

*Five Aspects of Modern Automotive Design That Depend on Connectors
Evolving connector design has helped transform the driving experience. Better lighting, greater comfort, and advanced safety are just the beginning.*

By Christine Knable

Today's automobiles are more connected than ever before. Automotive electronics deliver the advanced communication needed for performance and comfort throughout the vehicle, and enable a variety of safety features for the driver, passengers, and public. Electronic connectors play a significant role in the uncompromised performance of these critical systems.

Lighting Connectors Lead the Way

Starting with the exterior, lighting is an essential aspect of vehicle design. The automotive industry has been actively moving away from halogen technology and adopting light-emitting diodes (LEDs) for headlights since the early 2000s. Not only do vehicle headlights illuminate the road, connected technologies enable headlights to adapt to the presence of other vehicles, automatically switching between high and low beam. Sensor-driven intelligent lighting features provide just the right illumination, based on weather and light conditions. Electronic connectors play a crucial role in the lifetime performance and reliability of LED lights. These connectors must meet an array of requirements, including operating currents of a few amps, power consumption of 10 watts or more, limited package size to keep size and weight low in electronics-heavy automotive systems, and the ability to endure high levels of vibration and heat without compromise to performance. Connectors for LED applications should also be easy to install securely, have low height requirements to enable maximum airflow and heat dispensation, and have secure latching for high resistance to shock and vibration. To provide designers with options for higher visibility in assembly and repair scenarios, white or blue housings are available for lighting applications, versus the standard black for connectors used in many other automotive applications.

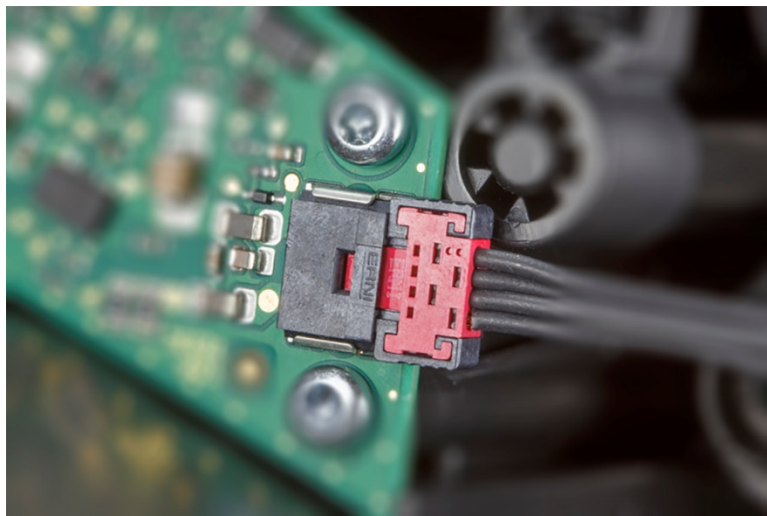


Fig 1: ERNI's MiniBridge delivers up to 12A per contact, making it an excellent choice for LED lighting applications

Interior Comforts Increase with Electronics

Moving inside the cabin, the modern automobile includes a variety of comfort and entertainment applications driven by advanced connectivity solutions. Passengers and drivers can enjoy automated navigation and other telematics, plus climate control, electric seat heating and adjustment, device charging, and a host of audio and video infotainment solutions. These features are enabled by reliable connectors, sensors, antennas, and cable assemblies that connect the vehicle with the cloud. It is essential these connectivity products be compact and lightweight in design yet deliver high current carrying capacity and high reliability. Features such as assured mating, low profile, dual latching, and ruggedization help connectors deliver uninterrupted signal and power despite the high vibration and heat present in automotive environments.

Safety First

Safety and security for the driver, passengers, and the public is increasingly reliant on electronics. Some of these solutions include airbags, hill descent control, and advanced driver assistance systems (ADAS). ADAS includes a safety features such as blind spot detection, adaptive cruise control lane, and speed, pre-collision, and parking assist systems. Beyond ADAS is the field of autonomous driving. Autonomous vehicles are still in development but highly sophisticated electronics are making such designs close to reality. Cybersecurity is another important aspect of the modern vehicle. Threats to vehicle systems, including those that power keyless entry, onboard diagnostics, and remote unlocking, require digital cryptographic techniques such as digital certificates of authentication and encryption. Security and reliability are critical in electronic systems. Connectors used in these applications must provide ease of mating for assembly and repair, and designs that prevent damage to the connections during the assembly process. Once mated, they must retain the connection and resist shearing and stress under harsh operating conditions.

Resisting Interference

Another important feature for connectors in automotive applications is shielding against electromagnetic interference (EMI). Electromagnetic interference occurs in busy electronic environments. In cars, electronic connections in the vehicle's many operating and safety systems — amplified by passengers' products such as smart phones, Bluetooth devices, and even garage door openers — could potentially create disruption to the performance of individual systems. This risk ranges from radio static to loss of control of mission-critical systems such as airbags or adaptive cruise control. Proper shielding and good electromagnetic compatibility mitigate such risks.



Fig 2: ERNI's MicroSpeed and accompanying power module provide power and data with excellent interference shielding, essential for the modern vehicle.

The Rise of e-Mobility

Powering the vehicle via electronic drivetrain, or e-mobility, is another aspect that increasingly defines the modern automobile. These solutions include battery electric vehicles (BEV), plug-in hybrids (PHEV), and hybrid electric vehicles (HEV). All of these variants require drive systems that are lightweight while also being more compact and powerful. Battery management systems (BMS) and power electronics (inverters) play key roles in these technologies. The BMS ensures safe charge/discharge of the battery and monitors the battery cells. At the time of assembly, the BMS is connected to the vehicle via a decoupled bus system (e.g. CAN) and the contact resistance at the charging input must be kept as low as possible. Therefore, connectors for a BMS application must have the lowest possible contact resistance and remain as constant as possible, even with rising temperatures. This performance is achieved through suitable contact design.

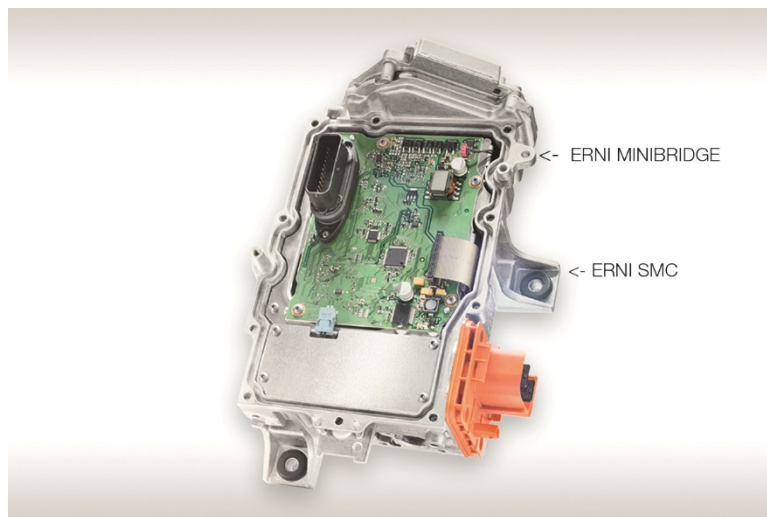


Fig. 3: The ERNI MiniBridge and SMC are ideal for e-mobility applications, as demonstrated with this inverter.

The demands placed on electronic connectors in the modern vehicle are higher than ever. These products require easy assembly, reliable connections, and the ruggedness needed to continually deliver signal and power while operating in harsh conditions with high levels of interference. Additionally, the space in which they operate continues to get smaller, so small form factor is important. Connector designers are meeting these demands, delivering connectors that are robust, powerful, and rugged, provide ease of assembly, and reduce system size and weight. Today drivers and passengers can enjoy their in-vehicle experience with a variety of safety, communication, and entertainment features, thanks to connectors that have evolved to meet the challenge of the connected car.