

Unleashing the Power of Connected Cars

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Today's consumers move in a digitally-enhanced world, checking sports scores or grooving to the beat of a personal playlist as they walk down the street. As a result, smartphones have conditioned us to expect a user-friendly, customized environment everywhere we go. And that environment increasingly includes the cars we drive.



Electronics Everywhere

Automakers are adding a slew of new electronics to their vehicles to satisfy customers and keep up with competitors. Autos contain digital dashboards with customizable displays for the speedometer, odometer, temperature gauges and other gauges the driver wants to see. Multiple screens offer driver and passenger infotainment options, as well as seat controls and lighting they can set to their preferences with a touch instead of fiddling with buttons or dials.

And that's just some of the fun stuff. New cars are now expected to provide a range of advanced safety features to protect the driver and passengers. Vehicles keep position in lanes while maintaining safe following distances, audible alerts are accompanied by visual warnings flashing on the windshield, and brakes are automatically applied in cases of emergency.

All these features rely on instantaneous transfers of information from sensors and equipment located throughout the vehicle. Whether it's for the driver's safety or for comfort and convenience, each feature has its own wiring and is encased in an electronic control unit (ECU) attached to the wiring harness. Today's vehicles often contain up to 150 ECUs, and that number will only continue to rise as consumers clamor for more features.

Automakers and component manufacturers are racing to keep up, miniaturizing everything to fit more content in the same amount of space.

Space, Energy and Environmental Concerns

This proliferation of electronics poses challenges for manufacturers. Vehicles were never designed to accommodate so much wiring, and engineers are running out of space to contain it.

Another concern is weight. A wiring harness today can weigh over 150 pounds. It is the third-heaviest component in the car, behind only the engine and the chassis, and is the third-most expensive part to produce.

While consumers crave electronics, they also want better energy efficiency. Unfortunately, these preferences are not compatible. A feature-heavy harness adds drag and reduces gas mileage for cars with internal combustion engines. In EVs, every new feature has the potential to drain power from the battery and decreases driving range—already a sore spot for consumers contemplating a shift to electric.

In addition to seeking energy efficiency for their vehicles, consumers are increasingly concerned about other environmental attributes such as emissions. A harness weighed down with wiring and ECUs produces more carbon-laden emissions. In EVs, it means a shortened battery life.

Miniaturizing Electronics

To fit all the new electronic features into vehicles while lightening the load, manufacturers and their suppliers have to consider out-of-the-box solutions. They have to think small to achieve more, shrinking modules and components to the maximum extent possible while still enabling 100 million lines of software code to be transmitted quickly and reliably throughout the car. That's especially important for safety features, which require high pin-count connectors to relay information to other parts of the vehicle.

Electronics producers have been working closely with manufacturers and Tier 1 suppliers to gain in-depth knowledge about their challenges and have designed miniaturized components that cut down on both space and weight. For example, Molex has reduced the

size of wiring harness terminals carrying heavy currents from the standard 1.5 mm² to just 0.13 mm². Lower-current terminals have been reduced from 0.64 mm² to 0.5 mm².

While these numbers may appear small, when you're trying to fit more and more content into a confined area, they add up to a big difference. In fact, compared to traditional systems, Molex miniaturized connector systems can create 50% more board space on devices within the vehicle. This frees room for the OEM to incorporate more advanced semiconductors on the board to support expanded functionality while helping harness manufacturers reduce weight: a best of both worlds.

In addition, the weight saved by using smaller connectors and wires improves energy efficiency while reducing emissions output. This allows EVs to use smaller battery packs and extend their range — an important consideration for buyers who want to spend as little time as possible waiting to complete a charge.

Miniaturized connectors also enable engineers to route wiring into vehicle spaces where it couldn't fit before, allowing them to place ECUs closer to the mechanisms they control and opening the door to new possibilities for future applications.

The Growing Need for Rugged, Reliable — and Smaller — Connectors

Though small and slim, vehicle connectors must be tough enough to withstand extremely high temperatures, strong vibrations and moisture capable of destroying circuitry as well as dirt and grit that inevitably find their way into the chassis.

Humidity can cause condensation both on the surface and inside the connectors. Water can also become trapped inside components during the manufacturing process and condense later, after the temperature changes. In addition, poor designs, assembly errors and operator fatigue can lead to connection backouts and system failure.

With safety systems dependent on electronics, ensuring reliability has never been more important. As manufacturers move up the scale towards Level 4 and Level 5 autonomy, more responsibility will fall on them to provide dependable connectors for primary systems and backups.

The future is also likely to bring more shared mobility to the auto industry. The two largest ridesharing platforms are already booking more than 40 million trips every day. The advent of autonomous vehicles could bring a new dimension to shared rides, with self-driving cars dropping off passengers and briefly self-parking before heading off to the next customer.

The efficiency and cost-effectiveness of this system could shift consumer preferences from public transit to shared private transportation. If that happens, vehicles will be in constant use, instead of sitting idle in parking garages all day and driveways all night. This would put more strain and wear and tear on parts — including vitally important connectors.

Thankfully, innovations in connector technology have enabled connector systems to simultaneously provide high reliability and durability, small sizes and simplified assembly: minimizing the risk of manual error during manufacturing.

Building for the Future

As cars increase their dependence on digital systems for navigation, safety, comfort and entertainment, connectors take on outsized importance. Making them smaller and lighter while increasing resilience and reliability is no small feat.

Molex is at the forefront of these miniaturization efforts, brainstorming with manufacturers and Tier 1 suppliers to create breakthrough solutions, such as the rugged Mini50 connectors, which increase reliability, provide manufacturers with more configuration options and make servicing easier.

Learn about how [Molex is enabling next-generation vehicle technology](#)