we exhibit at. And they went fast from our booth and the bins in the exhibition hall. We look forward to continuing at EWPTE in the future.

Thanks to the following for contributing to us editorially this month: Greentech, Littelfuse, Littelfuse Industrial (a newbie for our readers to enjoy), MacTac (another newbie), Snap-on and Vitrek. And thanks and credit to Tech Briefs, who allowed us to re-publish their fine work entitled ''The Rising Presence of Women in Engineering''. Moving women and minorities into STEM is a must for the future! Every year June 23 is Women in Engineering Day. Last but not least, thanks to the folks at Latin Press Inc, owner of AFTERMARKET INTERNATIONAL, for giving us permission to publish the Snap-on article.

Regards,
Brad Glazer
Editor/Publisher
brad@appliancehvacreport.com
216 233-6943

APPLIANCE&HVAC REPORT Reaching Design Engineers at the OEM Level

Reaching
Design Engineers
at the
OEM Level

Brad Glazer
Founder & Publisher
brad@appliancehvacreport.com
(216) 233-6943

Stefanie Mirman
Art director
stefaniemirman@gmail.com

JABS Media, LLC

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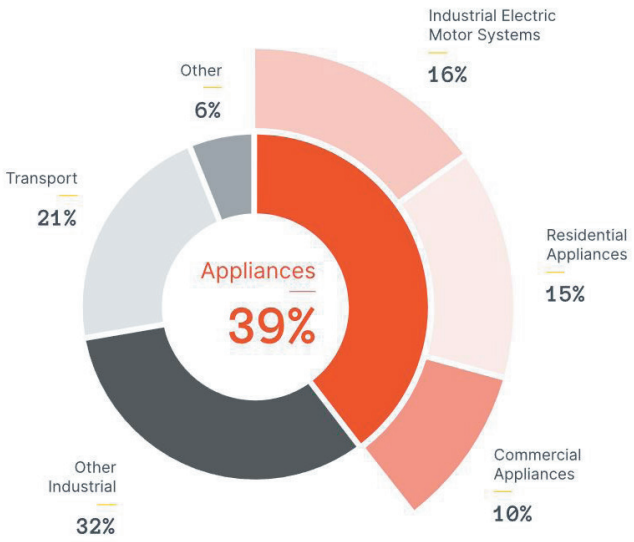
Technology:

Powering the home toward a smart and efficient future

Includes total energy-related CO2 emissions by sector in 2021 with indirect emissions (from electricity and heat) apportioned across sectors. 35.9 Gt total across all sectors. Source: CLASP's Appliances: Impacts and Benefits report.

New design trends in appliances not only bring changes to their look and style, but more importantly to technology and sustainability. Technology can help homeowners minimize food waste with refrigerators that can track expiration dates, create grocery lists and get dinner served on time by remotely preheating the oven. Sustainability is achieved through greater energy efficiency, which designers deploy energy saving technology to earn ENERGY STAR Certification and reduce overall energy consumption.

According to the International Energy Agency (IEA) the building sector was responsible for 30% of total global energy consumption in 2021. Further analysis performed by CLASP, a global nonprofit focused on the appliance sector, determined that appliances accounted for 35% of global energy demand and nearly 40% of global energy related CO2 emissions in 2021. The emissions come from either the direct combustion of fossil fuels delivered to the building or indirectly from electricity consumed to power the appliance.



How are manufacturers implementing smart technologies while improving overall energy efficiency? Let's explore some of the ways modern appliance design can help create a sustainable future.

Inverters enable energy reduction.

Whether we're looking at washer and dryer combos like LG's 5.0 Smart Mega Capacity All-in-One Electric Washer/Dryer Combo or hot water heaters like LG's inverter heat pump water heater, the use of inverter technology to reduce energy consumption can significantly reduce the appliance's carbon footprint and save the homeowner money. Estimates show that inverter technology reduces energy use by as much as 50% compared to traditional devices.

Inverters save energy by controlling the speed of a motor to

eliminate unnecessary start-stop operation. One of the best examples is inverter air conditioners, the inverter keeps the motor in continuous motion to reach the desired temperature. The stop and start of any motor are responsible for significant amounts of energy consumption. A common analogy to understand the benefit is the exercise of running. It takes more energy to stop and start running instead of running at a continuous slow speed.

Heat pumps create efficient heating and cooling.

A heat pump is an energy saving technology that conveys heat without the need to generate it. A heat pump controls temperature by transferring heat from an area of warm to an area of cold. Essentially, the systems' refrigerant absorbs heat from an outside unit, and carries it to the inside unit and in the process the refrigerant condition changes to provide heating and cooling. Simply put, heat pumps move heat around to create the desired condition. This technology is not new, getting its start in the late 1800s, but advances in these systems have made them critical for modern appliances like clothes dryers and HVAC systems, enabling them to operate with less electricity. According to MIT Technology Review, heat pumps today can reach 300% to 400% efficiency, meaning they are putting out 3 to 4 times as much energy in the form of heat as they are using in electricity.

When appliance manufacturers combine heat pump technology with the use of modern inverters the impact is quite powerful. For example, LG's heat pump water heater offers significant energy reduction. The system obtains 75% of its heat from the outside air and the remaining 25% is supplied using electricity. This is an overall reduction of 70% in energy consumption. Combined with inverter technology, the system can both operate with less electricity input and provide high-speed heating, meeting the goals of nearly on-demand hot water with less demand for electricity.

Semiconductors drive smart technology.

The use of inverters and heat pumps, both game-changing technologies, is needed to reduce overall energy consumption. Effective inverters require advanced semiconductor technology to operate with stability. In addition, semiconductors are critical for the smart technology features being used in modern appliances. In a nutshell, semiconductors provide the necessary hardware for smart devices to handle complex algorithms and computations. Advanced AI features that save the owner time and money could not exist without the modern semiconductor.

Developments in semiconductor technology during the past 50 years have made our devices smaller, faster and more reliable. A single semiconductor chip has as many transistors as all the stones in the Great Pyramid of Giza. Today there are more than 100 billion integrated circuits in use around the world and this number is expected to grow.

Smart appliances like the LG model mentioned previously employ semiconductors to drive AI features as well as energy saving technology. As of 2023 the smart refrigerator market was around $3.5 billion, and according to research by Global Market Insights this market is expected to reach somewhere between $6.8 billion and $7.5 billion by 2032, representing more than 2 million units in operation. The smart refrigerator segment is led by North America representing more than 32% of global share.

Modern convenience driven by advancements in technology.

As residential construction catches up with consumer demand, according to Lawerence Yun, chief economist, National Association of Realtors, the building market is estimating new home construction will continue to tick upward through 2024 due to low inventories, and existing home inventory will begin to increase as sellers start to trade upward. As new homeowners furnish homes, the demand for appliances is going to be strong, and advancements in appliance design must continue to offer performance with lower energy consumption.

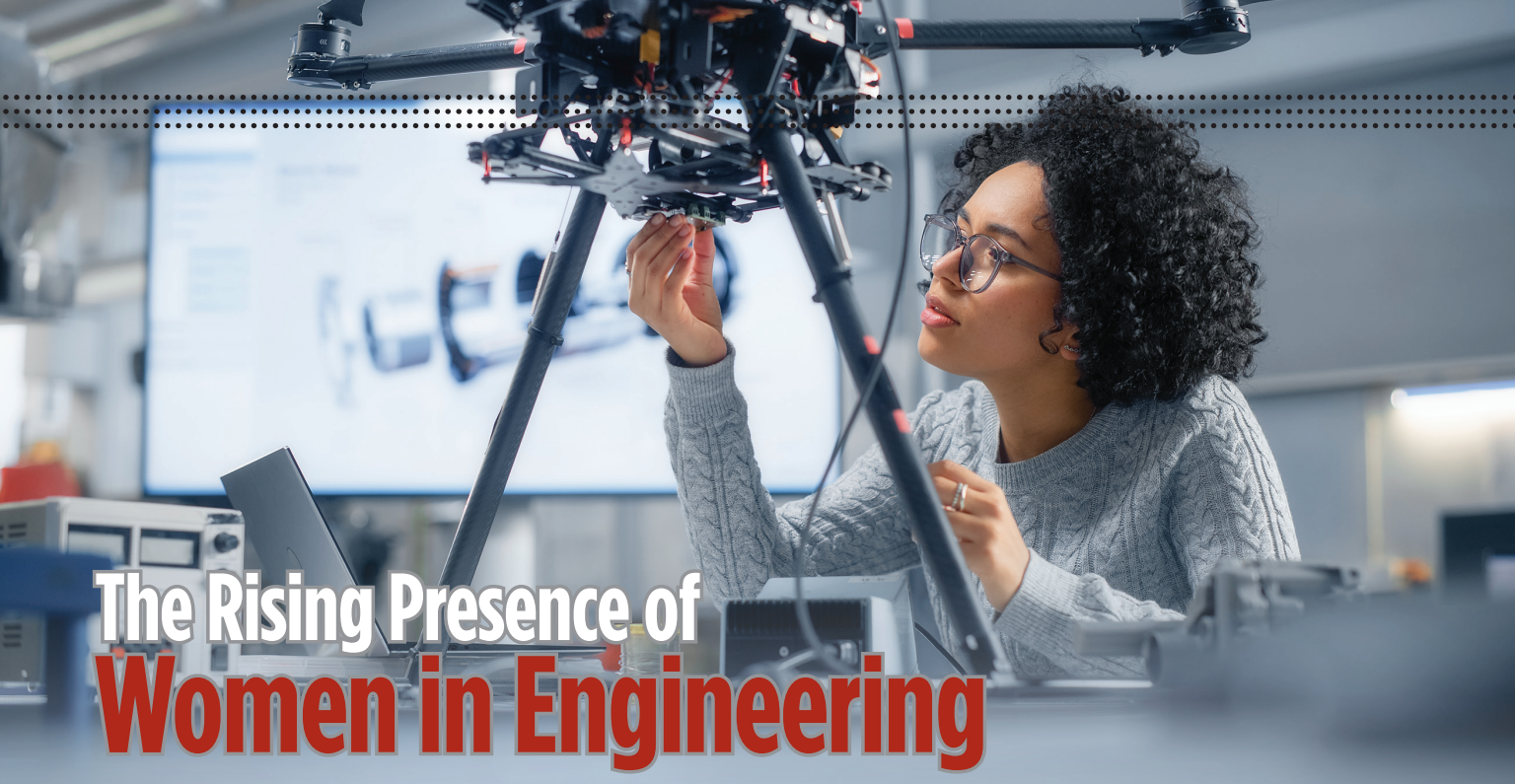
Energy reduction is a critical issue of our current era, whether homeowners are motivated to reduce their monthly expenditure or their home's carbon footprint, modern appliances can meet the challenge on both fronts. The use of modern inverters, heat pumps and semiconductors is powering our homes toward a greener and smarter future, enabling our population to meet housing challenges in a more sustainable way.

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Includes total energy-related CO2 emissions by sector in 2021 with indirect emissions (from electricity and heat) apportioned across sectors. 35.9 Gt total across all sectors. Source: CLASP's Appliances: Impacts and Benefits report. ■



Janet Page is a Business Unit Manager for Mactac. She is responsible for the Industrial and Medical Tape Divisions, leading product development and providing customer solutions for all major industrial markets including appliance, automotive, building and construction and medical device manufacturing.



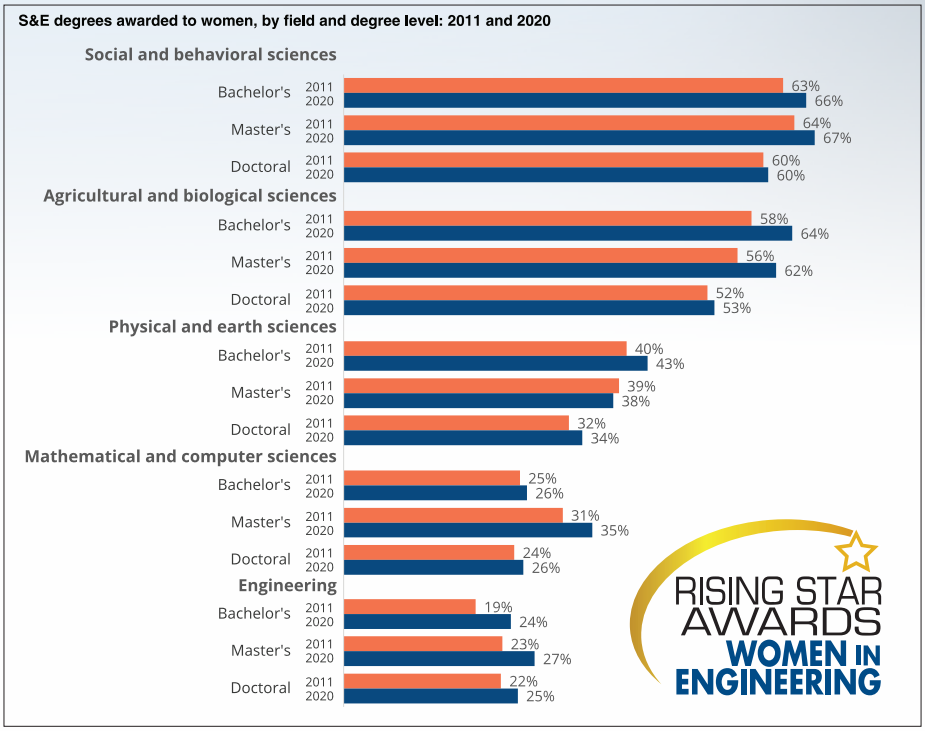
The Rising Presence of Women in Engineering

Diversity in the workforce contributes to creativity, productivity, and innovation. More women today are studying and excelling in science, technology, engineering, and mathematics (STEM). In the U.S., women make up 14 percent of the engineering workforce. The number of female engineers across the globe is on the rise but compared to male engineers it is still much lower.

"I started flying for the Air Force in 1978. The work environment was very different, as there were few women. Today, women have successfully displayed their competency in every area of work," said Colonel Eileen Collins (Retired), NASA's first female shuttle commander, when she shared leadership lessons for women in aerospace with Tech Briefs last year in an interview. "I would not say we are at gender equity yet, but the aerospace industry has enough women that it is not considered unusual anymore."

The 2023 Diversity and STEM: Women, Minorities, and Persons with Disabilities report by the National Center for Science and Engineering Statistics, indicates the U.S. STEM workforce gradually diversified between 2011 and 2021, with increased representation of women and underrepresented minorities. According to the report, in 2021, among people ages 18 to 74 years, women made up half (51 percent) of the total U.S. population and about a third (35 percent) of people employed in STEM occupations (Figure 1).

The report states that the number of science and engineering (S&E) degrees awarded continues to increase at all levels and across many fields. S&E degrees increased at the associate's, bachelor's, master's, and doctoral levels from 2000 to 2019, both in numbers and as shares of total degrees. Women earned almost two-thirds of the degrees awarded in psychology, biological sciences, and social sciences in 2019 but received only about a quarter of those in



engineering and computer sciences.

According to the NCSES report, the representation of women among postsecondary S&E degree recipients may indicate their forthcoming participation in STEM workforce. The number of S&E degrees earned by women increased at all degree levels between 2011 and 2020.

In 2020, women were awarded approximately 53,000 degrees, 375,000 bachelor's degrees, 99,000 master's degrees, and 17,000 doctoral degrees in S&E fields (Figure 2). From 2011 to 2020, the number of S&E degrees awarded to women increased the most at the bachelor's degree level (96,000 degrees), representing a 34 percent increase. The 63 percent increase in S&E degrees awarded to women was the largest percentage increase over this period among all degree levels. S&E master's degrees awarded to women increased by 45 percent, and doctoral degrees awarded to women increased by 18 percent over this decade.

The report also indicated that women accounted for 66 percent of bachelor's degrees in social and behavioral sciences and 64 percent of degrees in agricultural and biological sciences in 2020 (Figure 3). In contrast, they accounted for 26 percent of these degrees in mathematics and computer sciences and 24 percent in engineering.

Although women remain underrepresented in engineering degree awards, their share of engineering degrees earned increased at all levels between 2011 and 2020. Growth was particularly pronounced at the bachelor's level, where the number of engineering degrees awarded to women more than doubled from nearly 15,000 in 2011 to over 31,000 in 2020. As of 2020, women earned approximately a quarter of engineering degrees at the bachelor's, master's, and doctoral degree levels.

According to the NCSES report, although a bachelor's degree S&E field can open doors to a variety of occupations, a master's or doctoral degree is required for employment or advancement in some S&E professions. The data show that the gap between men and women in S&E graduate enrollment is shrinking.

Between 2017 and 2021, the number of women enrolled in S&E master's programs increased by 37 percent (from 137,000 to 188,000), and the number of women in doctoral programs grew by 16 percent (from 104,000 to 122,000). Men outnumber women at both degree levels, but the enrollment gap has decreased due to faster growth in enrollment of women.

These figures are encouraging and indicate that longstanding efforts made by universities, associations, and companies to encourage more women to pursue STEM careers is showing results. While there is more gender diversity than ever in STEM fields, women remain a small share of degree earners in fields like engineering and computing. More work needs to be done.

For more information, visit https://ncses.nsf.gov/pubs/nsf23315/.

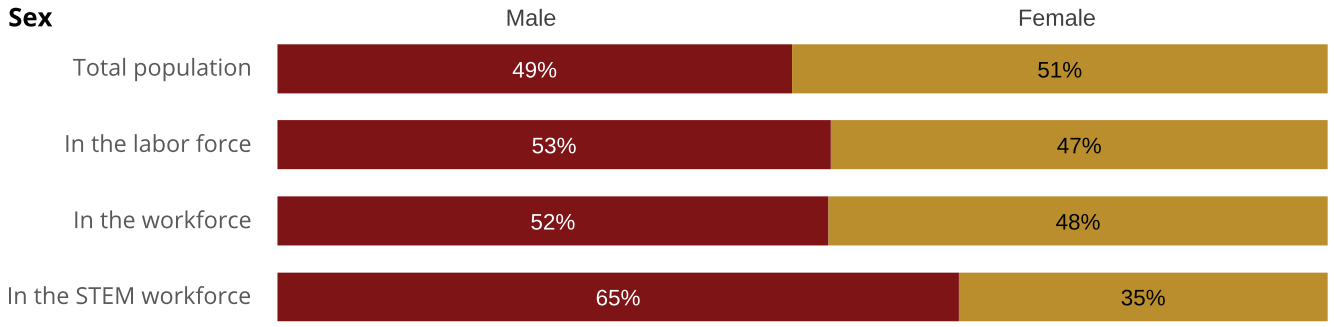
Women in Aerospace: 7 Questions with Slingshot's Audrey Schaffer



From flying planes to leading space missions and conducting groundbreaking research, women have been contributing to the aerospace industry for decades. However, the number of women employed in the international space industry represents just 20-22 percent of the workforce, according to figures released by the United Nations in 2021. Only 11 percent of astronauts so far have been women.

Progress is being made and NASA has pledged it will have the first woman and the first person of color

Characteristics of the U.S. population ages 18–74, by labor force status: 2021



walk on the Moon in the very near future. It's crewed lunar mission Artemis 2 includes Astronaut Christina Koch, who will become the first woman to fly by the Moon in 2025.

What are the challenges for women in aerospace and what more can be done to increase the number of women in the STEM workforce? Tech Briefs interviewed Audrey Schaffer, Vice President of Strategy and Policy, Slingshot Aerospace, who has made significant strides in the aerospace industry. Prior to Slingshot, Schaffer held roles at the White House National Security Council (NSC), the U.S. Department of Defense (DoD), the U.S. Department of State, and NASA.

In her prior role in the Office of the Secretary of Defense, Schaffer led DoD efforts to establish in law the United States Space Force (USSF) as the sixth branch of the armed forces. Schaffer also led a government-industry team that represented the United States in negotiating the first-ever United Nations guidelines for space sustainability. Schaffer holds a M.A. in International Science and Technology Policy, with a concentration in Space Policy, from the George Washington University and a B.S. in Aerospace Engineering from the Massachusetts Institute of Technology.

Tech Briefs: You joined Slingshot as Vice President of Strategy and Policy in September 2023. Can you tell us more about your current role and what you plan to achieve?

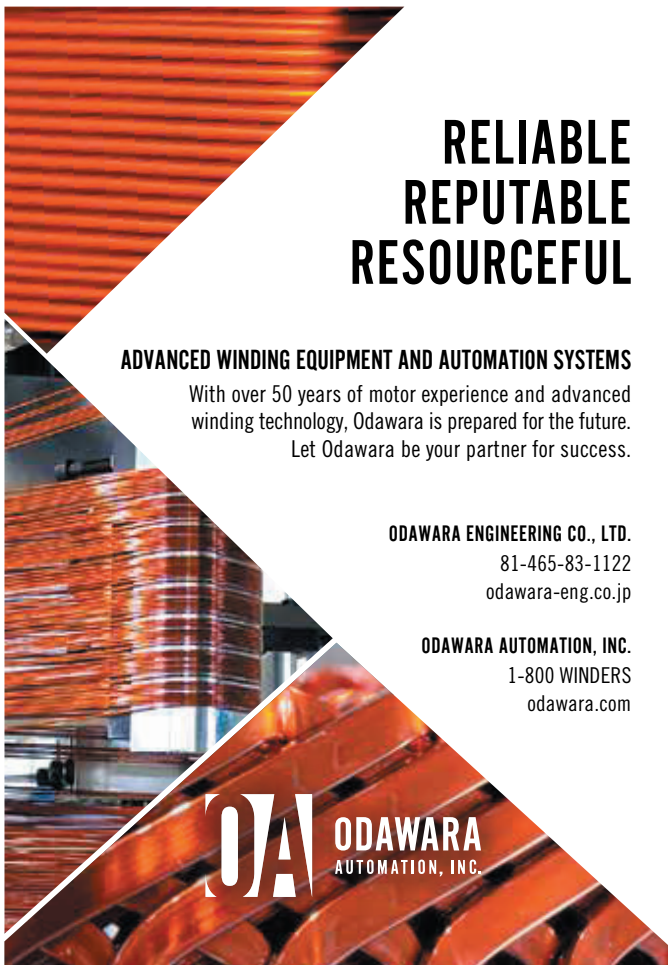
Audrey Schaffer: I strive to be a leading voice on space sustainability and space security — to shape the world's views on the steps we need to take to preserve the use of space for current and future generations, whether that's establishing a global space traffic coordination system or training Space Force Guardians to deter space threats. I also bring that vision into Slingshot to inform our strategy and product roadmap, ensuring that the capabilities we develop are meeting the world's most pressing needs. By marrying these two aspects of my role — the internal and the external — I hope to put in place not only policies but also products and capabilities that protect the space domain as an operating environment and enable the long-term utilization of space.

Tech Briefs: Having worked at NASA, DoD, and NSC, you have been pivotal in shaping national and international space activities. What has been your biggest career accomplishment?

Schaffer: I have had the privilege of contributing to a number of significant national and international space milestones over the course of my career — from shaping international norms on space security and sustainability to classified activities I can't discuss here! But if I had to choose just one accomplishment, it would be leading DoD efforts to establish in law the United States Space Force as the sixth branch of the armed forces. As space becomes increasingly contested, it is critical that the United States have a dedicated military branch with servicemen and women who are experts in space warfare and ready to protect and defend U.S. interests in space. Establishing the Space Force did just that, and I am proud to have been a key member of the team that made it a reality.

Tech Briefs: Who inspired you to pursue a career in aerospace and did you face any challenges being a woman in a male-dominated field?

Schaffer: Ever since I was a little girl, I have wanted to pursue a career in space. When I was eight, I wanted to be an astronomer. Around age 13, I decided that instead I wanted to be an engineer. And in college, I believed that I could make the most impact by being a space policymaker, which is what I am today and where I have, indeed, made a significant impact. I share that evolution because my challenge wasn't necessarily



being a woman in a male-dominated field, but in figuring out how to bring my personal strengths to bear in a highly technical field. I do think it's natural for women (and men) to think that the only way to contribute to a highly technical field is to be a scientist or an engineer. But that isn't true. Any industry, even a highly technical one, needs people of all backgrounds to fill all kinds of roles. In the space industry, we need space lawyers, space economists, space public relations experts, space program managers, and yes, space scientists and space engineers.

Tech Briefs: Finding a mentor can be valuable, especially for women in male-dominated industries. Do you agree and did you have a mentor?

Schaffer: I agree that it's important to have mentors. Throughout my career, I have developed a network of men and women who I call upon for advice when I'm facing a tough situation or a new transition. I think it's important to cultivate many mentors because each has something unique to offer, and your career needs will change over time. Additionally, it's important to find allies and sponsors — people who will proactively support your career advancement, whether by recommending you for a new role or by opening doors that could lead to new opportunities. I am grateful to have had many mentors, allies, and sponsors who believed in me and helped me get to where I am today.

Tech Briefs: The Bureau of Labor Statistics recently reported that the earnings gap between American women and men narrowed to the smallest on record in 2023. While there is more gender diversity than ever in the science and engineering fields, do you think that women are still under-represented?

Schaffer: Female representation in science and engineering fields has come a long way over the past few decades. Earlier in my career, it was not uncommon for me to be the only woman in a room. But that's not the case anymore. I frequently find myself in meetings where everyone in the room is a woman — and that is amazing. One of the reasons I joined Slingshot is our commitment to diversity in the workforce. We were inaugural signatories to the Space Workforce 2030 Pledge, which, among other things, aims to significantly increase the number of women and employees from underrepresented groups in the space industry's technical workforce.

Tech Briefs: The number of female engineers is on the rise but compared to male engineers is still alarmingly low across the globe. How can we address the challenge of increasing the number of women in the STEM workforce?

Schaffer: All too often women are discouraged from pursuing STEM careers, sometimes in subtle or unintentional ways. When I was in college, I often found myself lost when trying to learn the fundamentals of aerospace engineering. That experience discouraged me from pursuing a career in engineering and led to my pivot to space policy. While I don't regret that move, I sometimes wonder whether I would have made that shift if I had been more successful at my engineering curriculum. Drawing from my experience, I believe we can increase the number of women in the STEM workforce by supporting women when they are in school and deciding what career path to take. Whether that's teaching technical concepts in different ways to speak to different learning styles or providing funding for internships to explore career options, we have to provide multiple pathways for women (and men) to gain confidence in their chosen career path.

Tech Briefs: What advice would you give to other women looking to step into leadership roles and carving their niche in aerospace?

Schaffer: The one piece of advice I would give to women in the aerospace industry is that not everything is about STEM. The aerospace industry is just that — an industry. We need people from all walks of life and with all types of strengths — from welders building space hardware to analysts crafting mergers and acquisitions. If you want to be a leader in the space industry, figure out what you're passionate about and find a way to do that. Your passion will fuel your career, and success will come naturally. ■

This article was written by Chitra Sethi, Editorial Director, SAE Media Group. For more information, visit www.techbriefs.com.

Figure 1: Among people ages 18 to 74 years, women made up half (51 percent) of the total U.S. population and about a third (35 percent) of people employed in STEM occupations. Source: Census Bureau, Current Population Survey, Annual Social and Economic Supplement, 2021.

Figure 2: In 2020, women were awarded approximately 53,000 associate's degrees, 375,000 bachelor's degrees, 99,000 master's degrees, and 17,000 doctoral degrees in S&E fields. Source(s): National Center for Science and Engineering Statistics, special tabulations (2022, Table Builder) of the National Center for Education Statistics, Integrated Postsecondary Education Data System, Completions Survey, provisional release data.

Figure 3: Women accounted for 66 percent of bachelor's degrees in social and behavioral sciences and 64 percent of degrees in agricultural and biological sciences in 2020. Note(s): Data are based on degree-granting, primarily postsecondary institutions eligible to participate in Title IV federal financial aid programs. Source(s): National Center for Science and Engineering Statistics, special tabulations (2022, Table Builder) of the National Center for Education Statistics, Integrated Postsecondary Education Data System, Completions Survey, provisional release data.

Image credit: Gorodenkoff/Shutterstock.com

Designing Smart Small Appliances for IoT Homes

How to make safe, efficient, and robust products



Consumers enjoy the benefits of today's new "smart" appliances, which include more intelligent convenience features. These products range from air fryers to robotic vacuum cleaners. The appliances save the consumer time with various chores and with food and drink preparation. Intelligence and IoT-based interfaces allow users to control their home environment and have more free time.

Designers must incorporate smart technologies into their new appliance designs to satisfy consumer demand. They must also make the appliances energy-efficient so that battery-operated products can operate with longer intervals between downtime and recharging.

The greater the appliance's electronic content, the greater the designer's challenge is to ensure the product is robust and reliable against electrical hazards such as overvoltage transients, overcurrent conditions, and electrostatic discharge. This article introduces designers to circuit protection schemes and some unique components that protect circuits from electrical hazards. Furthermore, the article recommends components to reduce power consumption for energy savings. All these components will allow the designer to develop a safe, efficient, robust, smart small appliance.

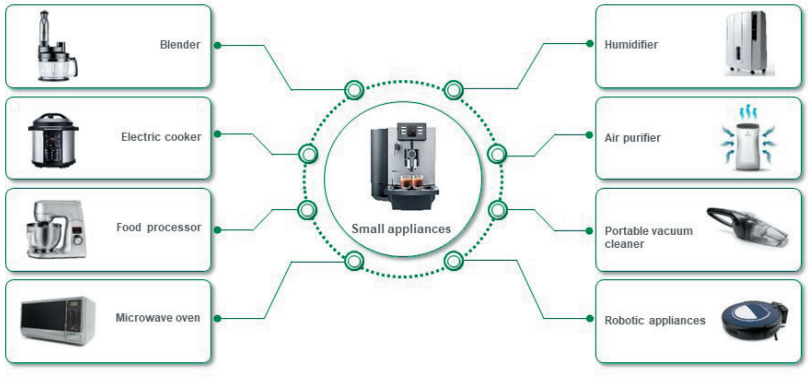


Figure 1. Small appliances are getting "smart" and many now include IoT-based interfaces

Recommended component types for developing robust and efficient small appliances

Figure 2 illustrates a few examples of smart small appliances and presents the circuits in these appliances that can use components for circuit protection, maximizing efficiency, and detecting the machine's state. These components will protect the circuits from electrical hazards such as overcurrent conditions and overvoltage transients. In addition, specific components will detect

overtemperature conditions and improperly positioned parts of the appliance. Also, some components will contribute to higher efficiency appliances.

Block diagram of a typical small appliance

Figure 3 breaks an example home appliance down into individual circuit blocks. The circuits include AC-DC power conversion, microprocessor control, motor drive, heating, manual controls, and a display. The table in the figure highlights recommended component types for the circuit blocks requiring circuit protection, efficient operation, and sensing.

Protecting the small appliance circuits from damaging electrical hazards

Protection components for the AC Input Primary Protection circuit

AC line-powered products must contend with the AC line's voltage transients and high current capacity, typically 15 A for a 120 VAC line in North America. The AC Input Primary Protection circuit must protect downstream circuit blocks from overcurrent conditions and voltage transients.

Use a time-lag fuse to protect the circuits from an overcurrent, such as a short circuit. Due to the product's inrush current, a time-lag fuse will avoid nuisance fuse openings. Ensure that the selected fuse has a voltage rating that exceeds the voltages in single-phase worldwide power line circuits. Also, ensure that the fuse's interrupting rating exceeds the current rating for typical worldwide single-phase AC power lines. To enable product sales in all regions of the world, consider a fuse that complies with IEC 60127-2.

AC power lines are susceptible to overvoltage transients that can strike products such as appliances that are connected to an AC line. Transients include lightning induced on power lines. Large motors switching on and off also induce transients. Using a metal oxide varistor (MOV) after the fuse and in parallel with the AC line will protect downstream circuitry. Select an MOV with:

- Peak current absorption from a single transient pulse of at least 4.5 kA
- Operating temperature rating of 105° C
- Ability to survive a 6kV/3kVA wave surge in compliance with Annex G of IEC 62368-1.

Protecting the AC-DC Power Supply

Portions of transients that get through the MOV due to its non-ideal response time can damage downstream components. In addition, electrostatic discharge (ESD) can damage integrated circuits. Protect the AC-DC power Supply with a transient voltage suppressor (TVS diode) from overvoltage conditions. Types of TVS diodes offer:

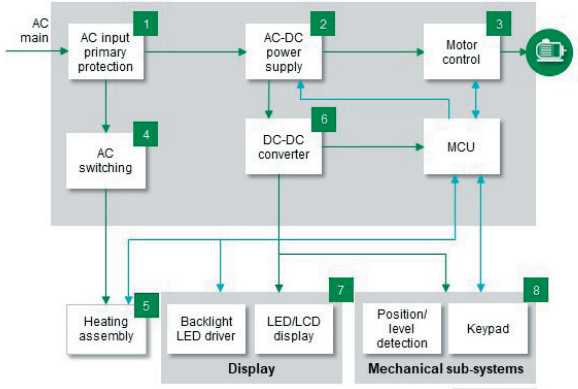
- As much as 600 W of pulse power absorption
- 30 kV withstand voltage from ESD strikes in compliance with IEC 61000-4-2
- Fast response time of under 1 ps
- Bi-directional and uni-directional models
- Space-saving surface mount packages.

Protecting the Motor Control Circuit

The appliance motor needs protection from damage due to short circuits, mechanical overloads, and overheating. Consider a polymeric positive temperature coefficient device (PPTC), a resettable fuse for short circuit protection. Ensure the PPTC fuse is rated for operation



Figure 2. Small appliances and components recommended for safe and efficient operation



	Technology	Series
1	Fuse	5X20mm Fuse
	MOV	M3, Xtreme
2	MOSFET	X2-class
	TVS Diode	P6SMB
	Schottky Diode	MBR, DST
3	PPTC	LVR
	Gate Driver	IX43
	Current Sense Resistor	WPB
4	TRIAC	QJxx16xHx
5	NTC	H6246
6	Load Switch	LQ050
7	TVS Diode	SMF, SMF4L
	TVS Diode Array	SP3423, SP1064
8	TMR Sensor	54140
	Reed Switch	Flex-14, 59177, 59141
	Snap Switch	ZMA

Figure 3. Smart small appliance block diagram with recommended components

in excess of the circuit's maximum voltage. Look for models that include hold current capacities of at least 2 A and fast trip times under 30 s. A good PPTC fuse will be compliant to EN 60730-1.

To prevent motor damage from mechanical overloads and overheating, monitor motor current with a current sense resistor. Use a current sense resistor with as low a resistance as possible to minimize power loss in the Motor Control circuit. Sense resistors are available with resistances that range from as low as 1 mΩ to 56 mΩ. Tolerances can be 1% for accurate current measurements, and the sense resistors can save PC Board (PCB) space with surface mount packaging.

Heating Assembly protection

For appliances that are heating liquids, avoid damage due to the heater reaching a dangerous temperature. Include a sensor to monitor the liquid temperature so that the appliance is not exposed to damaging high temperatures. Consider a NTC thermistor that can reside in a stainless-steel probe housing. Littelfuse can help designers with customized solutions for a liquid temperature probe.

The Display block - Backlight LED Driver and LED/LCD Display

The Display block communicates and receives its data from the MCU. To maintain error-free data between the MCU and the Display circuit, use a TVS diode to protect the integrated circuits from ESD. TVS diodes can have low clamping voltages to ensure the safety of the ICs in the circuit. As with the TVS diodes recommended for the AC-DC Power Supply, models can absorb as much as a 30 kV ESD strike. In the Display circuits, 200 W peak pulse power absorption capacity is sufficient along with less than 1 ns response time. Choose from uni-directional or bi-directional versions and take advantage of surface mount packaging.

As an alternative to a single TVS diode, consider a TVS diode array which can protect two data lines and reduce component count. Figure 4 illustrates a two-line TVS diode array with a Zener diode for ESD protection. This TVS diode array offers low capacitance of around 0.2 pF per I/O signal line. The array consumes minimal power with a leakage current of 10 nA.

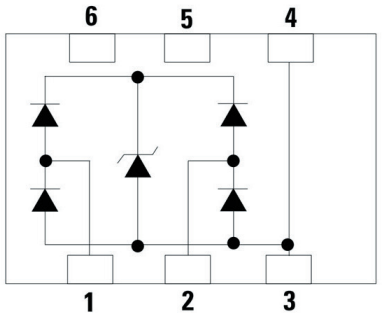


Figure 4. Example TVS diode array, which protects two data lines

Mechanical Sub-System – Position/Level Detection and Keypad

Ensure that fluid levels are at appropriate levels and lids or chambers are properly closed for safe operation of the appliance. One solution for level and proximity detection is a tunneling magnetoresistance (TMR) sensor. Figure 5 shows a TMR sensor with active power drive. TMR sensors offer the benefits of excellent sensitivity, 17 G, and ultra-low power consumption drawing only 1.5 µA at supply voltages from 1.8 to 5.5 V. TMR sensors have an exceptionally long life that can be as much as 20 billion cycles. The sensor also has an environmental rating of IP67 against ingress from moisture and dirt.

As an alternative for position sensing, consider a reed switch. A reed switch does not consume any power. Versions are hermetically sealed and can switch up to 10 W at either 200 V or 0.5 A. A third option, depending on the type of small appliance, is a snap switch. A snap switch is the simplest of the three sensor types to implement position detection. This type of mechanical switch can have a contact rating of 3 A at either 125 VAC or 24 VDC. Operating life can range from 10,000 cycles at 3 A to 300,000 cycles at 0.1 A.

These protection and sensing components can help to ensure a robust and reliable design for the appliance. Furthermore, the recommended components do not interfere with the primary circuitry that makes the product functional.

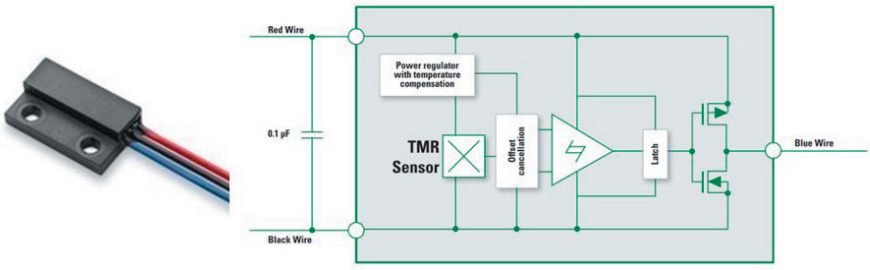


Figure 5. TMR sensor for position sensing – 6 x 14 mm component and block diagram

Designing efficiency into the appliance

AC-DC Power Supply

MOSFETs can help to maximize the efficiency of the AC-DC Power Supply by allowing operation of the switch-mode power supply at a high switching frequency. To obtain minimal power loss in the circuit, select a MOSFET with the following characteristics:

- Low RDS(ON) below 450 mΩ
- Low gate charge in the 10's of nC
- Fast slew rates with dV/dt values in the range of 50 V/ns.

In the DC rectification stage, consider using Schottky diodes. An example Schottky diode package, shown in Figure 6, contains two legs of a full wave rectifier. An effective Schottky diode will have a low forward voltage drop under 0.5 V, low junction capacitance of around 84 pF, and low leakage current under 14 mA.

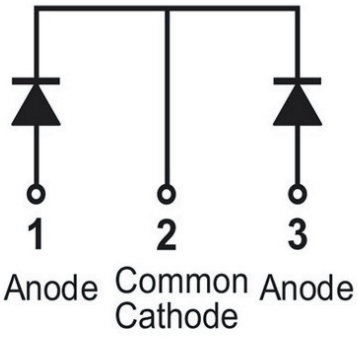


Figure 6. Two-leg Schottky diode rectifier

Motor Control circuit

Gate driver ICs provide efficient driving of MOSFETs or IGBTs. Gate drivers have low propagation delays and fast rise and fall times to facilitate high frequency operation of power transistors. Versions can be either single or dual drivers, and they can source and sink at least 2 A.

AC Switching circuit

In this circuit, an alternistor triac can control an AC heater. The thermally robust component can operate with a junction temperature that can reach 150° C. These components can carry 16 A to power the heater.

DC-DC Converter

Consider using a low power load switch for efficient distribution of power to the MCU, Display, and the Mechanical Sub-Systems (see Figure 7). The load switches provide:

- Current delivery of up to 2 A
- Operating current of 1 µA
- On-resistance under 120 mΩ
- A typical quiescent current of 7 nA
- A 335 µs controlled rise time to mitigate effects of inrush currents.

These components will enable the appliance to run with maximum efficiency. Not only does low power consumption save on annual utility costs for the consumer, but lower power circuits contribute to longer life appliances.

Collaborate with experts for a robust efficient product

Protection against electrical hazards such as overcurrent, overvoltage, ESD, and overtemperature is critical for ensuring reliable operation. The recommended components enable designers to develop safe, reliable, and low power-consuming small appliances.

To ensure they develop a robust and efficient product, designers should take advantage of the component manufacturers' application engineers to save design time and compliance costs. The application engineers can help with:

- Selection of cost-effective protection, sensing, and high-efficiency components
- Knowledge of the applicable safety standards
- Pre-compliance testing, which Littelfuse can perform, to avoid compliance test failures and save on delays and added costs for multiple compliance test cycles.

Collaborating with the component manufacturer's application engineers and using the recommended components will help to produce robust, reliable, and efficient, smart small appliances.■

References: Standards

- IEC 60127-2 Ed. 3.0 b:2014 - Miniature fuses - Part 2: Cartridge fuse-links (ansi.org)
- IEC 62368-1 Ed. 1.0 en:2010 - "Audio/video, information and communication technology equipment - Part 1: Safety requirements " (ansi.org)
- IEC 61000-4-2 Ed. 1.2 b:2001 - Electromagnetic compatibility (EMC)- Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test (ansi.org)

References: Additional resources, courtesy of Littelfuse, Inc.

- Circuit Protection Product Selection Guide
- Sensing Products Selection Guide
- C&K® Switch Product Selection Guide
- Power Semiconductor & IC Selection Guide
- Integrated Circuits Selection Guide

Scan the QR code to learn more about protecting appliance designs with proper circuit protection, courtesy of Littelfuse, Inc.



About the author



Paulius Juskevicius is a Strategic Marketing Manager for the Electronics Business Unit at Littelfuse. Paulius Joined Littelfuse in 2016 as field applicaion engineer for the EMEA region. His current responsibilities include the management of marketing activities for new product launches and performing marketing studies and feasibility analysis for new product ideas. Paulius earned his master's in electrical engineering from Kaunas University of technology.

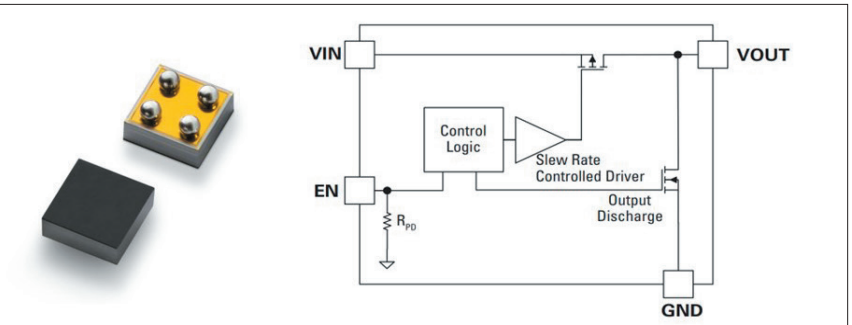


Figure 7. Load switch with slew rate control (Littelfuse LQ05022QCS4 Protection IC)



Odor Control Solutions in Cannabis Don't Need to be High Maintenance

If you're in the cannabis industry, you have odor problems.

In the growing world of indoor agriculture, air quality plays an important role in creating an ideal atmospheric environment free of airborne pollutants and odors.

Cannabis produces a pungent odor during the flower cycle caused by the release of terpenes. Terpene odors are present in the air inside the facility and affect staff, but also escape the building and affect surrounding neighbors and their businesses.

In addition to the significant odors, the cultivation process also produces high levels of volatile organic compounds (VOCs) in the enclosed space. Many grow facilities do not bring in much – if any – outside air directly into the rooms. There are several reasons for this:

- The primary concern is bringing in mold spores and other pests that can harm the plants. For example, in June 2023, the Oregon Liquor and Cannabis Commission issued a recall for several batches of cannabis flower due to mold. The impacted batches were sold to about 75 different Oregon recreational marijuana retailers.
- Second, the facilities generate CO2 to help with plant photosynthesis, so exhausting the air they spent money to created is not desired, especially when the added CO2 helps increase yields and growth.
- Finally, while there is overwhelming consensus that cannabis farms require proper ventilation and constant air movement, the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) does not provide guidance in its current standards for cannabis odor filtration. This creates a bit of a Wild West scenario, where every individual owner, operator, or engineer is left to their own devices to figure out the design requirements they feel are best for their space.

While the use of cleaners like isopropyl alcohol and other compounds seem like a quick fix, those can help raise the total VOCs to unhealthy levels.



There are several reasons why indoor cultivation facilities needs to prioritize indoor air quality solutions:

- Employee experience: The right filter ensures the air is free from harmful particles and VOCs for an enhanced level of cleanliness, improving the overall employee experience. Clean and fresh air is essential for comfort and well-being and can be vital to worker safety. In 2022, a cannabis worker tragically died on the job from occupational asthma. Following the fatal attack, a federal report was released and stated that allergic diseases like asthma are a growing concern in the U.S. cannabis industry. It said the worker's death "illustrates missed opportunities for prevention, including workplace exposures." This will be an area of intense focus and scrutiny, especially as more states legalize recreational use.
- Energy efficiency: HVAC systems that operate more efficiently result in energy and cost savings that can be better used elsewhere in a company's budget.
- Sustainability: It's a great way to demonstrate a commitment to a greener future and align your facility with the values of an eco-conscious world, while setting a good example for the neighboring facilities.
- Cost efficiency: A higher-efficiency filter translates to savings on energy, maintenance, and HVAC repairs, optimizing operational budget.

Below are four considerations for the cannabis industry to help attack odor problems and prioritize air filtration both inside and outside their grow facility:



- Rethink carbon filters. Traditional active carbon filters work through a process called adsorption. Higher humidity environments like cultivation facilities make these filters less efficient as they readily adsorb water vapor. They can quickly become saturated and lose their efficacy.
- Look for the "A". One of the other issues facing cannabis cultivation facilities is the particles in the air. A higher MERV rated air filter such as MERV 11 or 13 is a good choice. However, a lot of the filters manufactured today rely on an electrostatic charge to obtain their MERV rating. Not all electrostatic charges are equal. The high humidity environment can reduce the effectiveness of some higher MERV rated air filters that rely on electrostatic charge. Growers should opt for a true mechanical filter that has a MERV A rating, MERV 11/11A or MERV 13/13A.

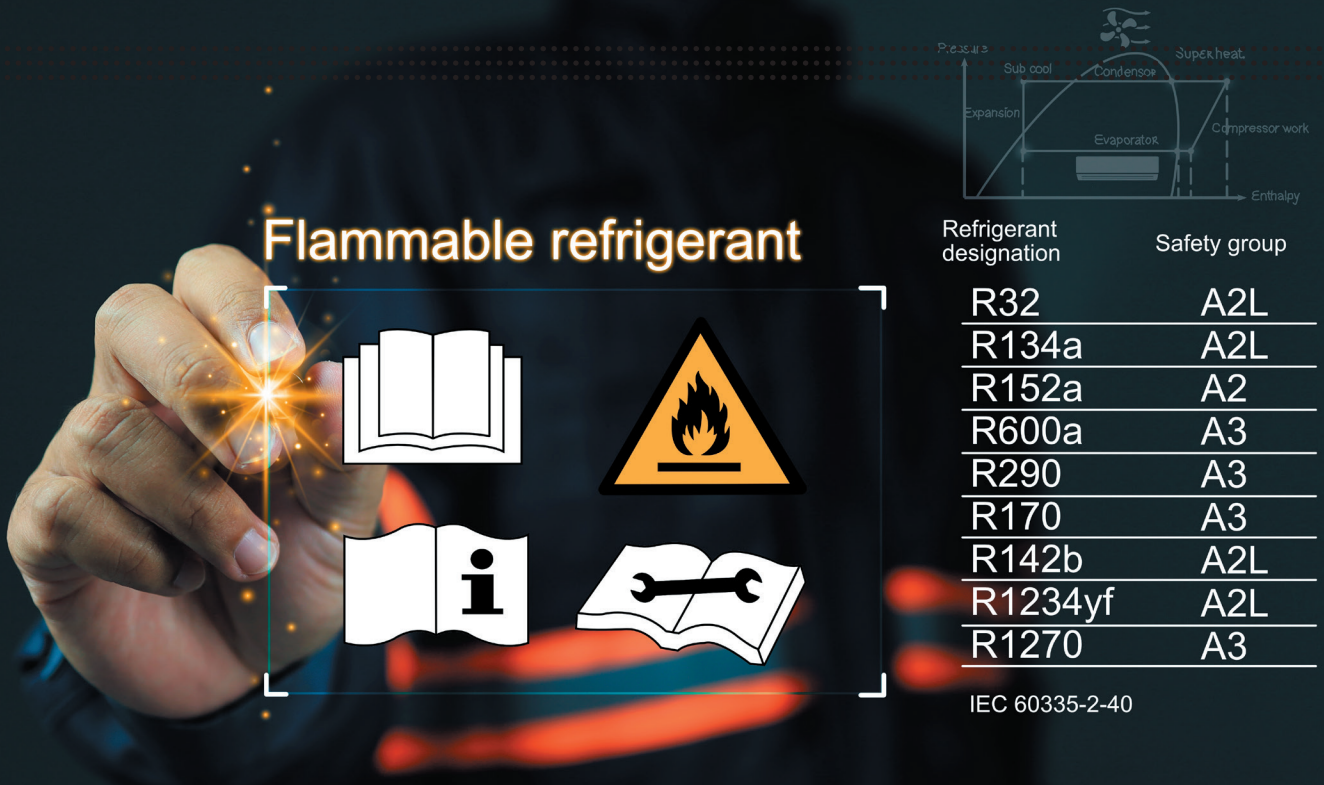
The "A" designation means that the filters' efficiency was tested by neutralizing the electrostatic charge before testing its particle efficiency. Nanofiber air filters maintain a higher particle efficiency without the use of an electrostatic charge. Nanofiber also helps keep the resistance (pressure drop) across the filter lower so that the HVAC system can more readily handle the higher MERV rating.

- Add technologies to "purify" the air. Growers who add technologies like photocatalytic oxidation, bipolar ionization, or low-level ozone to their filter strategy can further reduce the levels of VOCs and odors in their facilities plus reduce the cases of powdery mildew and aspergillus. Some of these technologies could see an additional 30-40% reduction in terpenes and VOCs.

The cannabis industry is here to stay but its odors do not need to linger. There are simple steps to take – and products to help – to specifically and significantly improve indoor air quality solutions at cultivation facilities, dispensaries, and independent grow houses that will mitigate odor while reducing airborne VOCs. ■



Robert Jauch is VP of Research & Development and Engineering, at Greentech. He is developing and using the latest technologies to solve the toughest indoor air quality and odor issues.



Navigating the Transition to A2L Low GWP Refrigerants:

Ensuring Safety with Certified Components in HVAC/R Equipment

The impending transition to low global warming potential (GWP) refrigerants marks a significant milestone in the HVAC/R industry's ongoing efforts to mitigate climate change. With regulations set by the U.S. Environmental Protection Agency (EPA) requiring the phase-out of hydrofluorocarbons (HFCs) in new HVAC/R equipment by January 1, 2025, manufacturers and stakeholders face the challenge of adapting to new standards while maintaining safety and performance.

A2L refrigerants have emerged as a promising solution to meet the demand for low-GWP alternatives. Characterized by their reduced environmental impact, A2L refrigerants offer a viable pathway towards sustainability. However, their flammable nature presents unique safety considerations, particularly in HVAC/R systems where electrical switching components, such as definite purpose (DP) contactors and electromechanical relays, pose an ignition risk due to arcing when switching occurs. Other electrical components, such as transformers, may not require any special certifications as they do not pose an ignition risk for the refrigerant.

In this article, we will explore the upcoming transition to A2L refrigerants, the challenges and opportunities they present, and the importance of ensuring safety through certified definite purpose contactors and electromechanical relays in HVAC/R equipment.

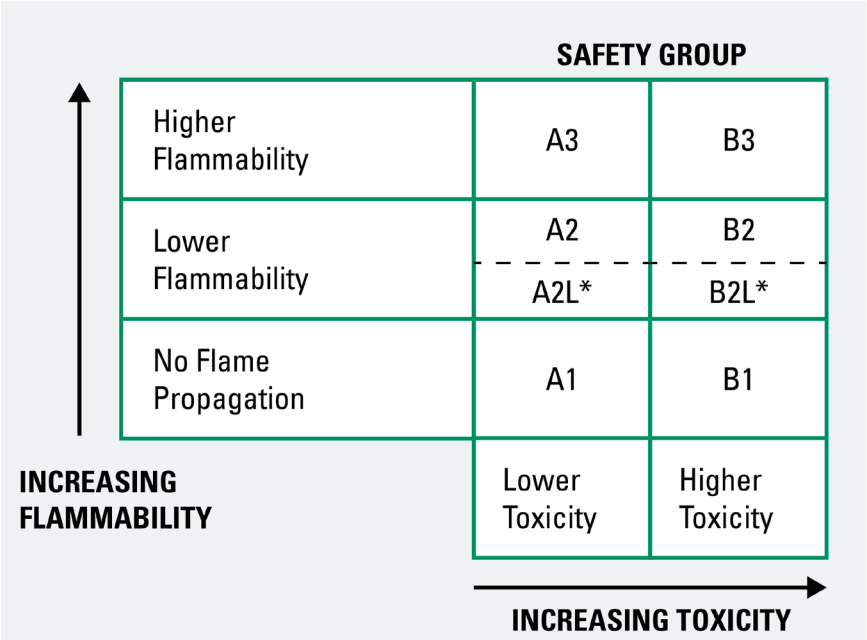
The Transition to A2L Refrigerants

The transition to A2L refrigerants signifies a change in thinking in the HVAC/R industry's approach to environmental sustainability. Unlike their high-GWP counterparts, A2L refrigerants have significantly lower global warming potential, making them a preferred choice for reducing greenhouse gas emissions.

Driven by regulatory initiatives such as those by the EPA, the transition to A2L refrigerants reflects a broader global effort to phase out HFCs and transition towards more environmentally friendly alternatives. Countries and regions worldwide are implementing similar regulations and standards to address climate change and reduce reliance on high-GWP refrigerants.

Despite the environmental benefits they offer, A2L refrigerants pose unique challenges due to their flammability characteristics. While classified as mildly flammable, A2L refrigerants require careful handling and consideration to ensure safety in HVAC/R systems where potential sources of ignition are present.

Figure 1: Safety Classifications of Refrigerants



* A2L and B2L are lower flammability refrigerants with a maximum burning velocity of ≤3.9 in/s (10 cm/s).

Safety Considerations and HVAC/R Equipment

One of the key concerns surrounding the use of A2L refrigerants in HVAC/R systems is the potential risk of ignition. Electrical components, such as DP contactors and electromechanical relays, are integral to the operation of HVAC/R equipment and can pose a risk of ignition if not designed properly and certified for use with flammable refrigerants.

DP contactors and electromechanical relays play a critical role in controlling the flow of electricity within HVAC/R systems. Their function involves the opening and closing of electrical circuits to regulate the operation of compressors, fans, and other system components. In the presence of A2L refrigerants, DP contactors and electromechanical relays must be designed and tested to ensure they do not pose a risk of ignition or contribute to the propagation of flames during normal operation or in the event of a fault.

Certification Programs for A2L Compliance

To address safety concerns and ensure compliance with A2L refrigerants, organizations have developed certification programs to assess the compatibility and performance of electrical components in HVAC/R systems. UL Solutions, a leading provider of safety certification services, has introduced a specialized program tailored for A2L compliance.

The UL Solutions certification program for A2L compliance establishes rigorous testing and evaluation criteria to assess the safety and performance of DP contactors and other electrical components. Now, HVAC/R equipment manufacturers can more easily achieve safe designs and UL compliance by utilizing the list of certified components that now exists. And for suppliers, having your components included in the specialized certification category means HVAC/R equipment manufacturers will have confidence that the parts have met rigorous testing specifications, and will streamline the certification of their products.

The LZGH2/8 component category was developed for UL 60335-2-40, the Standard for Household and Similar Electrical Appliances – Safety – Part 2-40: Particular Requirements for Electrical Heat Pumps, Air-Conditioners and Dehumidifiers. (“New Component Category Is the Smart and Simple Pathway ... - UL Solutions”) Nevertheless, manufacturers can leverage the component category under the adjacent IEC standards as well. Presented as part of a CB report, certificates and test reports of components according to LZGH2/8 enable customers to prove the absence of any ignition source inside the unit according to Clause 22, which enables UL to waive IEC 60335-2-40 ANNEX FF testing. (“New Component Category Is the Smart and Simple Pathway ... - UL Solutions”)

By achieving certification through programs such as those available from UL Solutions, HVAC/R manufacturers and OEMs can demonstrate compliance with regulatory requirements and provide assurance to customers regarding the safety and reliability of their equipment.

Conclusion

The transition to A2L low GWP refrigerants represents a significant milestone in the HVAC/R industry’s journey towards environmental sustainability. While offering promising environmental benefits, the adoption of A2L refrigerants necessitates careful consideration of safety concerns, particularly regarding potential sources of ignition in HVAC/R equipment.

Certification programs, such as those offered by UL Solutions, play a critical role in ensuring the

compatibility and safety of electrical components, such as DP contactors and electromechanical relays, in A2L-compliant HVAC/R systems. By adhering to rigorous testing and evaluation criteria, manufacturers can mitigate risks and provide customers with confidence in the reliability and performance of their equipment.

Littelfuse definite purpose contactors comply with the A2L refrigerant requirement of UL Category Control Number (CCN) LZGH2/8 for Annex JJ of UL 60335-2-40. ■



Andy Wu is the Senior Field Application Engineer for the Industrial Business Unit. Andy joined Littelfuse in 2021 from the acquisition of Hartland Controls LLC as a Product Engineer. His current responsibilities include providing technical support and engineering solutions to our customers in addition to assisting with the preparation of technical & marketing materials. Andy earned his BS in Mechanical Engineering from University of Illinois at Chicago.

References:
New Component Category Is the Smart and Simple Pathway to A2L Compliance: UL Solutions, July 2020
ASHRAE Standard 34: Safety Group Classifications, April 2023, ASHRAE

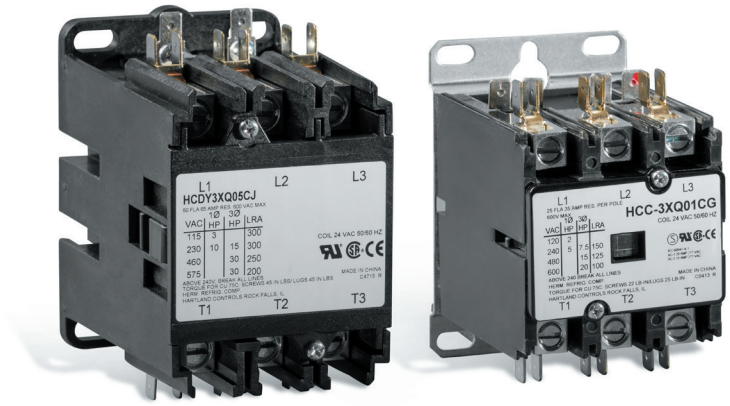


Figure 2: Littelfuse HCC and HCD Series Definite Purpose Contactors

As the industry continues to transition towards A2L refrigerants, collaboration between regulatory agencies, industry stakeholders, and certification bodies will be essential to facilitate a smooth and successful transition. Through collective efforts and adherence to safety standards, the HVAC/R industry can embrace the benefits of A2L refrigerants while ensuring the safety and reliability of equipment for years to come.

Littelfuse Definite Purpose Contactors

Littelfuse Definite Purpose Contactors are electromechanical switching devices designed and engineered for switching on and off heating, ventilation, air conditioning, and refrigeration (HVAC/R) applications. They are meant to switch high-current circuits for specialized inductive and resistive loads. These loads include, but are not limited to, compressors, pumps, and electric heating and lighting applications.



The Comfort Zone – Heating, Ventilation and Air Conditioning (HVAC)



Creature comforts definition: things that contribute to bodily comfort and ease, such as a hot meal, a comfortable bed, hot water, warmth, cool, etc.

I am very thankful to have two of those in my personal vehicles and my home. Air conditioning, and even factory heaters, have not always been available in automobiles. Air conditioning in homes was not common until the 1960s. I lived in Houston long enough to learn about the debilitating heat and humidity. Before HVAC became affordable for homeowners, the Houston population was around 596,000. With a home where you could escape the heat and humidity, the population soared to 1.3 million by the end of the '60s.

It is also hard to believe that it wasn't until 1962 that hot water-based heaters became standard on General Motors® vehicles. In fact, heaters were optional in the industry until the Motor Vehicle Safety Standards required a windshield defroster starting in 1968. The only way to do that was to make heaters a standard accessory on all cars.

In previous articles, I have mentioned my first vehicle was a 1951 Chevrolet® pickup. It did have A/C, a 250 model; open the two-wing windows and go 50 MPH or 80 KPH. Note that wing windows, also known as wing vents, went away by the 1980s as automobile air-conditioning became more popular.

My old truck did not have a heater. I kept an old quilt in it for longer trips. If I had a date in the winter, I would bring an extra quilt.

Our ancestors would heat up bricks and place them in the cab for a little warmth. I wish I would have thought of that for the 'ole truck. Optional add-on heaters included coal burning stoves, gasoline burning heaters and heat exchangers around the exhaust were all used.

Packard® introduced a primitive form of air conditioning in 1939. Unfortunately, it did not work so well. First off, the evaporator and blower system took up half the trunk space. It did not have an adjustable thermostat; it was either on full blast or off. All the plumbing running from the engine to the trunk made it very inefficient. Oh, and the cost of the system was $274, with the starting price for the car was $1,099. With today's money, $274 would be $6,003!

During the '70s, nearly all new cars were being produced with air conditioning as standard equipment, except for Datsun®. Other imports, I am sure, would ship them with no A/C and then the dealership would install as an option after someone purchased the vehicle. Being of low seniority at that time, the above-mentioned and radio installs became my job. I did get good at A/C work and I definitely learned how to charge auto air conditioning.

With today's technology, HVAC work can be one of the most profitable types of work a shop or a tech can do. However, it can also be highly subject to a comeback if not serviced thoroughly, and a comeback is the biggest "profit killer" there is. The only thing worse

than a comeback is they don't ever come back.

Case study – 2014 Chrysler® 300:

The customer states that on hotter days, the A/C does not work as well as it used to when it was new. The car has over 58,000 miles or 93,341 km. Another big hint perhaps, the A/C had been serviced at a discount repair shop

Diagnostic Strategy

-Should we check pressures and vent temperatures first?

-It's 80°F degrees or 27°C in the shop.

-It's 45°F or 7°C at the vent.

-Low pressure = 60 PSI

-High pressure = 230 PSI

Both low and high pressures are high, aren't they? So, what could cause that?

It looks like the cause could be due to refrigerant overcharge or air in the system as there was some cooling at the vent, right? Remember, the customer said it wasn't cooling as good as it used to and had it serviced at a "discount" place. I have a feeling that it was overcharged and probably still has another problem.

Today's vehicles call for much more accuracy when charging an A/C system because they require way less refrigerant than ever before.



Any system using less than 24 oz., or 680 grams, is considered a critical charge system with an accuracy level of as much as +/- 15 grams or +/- .5 oz., commonly considered tolerable. Many manufacturers of AC equipment push the limit and use economy scales that would only have +/-15 grams accuracy. Snap-on uses scales with a +/- 10-gram accuracy to ensure critical charge vehicles do not get overcharged, resulting in a comeback or a no comeback like in this case study.

Obviously, a complete evacuation and recharge of the car's air-conditioner is step one.

- Retest results

-Low pressure = 42 PSI

-High pressure = 185 PSI

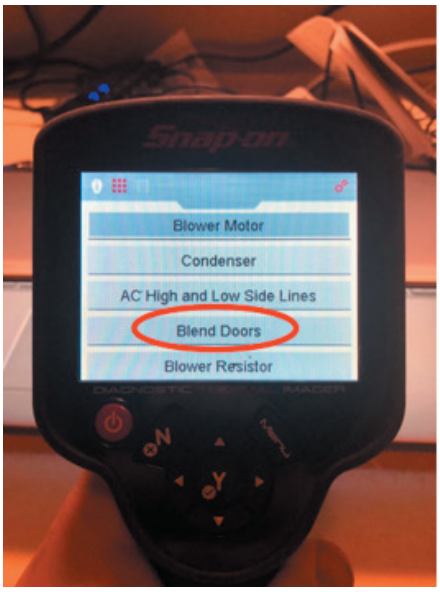
Both pressures are where they should be.

Temperature Pressure Chart		
Ambient Temperature °F/°C	Low-Pressure Gauge	High-Pressure Gauge
65°F (18°C)	25-35 psi/172-241 kPa	135-155psi/931-1069 kPa
70°F (21°C)	35-40 psi/241-276 kPa	145-160psi/1000-1103 kPa
75°F (24°C)	35-45 psi/241-310 kPa	150-170 psi/ 1034-1172kPa
80°F (27°C)	40-50 psi/276-345 kPa	175-210 psi/ 1207-1448 kPa
85°F (29°C)	45-55 psi/310-379 kPa	225-250 psi/ 1551-1724 kPa
90°F (32°C)	45-55 psi/310-379 kPa	250-270 psi/ 1724 - 1862 kPa
95°F (35°C)	50-55 psi/345-379 kPa	275-300 psi / 1896 - 2068 kPa
100°F (38°C)	50-55 psi/345-379 kPa	315-325 psi / 2172 - 2241 kPa
105°F (41°C)	50-55 psi/345-379 kPa	330-335 psi / 2275 - 2310 kPa
110°F (43°C)	50-55 psi/345-379 kPa	340-345 psi / 2344 - 2379 kPa
Ambient temperature is the outside atmospheric temperature.		

Low Side	High Side	Duct Temp	Possible Cause
Low	Low	Warm	Low refrigerant charge
High	High	Warm	Overcharge of refrigerant
High	High	Some Cool	Air in the system or overcharge
Normal	Normal	Warm	Mositure in the system
Low	Low	Warm	Expansion valve stuck closed
Low	Low	Warm	Orfice tube plugged
Low	Low	Warm	High side restriction
High	Low	Warm	Compressor or control valve failed



The temperature at the vent is only three degrees colder. Not bad, but I bet on a hot day it would not be as cold as it "used to be when it was new." Could we have an air distribution problem?





Click here for more on this topic, and for so much more, visit **Snap-on's technical article pages.** ■



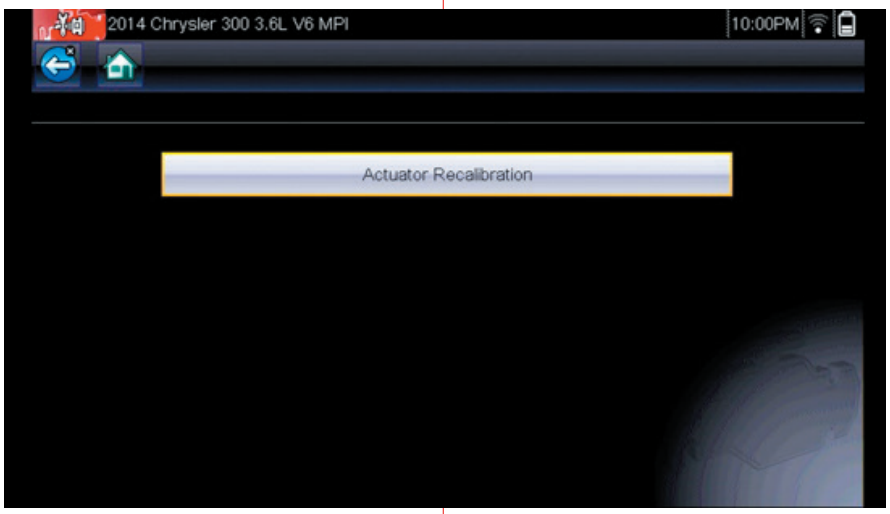
Keith Wray
Snap-on
The Comfort Zone – Heating, Ventilation and Air Conditioning (HVAC)

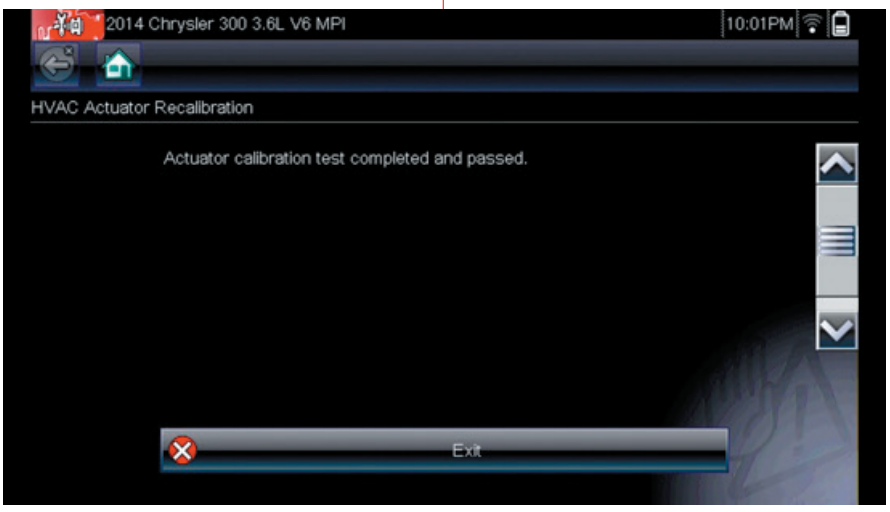
They say a picture is worth a thousand words, so let's take a look at some above. Using a thermal imager with the A/C on max and the blend doors set on the dash vents, we grabbed this image showing the culprit. Toward the bottom of the picture, we see two dash vents to the right of the steering wheel (see the green squares) and three defroster vents on top of the dash (see the green circles). There should be zero cold air hitting that hot windshield, right? The hot glass would warm that cold air up before it got the passengers. In fact, on hotter days this A/C would not get as cold as it used to when it was new.

Now, the blend door actuator is either bad or out of calibration, which is pretty common on certain OEMs. Let's get a scan tool and see what we can do.

The screen shots to the left show that there is a recalibration function that should solve the issue by making sure the blend door swings all the way closed in the dash vent position. If the calibration fails, it indicates a bad actuator or something obstructing the door.

To finalize this case, a great habit to have with any HVAC repair is to replace the cabin air filter. Restricted air flow is always a common culprit of inefficient A/C.





What's Happening

High Current Ring Terminals for Ultrasonic Welded Wire Attachment



A new line of heavy-duty locking ring terminals especially designed for the secure ultrasonic welded wire attachment process preferred in high current applications is being introduced by ETCO Incorporated of Bradenton, FL.

ETCO BT-Series Heavy-Duty Battery Terminals are made from 0.060'' thick brass or copper for maximum conductivity and are designed to be ultrasonic welded for use in any high current application. Featuring four teeth that extend 0.065'' from the terminal surface of the ring, their sharp wedges bite into metal and anchor the terminal to help prevent unwanted rotation.

Suited for attaching 0-6 Ga wire by automated equipment, ETCO BT-Series Heavy-Duty Battery Terminals have an insulation support to bend around the wire jacket insulation. They are ideal for virtually any high voltage wiring including EV batteries, alternators and starters in automotive, AG and construction equipment, process control, and trucking applications.

ETCO BT-Series Heavy-Duty Battery Terminals are priced according to size and quantity; manufactured in the USA.



Vitrek Hires New President Gary Schafer to Build Synergies Among Company's Signature Brands Used in Key Industries

Vitrek is positioning its multiple brands -- Vitrek, GaGe, MTI Instruments – as a company offering a unique selection of test and measurement instruments used in a wide range of applications

Gary Schafer, Vitrek President

''Vitrek is getting out the message that we offer a vast selection of test systems, instruments and software for many different-yet-synergistic applications – from test and measurement to data acquisition and signal recording, to engine vibration and balancing,'' said Don Millstein, Vitrek's CEO. ''With his proven record and experience, Gary Schafer is the ideal choice as our new president. With the support of Michelle Sweetman heading up marketing, Gary will help us educate the test-engineering community that Vitrek is a one-of-a-kind company with all the necessary product capabilities to support key, global industries.''

Vitrek's signature brands combine to serve the needs for precision instrumentation for use in semiconductor manufacturing, aviation and aerospace, electromobility, and many other industries. Products include:

- Vitrek - Test & Measurement: Hipot testers, power analyzers, electronic loads and high-voltage instruments
- GaGe - Digitizers & RF Recording: High-speed digitizers, digital signal processors, signal recording systems
- MTI - Turbine Engine Machine Vibration & Balancing Systems: Measurement and analysis equipment, signal simulators, charge amplifiers, metrology systems

To learn more about Vitrek's extensive product portfolio, please go to: Vitrek.com.

GaGe, Signatec, and KineticSystems. Vitrek also supplies precision high voltage measurement standards to national laboratories and calibration labs around the world. This unique and complementary combination of product and engineering capabilities positions Vitrek as a leading provider of test solutions serving the photovoltaic, medical equipment, power conversion, electrical/electronic component, semiconductor, aerospace and appliance industries. Vitrek is an accredited ISO 17025 Calibration Laboratory and ISO 9001:2015 Certified organization.

Radix Wire & Cable Names New CEO



Radix Wire & Cable has named Jeremy Tuttle as its new CEO, replacing retiring CEO Jeff Leone. Leone will continue to serve on the Radix Board of Directors and provide guidance during the transition.

Tuttle joined the Radix team three years ago as the VP of Sales and Marketing and has been instrumental in growing the company's product line and revenue. Prior to Radix, Tuttle spent 14 years with ITW Powertrain Fastening, where he last served as the Director of Global Sales and Engineering, leading sales and engineering teams in the United States, Europe, and China.

"Jeremy has been a tremendous asset to Radix and our customers," said Leone. "His leadership has led to enhanced collaboration across departments, and he has a talent for motivating teams and delivering exceptional results."

Tuttle graduated from the University of Michigan with both a B.S. in Materials Science & Engineering and an MBA.

Leone added that Tuttle's strategic mindset, industry knowledge, and commitment to excellence will continue to strengthen Radix's operations and innovation, leading the company into a new era of growth and prosperity.



Radix Wire & Cable Welcomes John Roggenburk as New VP of Sales and Marketing

We are pleased to announce that John Roggenburk has joined the Radix team as the new VP of Sales and Marketing for the company's High Temperature Business Unit.

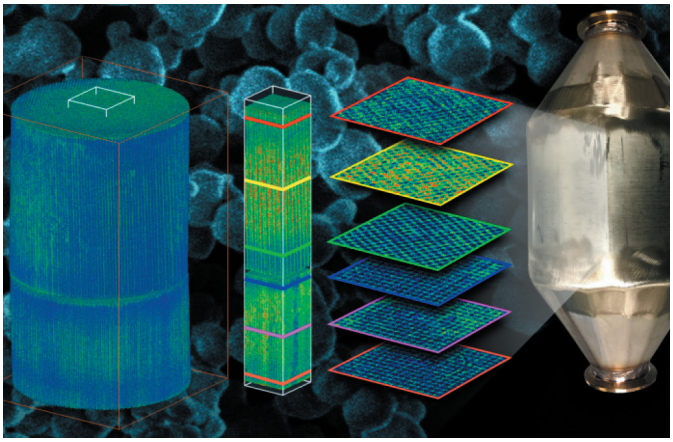
John joins Radix with 30 years of diverse commercial experience serving global aerospace, automotive, electronics, medical, packaging, and industrial markets. John's last position was VP of Global Marketing for Howmet Aerospace, where he led the marketing and inside sales organization. John has been successful at building and training a talented and focused sales force through coaching, market intelligence, incentive programs, and strategic hiring practices throughout his career. He is also heavily focused on new business development and brings his ability to recognize market trends and drive significant revenue growth and value for the organization.

John holds his Bachelor of Mechanical Engineering from University of Dayton and his MBA from DePaul University. In his spare time, John coach's youth basketball and soccer teams.

With his extensive background and experience, we are confident that John will be a leader in supporting and growing Radix Wire & Cable.

Add-on device makes home furnaces cleaner, safer and longer-lasting

Natural gas furnaces not only heat your home, they also produce a lot of pollution.



Even modern high-efficiency condensing furnaces produce significant amounts of corrosive acidic condensation and unhealthy levels of nitrogen oxides, carbon monoxide, hydrocarbons and methane. These emissions are typically vented into the atmosphere and end up polluting our soil, water and air.

Now, scientists at the Department of Energy's Oak Ridge National Laboratory have developed an affordable add-on technology that removes more than 99.9% of acidic gases and other emissions to produce an ultraclean natural gas furnace. This acidic gas reduction, or AGR, technology can also be added to other natural gas-driven equipment such as water heaters, commercial boilers and industrial furnaces.

"Just as catalytic converters help reduce emissions from billions of vehicles worldwide, the new AGR technology can virtually eliminate problematic greenhouse gases and acidic condensation produced by today's new and existing residential gas furnaces," said Zhiming Gao, staff researcher with ORNL's Energy Science and Technology Directorate. "An eco-friendly condensate eliminates the need to use corrosion-resistant stainless steel materials for furnace heat exchangers, which reduces manufacturing costs."

To demonstrate the effectiveness of acidic gas reduction in a furnace, the researchers fabricated an AGR catalyst, enclosed it in a metal housing and installed the device on a standard commercially available high-efficiency condensing furnace. Results after a 400-hour reliability and durability test showed the AGR almost completely removed harmful emissions from the flue gas and produced a nonacidic condensate with a neutral pH level.

To examine the internal condition and soot distribution of the post-test AGR without damaging the device's gas flow-through channels, the scientists used neutron computed tomography at ORNL's High Flux Isotope Reactor, or HFIR. Unlike X-rays, neutrons can penetrate the metal housing to record images that are then used to produce 2D and 3D representations of the used device.

"Such insights will enable improved AGR device designs for a more uniform and self-cleaning gas flow pattern," said Gao. "This will also help alleviate excessive soot accumulation to enhance AGR-enabled furnace performance."

Soot particles, which typically form because of the incomplete combustion of hydrocarbons, contain substantial hydrogen. Neutrons are especially good at detecting and mapping hydrogen and other light elements.

"Neutron imaging and mapping after the AGR test provided details about how the flue gas flowed through the AGR, which revealed the heavy accumulation of soot particles in the middle of the catalyst," said ORNL's Yuxuan Zhang, a neutron instrument scientist at HFIR.

AGR technology would allow furnace manufacturers to use materials that are more affordable than the stainless steels used in most heat exchangers. This increased affordability could allow furnace manufacturers to sell more high-efficiency furnaces that meet California's proposed new standards for residential and commercial furnace emissions.

"Currently, AGR-enabled furnaces would require offline regeneration of the device about once every three years under normal use conditions," Gao said. "The AGR unit could be removed by a homeowner or technician and carried to a regeneration and recycling location. This would be similar to how consumers bring their empty natural gas tanks for their outdoor grills to a dealer to exchange them for full tanks."

In 2022, the ORNL AGR technology received a coveted R&D 100 award and was selected for targeted investment through ORNL's Technology Innovation Program.

The research was sponsored by the DOE Building Technologies Office and used resources at ORNL's Building Technologies Research and Integration Center, HFIR and the Center for Nanophase Materials Sciences, or CNMS.

HFIR and CNMS are DOE Office of Science user facilities. UT-Battelle manages ORNL for the Department of Energy's Office of Science, the single largest supporter of basic research in the physical sciences in the United States. The Office of Science is working to address some of the most pressing challenges of our time. For more information, please visit energy.gov/science. – by Paul Boisvert

TTI Announces Organization Changes Building upon a Legacy

Mike Morton, TTI CEO, today announced organizational changes are underway to support the growth of the legacy distributor and its parent company known as TTI, Inc., while separately recognizing the operating segment of the company, TTI IP&E.

Commenting on this new internal alignment, Morton offered, "TTI has become synonymous as both a Berkshire Hathaway owned parent company and an operating company specializing in IP&E components." TTI has been evolving toward internally recognizing the parent company as TTI, Inc., and the operating company as TTI IP&E. This restructure will not affect our business partners – we simply will continue to be known as TTI."

To support the global and regional functions taking place within the company, the following leadership promotions have been announced and are noted to be effective March 1, 2024.

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John Drabik, President, TTI Americas steps into the new position of Global President TTI IP&E. Geoff Imlach, Vice President, TTI Sales Americas, is positioned to succeed Drabik as President, TTI IP&E Americas.

Reporting to Drabik will be the IP&E regional presidents along with Jeff Ray, Senior Vice President Global Strategic Accounts and Jim Hawersaat, Senior Vice President Transportation Business Unit.

Further, Melanie Pizzey, has been named to the position of Corporate Senior Vice President Strategic Initiatives and Business Transformation. John Archer, Senior Vice President Ethics and Compliance, General Counsel, moves into position as Corporate Senior Vice President and Chief Administrative Officer for TTI, Inc. Pizzey and Archer continue to report directly to Mike Morton as TTI, Inc. executive staff.



Michael Mann, a Leading Climate Scientist, Wins His Defamation Suit

The researcher had sued two writers for libel and slander over comments about his work. The jury awarded him damages of more than $1 million.

The climate scientist Michael Mann on Thursday won his defamation lawsuit against Rand Simberg, a former adjunct scholar at the Competitive Enterprise Institute, and Mark Steyn, a contributor to National Review.

The trial transported observers back to 2012, the heyday of the blogosphere and an era of rancorous polemics over the existence of global warming, what the psychology researcher and climate misinformation blogger John Cook called "a feral time."

The six-member jury announced its unanimous verdict after a four-week trial in District of Columbia Superior Court and one full day of deliberation. They found both Mr. Simberg and Mr. Steyn guilty of defaming Dr. Mann with multiple false statements and awarded the scientist $1 in compensatory damages from each writer.

The jury also found the writers had made their statements with "maliciousness, spite, ill will, vengeance or deliberate intent to harm," and levied punitive damages of $1,000 against Mr. Simberg and $1 million against Mr. Steyn in order to deter others from doing the same.

"This is a victory for science and it's a victory for scientists," Dr. Mann said.

In 2012, Mr. Simberg and Mr. Steyn drew parallels between controversy over Dr. Mann's research and the scandal around Jerry Sandusky, the former football coach at Pennsylvania State University who was convicted of sexually assaulting children. Dr. Mann was a professor at Penn State at the time.

"I am pleased that the jury found in my favor on half of the statements at issue in this case, including finding my statement that Dr. Mann engaged in data manipulation was not defamation," Mr. Simberg said in a statement emailed by his attorney.

Mr. Steyn's manager, Melissa Howes, wrote in an email: "We always said that Mann never suffered any actual injury from the statement at issue. And today, after twelve years, the jury awarded him one dollar in compensatory damages. The punitive damage award of one million dollars will have to face due process scrutiny under U.S. Supreme Court precedent."

The two sides argued for days about the truth or falsity of the posts, presenting evidence that included unflattering emails between Dr. Mann and colleagues, excerpts from investigations by Penn State and the National Science Foundation that cleared Dr. Mann of academic misconduct, other scientists who testified that Dr. Mann had ruined their reputations, and a detailed but controversial critique of his research methods by a statistician.

"It's constitutionally deliberately hard to win defamation suits in cases involving matters of public concern and prominent public figures," said RonNell Andersen Jones, a law professor at the University of Utah.

Mr. Simberg and Mr. Steyn testified that they sincerely believed what they wrote.

In statements in court at the beginning and again at the end of the trial, Mr. Steyn said he stood "on the truth of every word I wrote about Michael."

"Inflammatory does not equal defamatory," said Mr. Simberg's attorney, Victoria Weatherford, in her closing statement. "Rand is just a guy, just a blogger voicing his truly held opinions on a topic that he believes is important. That is an inconvenient truth for Michael Mann."

Dr. Mann argued that he lost grant funding following the blog posts and that he had been excluded from at

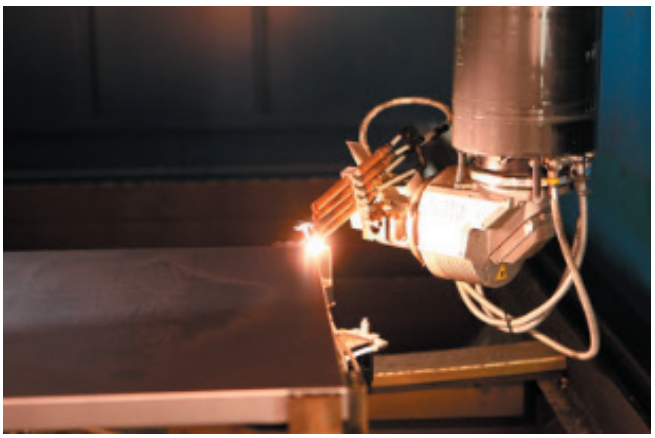
least one research collaboration because his reputation had suffered. The defendants argued that Dr. Mann's star continued to rise and that he is one of the most successful climate scientists working today.

The presiding judge, Alfred Irving, emphasized to the jury that their job was not to decide whether or not global warming is happening. ''I knew that we were walking a fine line from a trial concerning climate change to a trial concerning defamation,'' he said earlier while discussing which witnesses to allow.

The story of this lawsuit isn't over.

In 2021, Judge Irving, along with another D.C. Superior Court judge, decided that the Competitive Enterprise Institute and National Review could not be held liable. The publishers did not meet the bar of ''actual malice'' imposed on public figures suing for defamation, the judges ruled, meaning employees of the two organizations did not publish Mr. Simberg and Mr. Steyn's posts knowing them to be false, nor did they have ''reckless disregard'' for whether the posts were false.

Dr. Mann's attorneys have indicated that they will appeal this earlier decision. Asked about Competitive Enterprise Institute and National Review, John Williams said, ''They're next.''



Estes Supplies ISO 9001-Certified Sheet Metal Design and Manufacturing

As a leading ISO 9001-certified sheet metal fabricator of components and assemblies for the HVAC and appliance industries, Estes Design and Manufacturing, Inc. works with multiple material types with the highest level of precision and expertise. The core of its operations is a commitment to innovation and the use of automated technology to ensure tailored solutions with unmatched flexibility and reactivity.

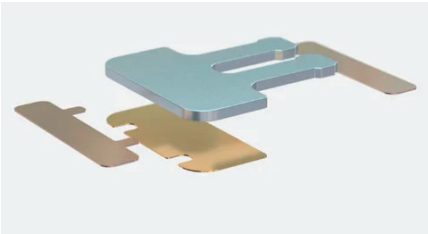
When collaborating with customers on new product ideas, Estes provides design, rapid prototyping and manufacturing services for complete support during the entire development cycle, serving as a valuable resource for its customers' design teams. Using Design for Manufacture and Assembly (DFMA), the company ensures that customers' products can be efficiently manufactured, while maintaining aesthetics and functionality, and their dedicated product development and prototyping personnel ensure that customers' speed-to-market goals can be achieved.

''At Estes, we don't just manufacture sheet metal parts and components, we forge partnerships and deliver excellence,'' said Tim Estes, President of Estes Design and Manufacturing Inc. ''With today's mindset of 'innovate or die,' we've assembled a core group of engineers that challenge modern methods and seek to improve on current fabricating processes. Our aim is to reduce lead-times with the end goal of assisting our customers in reducing their costs.''

Paired with its expert engineering, Estes incorporates Lean Manufacturing initiatives along with the latest, state-of-the-art technology and automation to further strengthen customer responsiveness. This allows the company to reduce processing time for the fabrication of extremely complex parts at the highest quality possible.

Among its advanced capabilities, Estes' 3D laser welding significantly reduces production time, with welding speeds that are 10 and 40 times faster than MIG and TIG welding, respectively. Additionally, 3D laser welding can produce highly aesthetic welds that minimize requirements for post-weld or finishing operations, resulting in further cost savings for customers.

Estes specializes in light-gauge sheet metal fabrication for carbon steel, stainless steel and aluminum. Part processing capabilities range from 24-gauge sheet metal to ¼'' plate to bar and tube stock. The company will also fabricate other material types and alloys per customer request.



Menlo Micro Brings in Power Products Business Unit Leader to Continue Proliferating its Industry-Leading Technology

Leadership Expansion will Drive Market Development and Strategic Growth to Power Market

Menlo Microsystems, Inc. (Menlo Micro), the company responsible for bringing to market the greatest electronic component innovation since the transistor with

its Ideal Switch® technology, today announced that it will be expanding its senior leadership team by hiring Chris Umminger as the company's Vice President of Power Products. Mr. Umminger will oversee the newly formed Power Products Business Unit and will report directly to the Chief Operating Officer (COO), Yalcin Bulut.

Mr. Umminger joins Menlo Micro after serving as Senior Director of Power Path Products at Linear Technology and Analog Devices. There he led the development of integrated circuits that controlled, protected, and monitored power. As head of the Power Products Business Unit, Mr. Umminger will help drive Menlo Micro's power switch technology which has been sampling with various early-access customers since 2023.

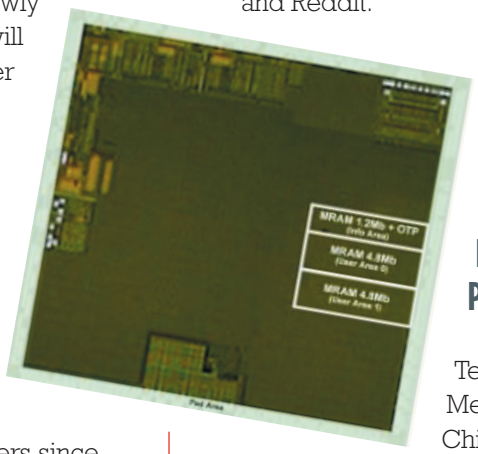
"We are very excited to have Mr. Umminger join us at Menlo Micro. With decades of experience in the power market, strong design expertise and his former experience of working with high-level customers on product definition and design, he will help support Menlo Micro's vision of bringing disruptive power product technology to the market." said Yalcin Bulut, COO. "We have already started building strong customer engagements with our ultra-low on-resistance MM9200 Ideal Switch and I am confident that Mr. Umminger will accelerate this trajectory."

"Menlo Micro's strong, innovative, and impressive product portfolio coupled with its expanding market presence drew me to the company," noted Mr. Umminger. "This is an exciting time in Menlo Micro's strategic growth, and I look forward to helping deploy the Ideal Switch® technology in power applications."

Mr. Umminger holds a bachelor's degree in electrical engineering from the California Institute of Technology (CalTech) and has a master's and PhD degree (both in electrical engineering) from the Massachusetts Institute of Technology (MIT).

About Menlo Microsystems, Inc.

Menlo Microsystems is on a mission to create a more energy efficient and sustainable world with an entirely new category of electronic switches. The Ideal Switch® eliminates compromises and tradeoffs by combining the benefits of electromechanical and solid-state switches into the best of both worlds. Menlo Microsystems is bringing more than 99 percent reductions in size, weight, power, and cost to dozens of industries such as medical, aerospace and defense, telecommunications, consumer electronics, industrial IoT (Internet of Things), and test and measurement. For more information, visit menlomicro.com or follow the company on LinkedIn, X, and Reddit.



Renesas Develops Embedded MRAM Macro that Achieves over 200MHz Fast Random-Read Access and a 10.4 MB/s Fast Write Throughput for High Performance MCUs

High-speed Circuit Technologies and Silicon Measurement Results of MCU Test Chip Presented in ISSCC 2024

Renesas Electronics Corporation (TSE:6723), a premier supplier of advanced semiconductor solutions, today announced that it has developed circuit technologies for an embedded spin-transfer torque magnetoresistive random-access memory (STT-MRAM, hereinafter MRAM) test chip with fast read and write operations. Fabricated using a 22-nm process, the microcontroller unit (MCU) test chip includes a 10.8-megabit (Mbit) embedded MRAM memory cell array. It achieves a random read access frequency of over 200 MHz and a write throughput of 10.4-megabytes-per-second (MB/s).

Renesas presented these achievements on February 20 at the International Solid-StateCircuits Conference2024 (ISSCC 2024), held between February 18 and 22, 2024, in San Francisco.

As IoT and AI technologies continue to advance, MCUs used in endpoint devices are expected to deliver higher performance than ever. The CPU clock frequencies of high performance MCUs are in the hundreds of MHz, so to achieve greater performance, read speeds of embedded non-volatile memory need to be increased to minimize the gap between them and CPU clock frequencies. MRAM has a smaller read margin than the flash memory used in conventional MCUs, making high speed read operation more difficult. On the other hand, for write performance, MRAM is faster than flash memory because it requires no erase operation before performing write operations. However, shortening write times is desirable not only for everyday use, but also for cost reduction of writing test patterns in test processes and writing control codes by end product manufacturers.

To address these challenges, Renesas has developed the following new circuit technologies to achieve faster read and write operations in MRAM.

(1) Fast Read Technology

MRAM reading is generally performed by a differential amplifier (sense amplifier) to determine which of the memory cell current or the reference current is larger. However, because the difference in memory cell currents between the 0 and 1 states (the read window) is smaller for MRAM than for flash memory, the reference current must be precisely positioned in the center of the read window for faster reading. The newly developed technology introduces two mechanisms. The first mechanism aligns the reference current in the center of the window according to the actual current distribution of the memory cells for each chip measured during the test process. The other mechanism reduces the offset of the sense amplifier. With these adjustments, faster read speed is achieved.

Furthermore, in conventional configurations, there is large parasitic capacitance in the circuits used to control the voltage of the bitline so it does not rise too high during read operations. This slows the reading process, so a Cascode connection scheme (Note 1) is introduced in this circuit to reduce parasitic capacitance and speed up reading.

Thanks to these advances, Renesas can achieve the world's fastest random read access time of 4.2 ns. Even taking into consideration the setup time of the interface circuit that receives the MRAM output data, we can realize the random read operation at frequencies in excess of 200 MHz.

(2) Fast Write Technology

For the write operation, the high-speed write technologies for embedded STT-MRAM announced in December 2021 improved write throughput by first applying write voltage simultaneously to all bits in a write unit using a relatively low write voltage generated from the external voltage (IO power) of the MCU chip through a step-down circuit, and then used a higher write voltage only for the remaining few bits that could not be written. This time, Renesas takes into account that because the power supply conditions used in test processes and by end product manufacturers are stable, the lower voltage limit of the external voltage can be relaxed. Thus, by setting the higher step-down voltage from the external voltage to be applied to all bits in the first phase, write throughput can be improved 1.8-fold.

Combining the above new technologies, a prototype MCU test chip with a 10.8Mbit MRAM memory cell array was fabricated usinga 22 nm embedded MRAM process. Evaluation of the prototype chip confirmed that it achieved a random read access frequency of over 200 MHz and a write throughput of 10.4 MB/s at a maximum junction temperature of 125°C.

The test chip also contains 0.3 Mbit of OTP (Note 2) that uses MRAM memory cell breakdown to prevent falsification of data. This memory can be used to store security information. Writing to OTP requires a higher voltage than writing to MRAM, making it more difficult to perform writing in the field, where power supply voltages are often less stable. However, by suppressing parasitic resistance within the memory cell array, this new technology also makes writing in the field possible.

Renesas continues to develop technologies for embedding MRAM in MCUs (IEDM 2021, VLSI 2022). These new technologieshave the potential to dramatically boost memory access speed to over 200 MHz, enabling higher-performance MCUswith embeddedMRAM. Faster write speed will contribute to more efficient code writing to endpoint devices. Renesas is committed to further increasing the capacity, speed, and power efficiency of MRAM.

Notes

1. Cascode connection is a configuration to connect a common source transistor in series to a transistor with a DC gate bias applied.
2. One-Time-Programmable memory. Configuring a part of the MRAM memory array to be converted to OTP makes it possible to implement an OTP with a smaller area than a general OTP macro that uses eFuses or oxide film breakdown of transistors.



Robertshaw's Master Gas Regulator Now Available for All OEM Gas Stoves

New Regulator Cuts Methane Emissions 90% More Than ANSI Standard

Robertshaw, the global leader in integrated flow control technologies, today announced that its Master Gas Regulator is now available to kitchen stove original equipment manufacturers (OEMs) seeking to increase safety and significantly reduce gas leakage and greenhouse (GHG) emissions from their gas ovens, cooktops, and ranges.

Robertshaw's new patent-pending Master Gas Regulator incorporates a lockout feature that ensures, when activated, no gas would be supplied to the stove when it is not in use-even if a stove knob is accidentally turned on by a child or pet. When utilized, this lockout feature negates the need for a customer to purchase and install additional child safety covers for stove knobs. Unlike gas regulators from other competitors, this lockout feature is integrated into the regulator itself, eliminating the necessity for OEMs to buy additional components to accomplish the same functionality. Moreover, OEMs have the flexibility to customize how the lockout feature is triggered on the Master Gas Regulator.

The Master Gas Regulator stops the flow of gas from entering the delivery system when the stove is turned off-which is when 76% of most methane emissions occur, according to a publication in Environmental Science and Technology. The regulator cuts methane emissions through its electronically controlled positive shutoff. While the stove is in the off position, the regulator limits gas leakage across the entire system by 90% more than the American National Standards Institute (ANSI) industry standard, reducing it 200 cubic centimeters per hour to 20 cubic centimeters per hour.

''It was almost two hundred years ago when the first commercially- produced gas stoves were designed, and they remain to this day the preferred choice by home cooks and professional chefs alike,'' said John Hewitt, Robertshaw CEO. ''Today customers deserve access to high performance gas stoves that far surpass safety, energy efficiency, and environmental standards. We are proud to offer innovative solutions, like the new Master Gas Regulator and our gas burners, for kitchen stove manufacturers and customers who are seeking a safer and more sustainable future.''

Robertshaw's Gas Stove Burners: Enhanced Efficiency, Lower GHG Emissions

Robertshaw is at the forefront of developing more sustainable solutions that prioritize efficiency and emissions reduction. This includes gas stove burners currently available on the market, and those in development.

When paired with the Master Gas Regulator, Robertshaw's exclusive Dralo, Halo and G8 burners offer a significant reduction in GHG emissions, cutting them by 75%. These burners are designed for easy assembly, cleaner combustion, faster ignition (within 2 seconds compared to the ANSI standard of 4 seconds), and improved performance, such as faster boiling times. All three burners are currently available for kitchen stove OEMs.

Robertshaw is soon launching the G12 high-efficiency top burner, which increases efficiency by 10% and is compatible with future hydrogen blends up to 30%. This initiative aligns with broader efforts to reduce GHG emissions during combustion. Collaborating with the European Commission's THyGA initiative, the company is undergoing testing and certification to ensure its burners are compatible with hydrogen, supporting the Commission's goal of transitioning to a 20-30% hydrogen blend.

Essentra finalizes acquisition of BMP TAPPI



Essentra, a leading provider of essential components and solutions, has announced the finalization of the acquisition of BMP Srl., Italy's leading manufacturer of protective caps and plugs.

Based in Milan, Italy, BMP TAPPI has over 60 years of history and a track-record of consistent growth. BMP TAPPI manufactures and distributes an extensive range of protective caps and plugs from their Italian based facilities, serving thousands of customers predominantly across Europe, in multiple end-markets, including industrial equipment, automotive and metal fabrication sectors, and has been a trading partner to Essentra for over 20 years, with a well-established relationship.

With over 100 injection molding machines and located in a modern facility, BMP TAPPI's strong market position is well-invested, and further enhanced by its R&D capabilities focusing on developing more sustainable products, and a number of sustainably sourced products are already included within its current range.

The integration process is expected to take several months as we work to make all BMP and Essentra products available to all customers and will communicate further when they become available on our hassle-free platform.

Scott Fawcett, CEO of Essentra, commented: "I am pleased to announce the completion of BMP TAPPI, which represents our second bolt-on acquisition as a pure-play components business. This acquisition will strengthen Essentra's product portfolio, unlock further cross-selling opportunities, and will enhance the Group's manufacturing footprint in Europe."

BMP TAPPI will be led by Essentra's established Italian management team, who have successfully led the Group's existing business in Bologna since the acquisition of the Richco business in 2011, providing a strong base from which Essentra has been able to grow.



Copper Development Association Promotes Adam Estelle to President and CEO

The Copper Development Association Inc. (CDA), has named Adam Estelle as its new president and CEO, effective May 1, 2024. Estelle who most recently served as the association's vice president, will succeed Andrew G. Kireta, Jr. as the sixth leader of the association.

Estelle moves to the top executive position following nearly 16 years with the association. He joined CDA in 2008 and served as project engineer for seven years before becoming the director of rod and bar. Then in 2022, he became vice president of the association. During his tenure at CDA, Estelle led numerous strategic initiatives with impactful results, including raising market awareness to the antimicrobial properties of copper, demonstrating the high-speed machining advantages of brass rod, and developing new industry datasets and standards to protect the viability of the scrap stream. In addition, Estelle played an instrumental role in the development and implementation of CDA's new subscription-based business model which empowers members to set strategic priorities and align their CDA investment with where they see value.

"As president and CEO, Estelle is well equipped to oversee a team of subject matter experts who work toward CDA's mission of bringing the value of copper and its alloys to society to address the challenges of today and tomorrow!" said Michael O'Shaughnessy, Chairman of the CDA Board.

"I'm honored and incredibly grateful for the opportunity to lead the next chapter in CDA's bright future," Estelle said. "With a strong team in place, I look forward to sharpening our mission focus, enhancing our member value proposition, and strengthening our strategic partnership with the International Copper Association."

Electrical Safety & Compliance Testing for Appliance & Consumer Product Manufacturers



Electrical appliances, computers and peripherals, power tools and other devices found in the home and office environments must be tested to confirm adherence to a plethora of stringent certification standards.

The vast array of consumer devices for the home and office — from blenders and ovens to computers and high-definition LEDa TVs — are becoming increasingly sophisticated. Refrigerators, once basic electrical appliances, now often include adjustablespeed motor controls, digital displays and Bluetooth communications.

While the complexity and functionality found in this class of devices varies extensively, there is one thing they all have in common when products enter the market: proven safety compliance. It is a foregone expectation that electrical and electronic devices designed for consumer environments will have been tested and labeled as compliant according to applicable safety standards, which means bearing the mark of a Nationally Recognized Testing Agency (NRTL). Depending on where in the world the product will be operating, the labeling could have one or many of those listed in Figure 1.

Compliance Considerations



Figure 1. A sampling of NRTL product labeling certifying consumer product safety compliance.

Compliance with the applicable standards, which can vary widely from country to country, typically involves both mechanical and electrical safety considerations. Manufacturers must either submit samples of their products to an NRTL for testing or secure the authorization to conduct the tests themselves. The certification process is conducted to confirm compliance with the relevant standard(s). This compliance evaluation investigates two key areas:

- Construction - mechanical construction, spacing, clearances, etc.; and
- Safety - to ensure safe operation (even under highstress conditions).

The following list (Table 1) outlines the details typically required in the certification process. Many of these criteria (as noted in blue type) are confirmed by using electrical safety (hipot) testing devices.

Table 1: Criteria for Product Certification

- Marking and instructions
- Protection against access to live parts
- Starting of motor-operated appliances
- Power input and current
- Heating
- Leakage current
- Creepage distances, clearances and distances through insulation
- Moisture resistance
- Resistance to rusting
- Overload protection of transformers and associated circuits
- Terminals for external conductors, screws and connectors
- Radiation, toxicity and similar hazards
- Stability and mechanical hazards
- Mechanical strength & construction
- Supply connection & external flexible cords
- Internal wiring
- Recognized components

Table 1. Criteria for product certification with blue text indicates where hipot testing is required.

Safety Standards

The details of what constitutes a certified product is dependent upon hundreds of safety standards and the region of the world where the device will be sold and used. Fortunately, work is being done to harmonize this daunting number of international standards. For example, a recent article entitled, "UL 60335-1" explained, "Safety of Household and Similar Electrical Appliances," points out the nearly identical counterpart in The European IEC 60335-1 standard. Here is how this harmonization is described:

- In North America, IEC 60335-1 has been used as the basis for a tri-national standard between the United States (UL 60335- 1), Canada (CAN/CSA C22.2 No. 60335-1), and Mexico (NMX-J-521/1-ANCE). In the US, UL 60335-1, which is in its 6th edition, is harmonized to IEC 60335-1 as part of its participation in the HOUS (Household and Other Similar Equipment) category of the IECEE (IEC Electrical & Electronics Equipment.)
- In Europe, the harmonized standard is EN 60335-1 and defines how appliances may comply with European Directives, such as the low voltage directive. Unlike the United States, the EU recognizes most, if not all, of the 100+ part 2 standards related to specific products.

Product Classification

For purposes of this paper, the harmonized UL/IEC standards will be used to categorize various classes of consumer apparatus.

- Class 0 - Products are provided with basic insulation only as a provision for basic protection and have no provisions for fault protection. Due to the limited safety features, their application is limited to areas that are physically protected from the public with fences or other measures that restrict access.
- Class I - Products have basic insulation and must incorporate a protective earth (ground) connection to mitigate the risk of electric shock.
- Class II - Products feature additional safety precautions such as double insulation or reinforced insulation thereby eliminating the need for a protective earth (ground) connection. Therefore, Class II input power supplies must have a 2-pin input receptacle instead of the 3-pin input receptacles found on Class I input models.
- Class III - Products are designed to be supplied from a separated extra-low voltage power source. The voltage from a SELV supply is low enough that under normal conditions a person can safely come into contact with it without risk of electrical shock.

Types of Tests Required

Electrical safety test equipment utilized to perform the range of tests prescribed in Table 1 will need to perform one or many of the following test procedures:

- Hipot testing
- Ground continuity testing
- Ground bond testing
- Insulation resistance testing

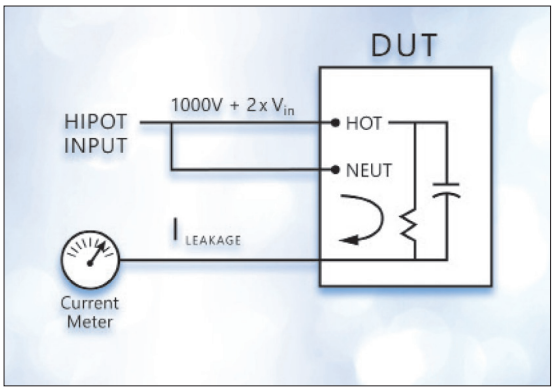


Figure 2. Hipot is applied to both conductors and leakage is measured in return circuit through the ground connection

Hipot Testing

Hipot is the short name for a high-potential (high voltage) dielectric withstand test. A hipot test checks for sufficient insulation and isolation between line and neutral to ground. Hipot testing is one of the minimum-production tests of consumer products. Defects that are often detected with the hipot test include contamination (dirt, debris) and lack of proper spacing (creepage and clearance) of components. Contamination would likely cause an unacceptable level of leakage current. Clearance problems could result in breakdown.

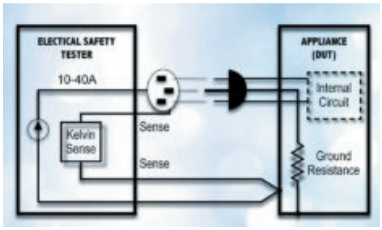


Figure 3. Ground continuity measures the resistance from the appliance's ground pin to the chassis.

Ground Continuity Testing

Ground continuity testing is performed to confirm that the conductive chassis of a device is safely connected to the earth ground pin on the power plug. This assures protection against shock hazards even if the equipment suffers an internal short to the chassis. The current would be shunted via the ground wire and would likely trip the breaker or blow the fuse. Ground continuity is performed by applying a low current (e.g. 50mA) and calculating the resistance from the ground pin on the power plug to selected locations on the exposed surfaces of the device under test, or DUT.

Ground Bond Testing

Where ground continuity measures the resistance of the safety ground connection, the ground bond test assures the integrity of the connection. Using the same test setup, a high current (up to 40A) is passed through the circuit. If the ground bond is solid, the current passes without a change in resistance. If weak, the resistive heating of the current would induce a failure of the bond. This is one area where the IEC and UL specifications differ. The EU standard commonly includes ground bond testing while the UL standard does not.

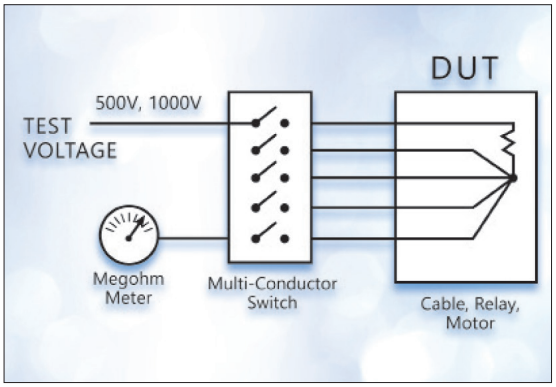


Figure 4. An insulation resistance test: voltage is applied to one conductor at a time while adjacent conductors are bundled. Resistance is calculated based on leakage current.

Insulation Resistance Testing

Insulation resistance testing is likely to be required in motor winding, transformer winding and other applications involving cabling or insulated wire. It typically involves confirming that the resistance exceeds a defined high-resistance value. In many instances, insulation resistance needs to be measured between several conductors. Examples include cable/connector assemblies, multiconductor cables and relays. To make this measurement, all the conductors except one are shorted together and the test voltage is applied from the remaining conductor across the bundled ones. Each wire is then, in turn, tested in this fashion (Figure 4.)

Application of the IEC/UL Standard

As noted, IEC/UL 60335-1 is a standard covering both mechanical and electrical aspects of the product. The specific area of the standard related to electrical conditions is Section 16.3. Common requirements for these tests include:

- Minimum output power rating of 500 VA
- Test voltages
  - 1250VDC - Class 0 and Class I
  - 1750VDC - Class II
- Basic test sequence
  - Ramp up from 0 V to Test Voltage - 5 seconds
  - Dwell at Test Voltage - 60 seconds

The 60335-1 standard also has a specific section (Annex A) that prescribes specific test conditions and pass/fail criteria utilizing the common requirements listed previously.

Annex A - Hipot

-Leakage Current:

- <5 mA (standard)
- <30 mA (high leakage equipment)

- Annex A - Ground Bond/Continuity

-Ground Bond Test Current: 10 A

-Ground Continuity Resistance

- Plug connected - <200 mΩ
- Hard-wired - <100 mΩ

ELECTRICAL SAFETY & COMPLIANCE TESTING

Vitrek Electrical Safety Testers

Vitrek is well equipped to provide the right equipment for every consumer product test, anywhere in the world. Here's a quick summary of the Vitrek product offering:

- **V7X Series Hipot Tester**



-V7X Series offers power, speed, accuracy & resolution
-AC & DC output voltages up to 5KV
-Accuracy & speed of calculations exceed industry standard
-Color touchscreen & automated test software available



- **95X Series Hipot Tester**

-95X Series offers power, speed,accuracy & resolution
-Wide range of AC/DC outputs up to 30 kV AC & 15 kV DC
-Accuracy and speed of calculations exceed industry standard
- 100 pA resolution for current
-Color touchscreen & automated test software available

- **964i High Voltage Switching**
  -964i HV switching for automated test systems
  -Multi-conductor/Milti-point
  -8 channels of HV switching cards (8 per card for a total of 64 test points)
  -Configurable voltage ratings - 3kV, 7kV, 10kV & 15kV



Vitrek Application Examples

Vitrek is the preferred source for electrical safety testing utilized by world-class consumer product manufacturers including:



- **Computer & Accessories**
  - Hewlett Packard - Palo Alto, CA
  - V7X & 964i for production line hipot testing

- **Small Consumer Appliances**
  - GE - Boston, MA
  - V7X & 964i for production line hipot testing





- **Large Consumer Appliances**
  - Sub-Zero Wolf - Madison, WI
  - 95X & 951i for production line ground bond testing

Conclusion

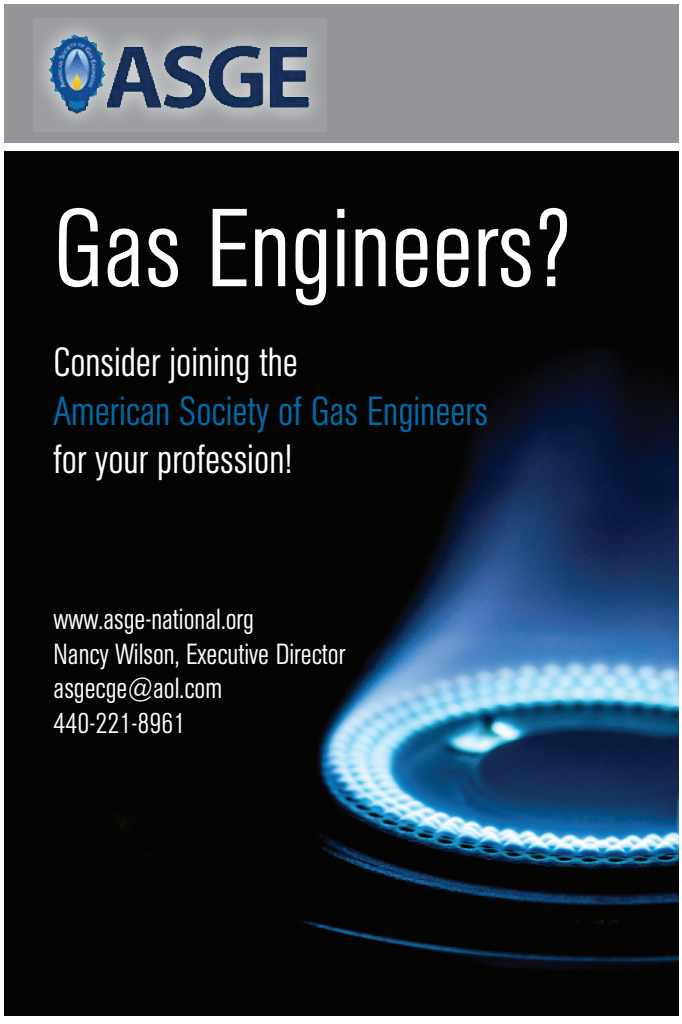
Basic appliances like refrigerators, toaster ovens, air conditioners, microwave ovens and many others have evolved to include a range of embedded electronics providing graphic displays, Bluetooth communications and other features. The IEC/UL 60335-1 standard provides a comprehensive roadmap for assuring that consumer appliances and other electrical/electronic devices found in the home are safe.

Many of these requirements are confirmed, both in the design stage as well as in production, using electrical safety (hipot) testers. Vitrek's line of electrical safety testers are ideal choices for this application.

- The 95X Series hipot tester features high output power with a wide range of output voltages combined with exceptional leakage current resolution
- The V7X Series hipot tester offers outstanding performance in a lightweight, lower-cost format

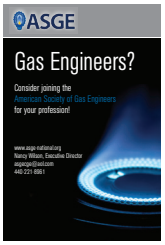
Vitrek hipot testers come standard with a variety of computer interfaces to simplify test automation and can be used with Vitrek's 964i Multi-Point Switching System & QT Enterprise software for test record management. Vitrek's decades-long experience in providing reliable, accurate and affordable test equipment is complemented by its application expertise, providing a complete solution to the full spectrum of consumer product safety testing - before, during and after the sale. For a FREE Product Demonstration email info@vitrek.com, visit www.vitrek.com/applianceindustrydemo/ or call (858) 689-2755. You can also view additional industry specific information including our webinar and application flyer at https://vitrek.com/consumer-product-appliance-industry-products/ ■

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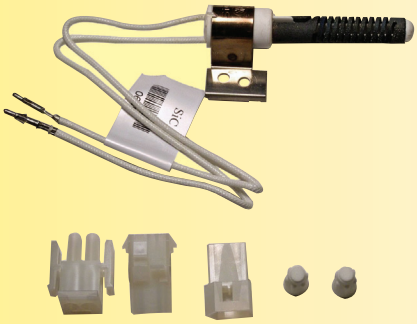
Brad Glazer, Founder and Publisher

(216) 233-6943 / brad@appliancehvacreport.com

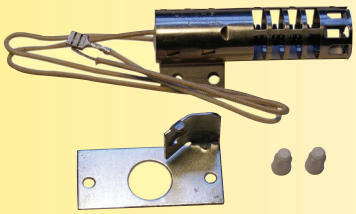
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