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Track & Infrastructure

celduc® relais

The Advantages of Solid-State Relays

As rail technology advances, solid-state relays deliver smarter, safer performance across applications writes Aurélie Reynaud, celduc® relais' Marketing Manager.

As the rail industry has evolved, so have the systems that keep it moving. But while we've seen developments in the biggest kit that powers the trains, it's the smallest components that have seen some of the most advanced innovation in recent years. These tiny but mighty technologies are critical for safety, efficiency, comfort and even sustainability, and advancements in these components have improved outcomes in all these areas.

Take the evolution of switching devices. While electro-mechanical relays (EMRs) were the go-to solution, these have now been surpassed by solid state relays (SSRs). Unlike EMRs, which use coils, magnetic fields, springs and mechanical contacts to operate and switch a supply, SSRs have no moving parts. Instead, they use the electrical and optical properties of solid-state semiconductors to perform input to output isolation and switching functions.

The Advantages of Solid-State Relays Over Electro-Mechanical Relays

This design offers SSRs many advantages over their predecessors, including a longer service life. This is

because they don't have any moving mechanical parts, so they're not subject to wear and tear, or deformation. When operated under the right conditions, this means the service life of an SSR can be 200 times longer than that of an EMR.

Another big advantage of SSRs is their ability to switch 'off' AC loads at the point of zero load current. This more precise switching time completely eliminates the arching, electrical noise and contact bounce associated with conventional mechanical relays and inductive loads.

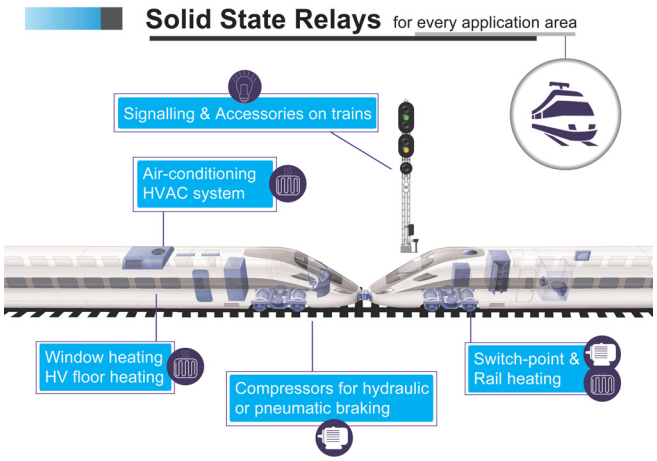
Other benefits include lower energy consumption, a very high switching frequency and shock and vibration resistance.

Railway Applications for Solid-State Relays

SSRs are used in a wide variety of applications within the rail sector, particularly for their energy saving and reliability features.

Uses include heating elements control; covering everything from HVAC systems through to windshield, switch-point and rail heating, motor control for compressors and railway switch-point motors, lighting and signalling.

Electrical components for the rail industry must provide safe and reliable operation even under extreme conditions such as large temperature variations, shocks, vibrations and electromagnetic interference; and celduc® relais has developed and manufactures its SSRs to the highest quality in compliance with the most stringent international standards.



Why Choose celduc® relais?

With deep roots in the sector, our company has long-standing ties to rail innovation. Based in the Loire – near the site of France's very first railway line – celduc® relais was founded by Michel Guichard, who played a key role in the development of technologies that helped transform the industry.

Over time, our SSR product line has evolved to meet the rail sector's changing needs. We've introduced models with integrated monitoring functions to simplify maintenance for example, and adapted our power elements to withstand extreme conditions.

Advantages of solid-state relays (SSR) over electro-mechanical relays (EMR):

- **Long service life:** Solid-state relays (SSRs) don't have any moving mechanical parts, so they're not subject to wear and tear or deformation. When used correctly, a solid-state relay has a service life that is 200 times longer than that of an electro-mechanical relay (EMR).
- **A more precise switching time:** One of the biggest advantages of SSRs over EMRs is their ability to switch 'off' AC loads at the point of zero load current, thereby completely eliminating the arcing, electrical noise and contact bounce associated with conventional mechanical relays and inductive loads.
- **Lower energy consumption:** A low drive power will allow SSRs to switch heavy power loads.
- **Very high switching frequency:** For very accurate temperature control. With an SSR, fast switching reduces hysteresis thanks to its huge switching capacity.
- **Silent operation:** Doesn't generate acoustic noise while the outputs are changing state.
- **Shock and vibration resistance:** No risk of accidental switching with solid-state technology.
- **Additional functions:** SSRs offer more possibilities in terms of diagnostics, protection and communication.

Today, we manufacture our SSRs using our bespoke fourth-generation thermal mechanical stress solution (TMS2) technology, which, under comparable conditions, offers a service life up to twice as long as most alternatives on the market. The result: reduced maintenance cycles and fewer product failures. We're also the only SSR manufacturer to oversee every stage of production exclusively within Europe. This ensures full quality control and supply chain transparency.

Custom Innovation, Proven Reliability

At celduc® relais, we work in close partnership with our customers to deliver solutions tailored to their specific needs. For example, a leading train unit manufacturer has relied on our AC solid-state relays (SSRs) for over 15 years to manage their trains' HVAC systems. Working collaboratively, we developed a pluggable module that integrates a current monitoring function, enabling fault detection, faster repairs and significantly reduced maintenance costs.

Another customer, a manufacturer of air-conditioning units for rail vehicles, approached us to create a high-voltage DC SSR for powering floor heaters directly from the catenary. Having previously used electro-mechanical contactors, they wanted to transition to a solid-state solution to extend service life and reduce the need for predictive maintenance.

Our ability to design tailored solutions and develop custom products is one of the many reasons celduc® relais stands out in the market. With SSRs making up 70% of our total turnover, they're our core business, not just a side offering. This singular focus allows us to deliver deep expertise and true specialisation, while many competitors offer only standardised solutions.

To find out more about how celduc® relais could support your organisation, take a look at our **product guide** or **get in touch**.

Key celduc® relais rail product launches:

2010: celduc® relais launches its celpac range with compact housing – a 22.5mm wide SSR solution and its current monitoring ESUC module.

2017: Launch of celduc® relais' insulated-gate bipolar transistor **(IGBT) -based SSR (SDI range)**, which can switch up to 100A @ 750VDC nominal fast, reliably and safely.

2024: celduc® relais launches its SMI, compact high-voltage DC solid-state relays and its **XKLD, EN50155-certified railway solution**.