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## AN ELECTRIFYING FUTURE: ELECTRIFICATION DRIVES NEW OPPORTUNITIES FOR COMMERCIAL VEHICLES—



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**It sure is quiet in here! And where's the smoke? If you have been to a city or airport recently and taken the bus, you know what I am talking about: whisper-quiet acceleration, regenerative braking, no roar of the accelerating big diesel and no squealing brakes. It seems like for the past few years we have heard about the impending industry change from straight diesel power to electrified vehicles. Based on my global travels, electric and hybrid electric vehicles are already in operation and their numbers are growing rapidly. We blinked, and the future is here in just a few short years.**



*Hybrid commercial vehicles reduce noise and lower wear and tear on the vehicle.*

I was in Stockholm, Sweden, recently and hitched a ride on a fully autonomous BEV (Battery Electric Vehicle) shuttling folks from hotels to the shopping mall and train station. No driver, near silent operation. It was so quiet complete strangers started talking to each other — didn't see that coming (quite amazing how far we've advanced). For those of you in the heavy-equipment market, we have seen countless press releases on the newest hybrid excavator, end loader, refuse and bucket trucks, and this list goes on. Nowadays, we see the cable or electric company working

but don't hear the truck running. Drive past a construction site, and you will see "HYBRID" on the vehicles, just like the cars many of us drive every day. For those of you who drive a hybrid, think of the savings on a commercial vehicle. And they are emissions compliant to boot — not bad.

While this trend is still in the earlier stages with much progress being made, the need to be competitive has never been more important.

Connection systems used in commercial vehicles have always needed to provide higher performance under more rugged conditions than those used in passenger cars and light trucks. Now they must also facilitate high-voltage and high-current connection systems safely and robustly. They must also accomplish this without expanding the overall size of the vehicle. Complexity and density abound!

### THE DRIVE FOR ELECTRIC POWER

Commercial vehicles, particularly for construction and mining applications, are implementing hybrid and full electric systems more than ever. The need for more efficient power application, reduced vehicle emissions and lower operating costs is more important than ever. Internal-combustion engines produce power that can be difficult to control in certain situations. When the driver accelerates, the vehicle tends to burst forward, and the immediate torque produces wear on gears, bearings, wheels and tires. Electric "engines", on the other hand, can be more finely controlled when under acceleration, leading to reduced wear — smooth ramp up, smooth ramp down.

In addition, regulation of commercial vehicles in the US, Europe and China continues to tighten, and vehicle manufacturers are reducing the levels of emissions their vehicles create. One of the best ways to achieve compliance is to convert at least part of a commercial vehicle fleet to an electric propulsion and/or accessory drive system (A/C, cooling fans, hydraulic systems and actuators).

As a result, manufacturers are looking for help from suppliers to reduce the costs of manufacturing these vehicles. Component costs, installation costs, ergonomics, and packaging, to name a few, are key considerations in overall system design. In discussions with customers, many are looking to industry standards for electric vehicles that will help drive needed manufacturing cost reductions.



*Electrified truck fleets are being implemented to help reduce emissions and significantly lower fuel costs for carriers.*



## ENGINEERING COMPLEXITIES

Designing electrical systems can be challenging. For one, they typically require 4/0-gauge wires, which have cables approaching an inch (25.40mm) in diameter, so designers have the challenge of configuring large cable assemblies with many turns and bends. Cable routing, clamping and strain relief, and connector clocking are essential to longevity in operation. Alternating-current, multi-phase motors also generate EMI and RFI that must also be dealt with to remain compliant to the many noise emission standards globally. As a result, components must be shielded, which complicates cable and connector design. Also, when electrical motors run at full power, current resistance can lead to overheating, so these vehicles require extremely low-resistance electrical systems, typically measured in microohms. There is much to consider in system design.

## SYSTEM OPTIMIZATION

Because of these challenges, electrical system optimization is vital. Some available systems provide more shielding and current density and can operate in the extreme shock and vibration conditions found in fully electric and hybrid commercial vehicles today.

Also, as mentioned above, components that reduce disruptive EMI and RFI are essential for electric vehicles. Some are designed for high-frequency switched-mode power supply (SMPS) applications, to significantly reduce EMI and RFI. These assemblies allow OEMs and end users to connect high-power electrical cables directly through an enclosure wall, simplifying the installation process. In addition to standard body and chassis connectors, a commercial vehicle

engine may have more than 40 sensors, not to mention multiple high-speed shielded cables and high-voltage cables for power and telematics. A large number of wires and connections are routed to control modules that can be as small as a shoe box or as large as a refrigerator. Just trying to get the wires routed through the vehicle is a major challenge.

## FULL VEHICLE VIEW

Finally, a commercial vehicle must be designed as an integrated system based on both power and network speed requirements, desired protocols, number of required ports, connector attachments, cable design, cable shielding levels, and performance expectations. As a result, the connector supplier must also be able to assist the systems designer, working closely with the customer early in the design process. While some commercial vehicle developers have a staff of experts overseeing electrical system design, others rely on their connector suppliers for recommendations to shorten the process. A good connector supplier should be capable of supporting the customer early in the process to ensure that a commercial vehicle's connector and cabling system for both power and networking systems can do the job and go the distance efficiently while being compliant.

If you are out and about, whether on the job site or in a public hybrid/electric vehicle, break the silence with a little electrification conversation. I think you'll be pleasantly surprised.



*The Molex MAX-LOC Plus Shielded Cord-Grip Assemblies are designed for high-frequency switched-mode power supply applications.*

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