

Advancing Climate Control Systems

Presenters:

Jason Gildea, Head of Regional Product Management, TE Connectivity

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KEY TAKEAWAYS

- The A2L transition requires changes to HVAC relay design and compliance standards.
- EMI filters enhance HVAC system performance.
- Smarter connector design is required to meet evolving HVAC demands.

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OVERVIEW

Recent trends in the HVAC industry are shaping the future of industrial climate control. The A2L transition, evolving HVAC standards, and modern sustainability goals are driving changes in HVAC system design changes. From UL-compliant relays to EMI filters and miniaturized connectors, choosing cutting-edge HVAC system components can help OEMs achieve compliance with new regulations, ensure safety, and improve efficiency—all without sacrificing performance.

TE Connectivity’s innovative product lines, including A2L refrigerant compatibility, advanced EMI mitigation, and rugged, sustainable connectors, address the evolving needs of the industry. As a global leader in advanced technologies and solutions for industrial HVAC systems, TE Connectivity also draws on its extensive experience to provide complete end-to-end support, from design consultation to post-installation.

CONTEXT

The presenters shared evolving trends and new HVAC standards and explained how TE’s innovative climate control technology offers enhanced performance and compliance.

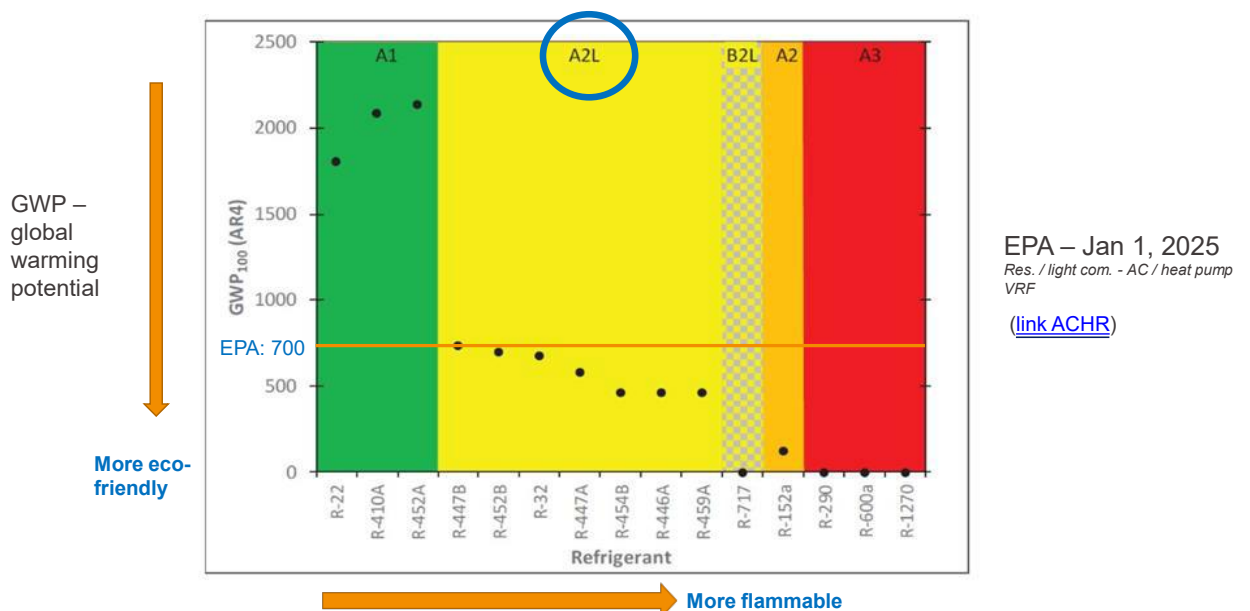
KEY TAKEAWAYS

The A2L transition requires changes to HVAC relay design and compliance standards.

The HVAC industry is undergoing a significant—and mandatory—shift toward low-GWP (global warming potential) refrigerants. The A2L transition requires any HVAC system designed from 2025 on to use A2L refrigerants, which are more eco-friendly than the traditional A1 gases used in older HVAC equipment.

However, because A2L refrigerants are more flammable, changes to the certifications of specific components that may cause sparks—such as electromechanical relays—are required to address ignition prevention and maintain safety.

Figure 1: Despite higher flammability, A2L refrigerants are considered a good compromise between safety and environmental impact



The Underwriters Laboratories (UL) 60335-2-40 provides standards for HVAC applications in which A2L refrigerants may be used. Specifically, UL 60335-2-40 Ed 3, Clause 22.116 offers guidance to HVAC OEMs on how to treat potential sources of ignition in applications such as:

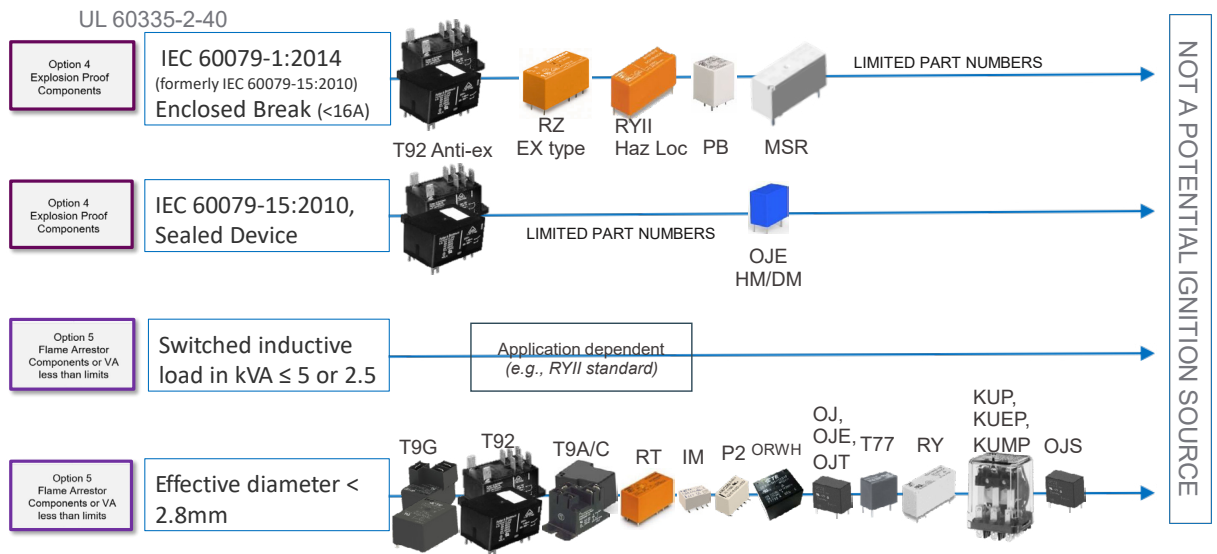
- Matched and packaged air conditioners/heat pumps
- Partial units (standalone systems)
- Liquid chillers
- Air handlers/hydronic fan coil units
- Hot water heat pumps
- Dehumidifiers
- Supplemental heaters

The clause includes a special certification for relays and switches for A2L applications.

“UL has specified how HVAC OEMs are to treat potential sources of ignition like relays... A couple of options [have] to do with the components used—this is where TE relays come into play ... we’ve been working on this for a few years in anticipation of this market coming and expanding.”

– Brian Lineberry, TE Connectivity

Figure 2: TE Connectivity offers a wide range of UL-certified relays for A2L applications



EMI filters enhance HVAC system performance.

Beyond the A2L transition, advancements in HVAC standards are also impacting system design, requiring the addition or replacement of EMI filters to enhance HVAC performance and meet compliance requirements.

EMI filters absorb unwanted electromagnetic noise generated by components such as relays, while at the same time allowing wanted signals to pass through. By reducing electromagnetic interference, EMI filters are critical in HVAC systems to ensure equipment reliability and compliance with electromagnetic compatibility standards.

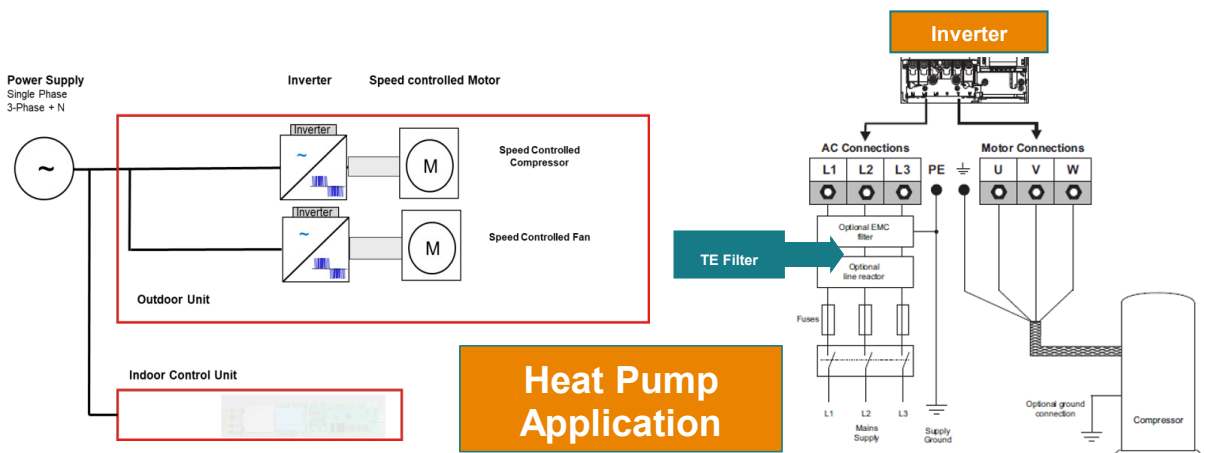
EMI filters provide HVAC manufacturers with higher-quality perception, reduced interference with other devices, and improved reliability and longevity. And as a preventative design measure, EMI filters provide a cost-effective solution and offer a potential reduction in warranty claims.

As the world’s largest manufacturer of EMI filters, TE Connectivity offers the greatest set of products available to customers globally. TE Connectivity’s EMI filters offer versatility across applications— heating units, cooling units, and heat pumps—and residential, commercial, and industrial compatibility. TE Connectivity conducts rigorous testing to ensure all its EMI filters meet reliability and compliance requirements, reduce energy losses, and minimize carbon footprint.

“Reducing energy losses and minimizing the carbon footprint is important not just to TE Connectivity in general, but also for EMI filters.”

– Jason Gildea, TE Connectivity

Figure 3: A TE Connectivity filter absorbs noise and diverts current away from sensitive components



Smarter connector design is required to meet evolving HVAC demands.

Connectors play a crucial role in HVAC systems: Connector failure means system failure. When designing HVAC connectors, engineers must consider and account for several factors that may impact connector function and lead to failure, including:

Harsh environments	Connectors need to be designed to withstand harsh environmental conditions, including extreme temperatures, humidity, dust, and debris. Designs must also account for corrosion resistance, moisture protection, and durability.
Space constraints	Connectors often must fit into tight enclosures yet remain accessible to field technicians for installation and maintenance, particularly in environments where connectors may require frequent servicing or upgrades.
Upgrades and adaptability	As HVAC systems become smarter, connectors must be flexible enough to support new functionality (e.g., sensors, actuators, communication modules) without a full system redesign.
Cost efficiency and compliance	Balancing the need for advanced features with cost efficiency is a priority in design. Connectors must also meet global compliance standards for safety and energy efficiency.

Achieving Key Design Goals with Connectors

TE Connectivity's connectors are designed to reduce application size while also managing power and signal usage and enabling increased performance in the harshest conditions.

TE Connectivity offers IP67-rated sealing options and ergonomics-friendly connectors that are glow wire tested (GWT), and come with optional terminal position assurance (TPA) and connector position assurance (CPA) for extra protection, with operating temperatures up to 150°C.

TE Connectivity offers a range of connector solutions to help engineers meet critical performance goals, including:

Safety: Safety is a top priority in system design, and TE Connectivity's connectors are built to protect both people and equipment. The connectors' low insertion force terminals reduce strain and repetitive motion injuries, as the force required to make connections can be reduced by as much as half. The connectors also help minimize fire and ignition risks while ensuring compliance with global HVAC safety standards.

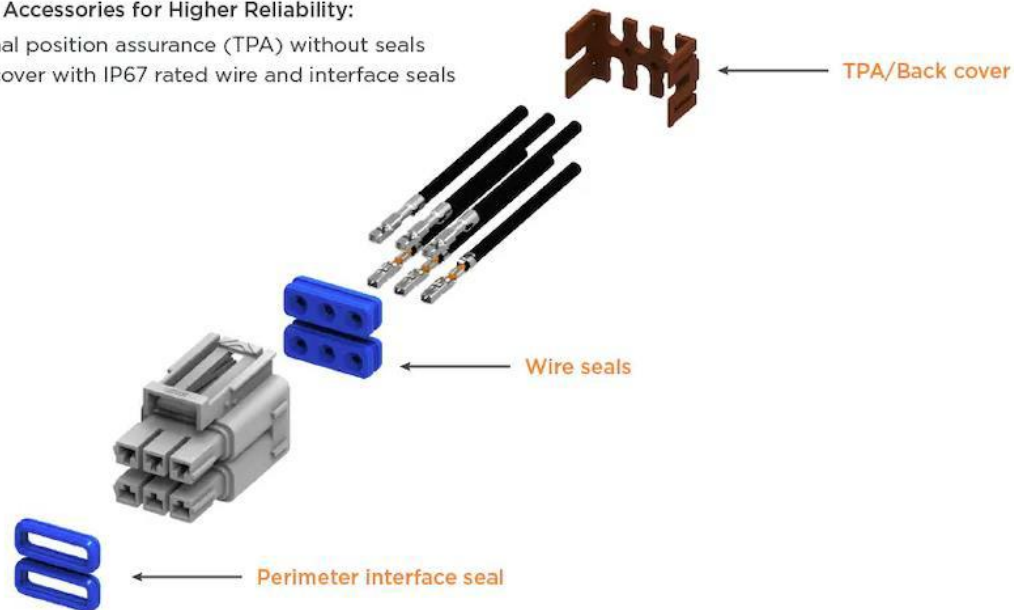
With the industry shift to A2L refrigerants, flammability readings are a significant safety consideration in HVAC design. UL 94 vertical burn (V) flammability ratings classify how quickly a material extinguishes after being ignited and whether it produces flaming drips. TE Connectivity offers both V-0 (higher safety margin, recommended for high-risk or critical systems) and V-2 rated connectors to help optimize design.

Harsh Environments: TE Connectivity's connectors are not only able to withstand harsh environments with exposure to moisture, dust, and vibration, but they also deliver consistent performance over the lifetime of the system. Design features such as wire seals and interfacial seals provide IP-rated protection, while optional accessories such as the terminal position assurance (TPA) maintain secure connections even under heavy vibration.

Figure 4: Connector solutions include accessories for higher reliability in harsh environments

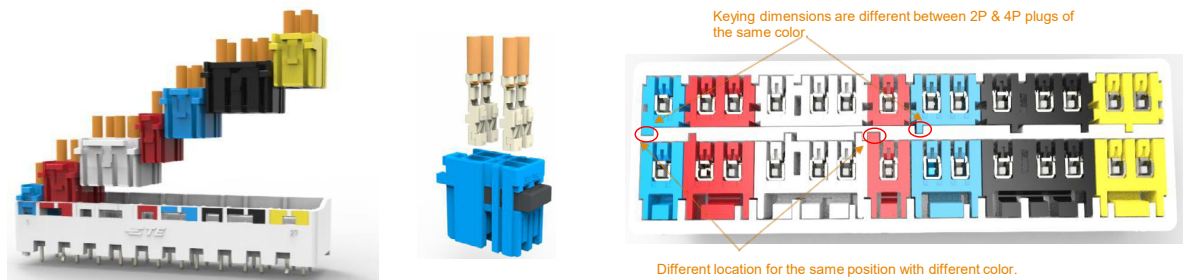
Optional Accessories for Higher Reliability:

1. Terminal position assurance (TPA) without seals
2. Back cover with IP67 rated wire and interface seals



Assembly Efficiency: In high-volume HVAC manufacturing, even small improvements in connector design can translate into notable savings. TE Connectivity's surface-mount components are pick-and-place compatible for PCB assembly, which supports automation to reduce errors and speed up the production process. Features such as Poka-Yoke keying and color-coding further prevent errors, while terminal position assurance ensures terminals are fully seated before final assembly, and high-density connectors offer cleaner layouts that help reduce takt times.lifetime of the system. Design features such as wire seals and interfacial seals provide IP-rated protection, while optional accessories such as the terminal position assurance (TPA) maintain secure connections even under heavy vibration.

Figure 5: Poka-Yoke, TPA, and high-density connectors decrease errors and speed production



Miniaturization: Compact HVAC systems require smaller connectors to free up board space for other components—without sacrificing performance. With a reduced PCB footprint, TE Connectivity's connectors give engineers greater flexibility in designing smaller HVAC systems that meet both efficiency and aesthetics demands.

“HVAC connectors face four big challenges—harsh environments, limited space, adaptability, and regulatory compliance. TE solutions are addressing these with a focus on safety, reliability, efficiency and miniaturization.”

Mike Tull, TE Connectivity

ADDITIONAL INFORMATION

To learn more, visit [TE Connectivity](#) and [TTI](#)

BIOGRAPHIES



Jason Gildea

Head of Regional Product Management
TE Connectivity

Jason Gildea serves as Head of Regional Product Management, Americas at TE Connectivity, where he develops and executes regional strategies to expand the Filters business across the Americas region. Based in Dallas, Texas, Jason leads go-to-market initiatives, drives pipeline and revenue growth, and optimizes product portfolio margins in alignment with TE Connectivity's global business unit strategy. In his role, he leverages TE Connectivity's position as a global leader in EMI filter solutions to deliver innovative filtering technologies that serve critical applications across automotive, industrial, aerospace, defense, and communications markets. Jason's strategic approach focuses on identifying market opportunities, developing customer-centric solutions, and ensuring regional business objectives align with TE Connectivity's broader mission of creating a safer, sustainable, productive, and connected world.



Brian Lineberry

Field Application Engineer, Relays
TE Connectivity

Brian, a Field Application Engineer at TE Connectivity, boasts over 37 years of experience in the company's Relays and Contactors business. His comprehensive background in testing, quality, and standards makes him a go-to expert for practical insights into relay technologies and applications.



Mike Tull

Field Application Engineer
TE Connectivity

Mike Tull is a Field Application Engineer with TE Connectivity's Connected Living Solutions business unit, based in Falls Church, Virginia. In this role, Mike provides customers with technical expertise in power connectors, signal connectors, and terminal and splice product to ensure reliable and efficient system designs. He also supports the advancement of TE's Application Focused Growth (AFG) strategy in the HVAC and Lighting markets, working closely with customers to identify design challenges and deliver connector solutions that improve performance, safety, and sustainability. By leveraging TE's broad portfolio and engineering resources, Mike helps customers bring innovative and dependable products to market.