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THE 4 MAJOR CHALLENGES OF WIRELESS IN-VEHICLE CHARGING

Wireless charging is the best way for automakers to meet consumer demand for better charging performance in their vehicles. But there are significant challenges to getting this innovation to market.

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Once key design challenges are overcome, in-vehicle wireless charging stations like the one shown here can be an ideal device charging solution for automotive consumers. (Image source: Molex)

Today's consumer expects to be connected via their mobile device wherever they go – especially in their vehicles, which have become more than transportation; they are a mobile extension of the owner's living space.

But charging a smartphone in a vehicle is antiquated and inconvenient. Connectors don't always fit the device, necessary adapters can be lost, cables get tangled, and connecting while driving creates a safety hazard.

Wireless in-vehicle charging solutions with high quality standards can provide OEMs the flexibility to design and develop unique solutions that are both convenient and essential to consumers.

However, while wireless in-vehicle charging presents the ideal solution to many of the traditional charging problems consumers face, its development and implementation comes with significant design challenges.

CHALLENGE #1 – ELECTROMAGNETIC INTERFERENCE

Inventor and technology pioneer Nikola Tesla first demonstrated the potential of wireless charging in 1891 with wireless "inductive" transfer of energy for lighting incandescent bulbs. Inductive charging converts an input voltage into a constant output voltage, the same way a standard combinatorial circuit component functions. The key difference is the power supply unit.

In wireless charging, the wound coils used in the power supply unit are wound separately. A magnetic field is created from a precisely defined frequency (between 105 kHz and 205 kHz) via the coils in the transmitter modules. The coils in the receiver devices receive electrical power with the identical frequency and generate voltage that charges the device's battery.

Electromagnetic compatibility (EMC) standards in automotive applications are stringent. EMC, the unintentional generation, broadcast, and reception of electromagnetic energy, can create unwanted effects on a vehicle's electrical system such as electromagnetic interference (EMI).

For an example look at the modern automotive KeyFob system. KeyFobs now control not only vehicle door lock/open and trunk open/close functions, but also critical in-vehicle and remote engine start functions. The electromagnetic fields created by

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wireless charging can have a negative influence on KeyFob system performance. It's vital that the wireless charging system does not emit EMC that interferes with the keyless go system.

That design challenge is intensified when the driver places the KeyFob on or near the wireless charging station. In this case, the vehicle operating system may not find the KeyFob signal and the car would not start; or not operate at all. The development of advanced EMC shielding techniques is essential to ensuring the seamless operation of the wireless charging system with the KeyFob and other critical in-vehicle communications.

CHALLENGE #2 – THERMAL CONCERNS

Temperature extremes present another challenge. Not only do they have a negative impact on a mobile device, but on the wireless charging station as well. The typical operating temperature for a smartphone is 0O C to 35O C. The interior of a vehicle sitting in a parking lot on a sunny summer day can easily reach more than 37O C. Conversely, that same interior can quickly dip below 0O C on a winter day. If not appropriately designed and protected, such extreme temperature fluctuations can lower the performance of the wireless charging system or cause damage that leaves it inoperable.

EMC and temperature fluctuations also can affect the efficiency of the system. When transferring power from the platform to the smartphone, some energy will inherently be lost. However, many wireless charging systems can achieve efficiencies of only about 45% under perfect conditions. EMC shielding and thermal management play an important role in increasing the energy efficiency of the in-vehicle system.

CHALLENGE #3 – THE AUTOMOTIVE INTERIOR

Every vehicle interior is different – including unique aesthetic and ergonomic designs and electronic functionalities and interfaces. In the meantime, Qi (pronounced "chee") is the only wireless charging standard available and every phone that has wireless charging inside will be Qi-certified. The coil area on many of these phones is different and the wireless charging system must be able to work with every version and no matter what the position of the phone is on the charging station.

CHALLENGE #4 – DISTANCE

Wireless charging modules' charging times are also dependent on the distance between the transmitter and the receiver module. Currently, technology is available to bridge distances up to 4mm. Greater distances are possible, but only at a higher transmitting power level, which would negatively affect the EMC in a vehicle interior. To meet the automotive industry's EMC standards, there is a need to reduce the electrical field below the limits.

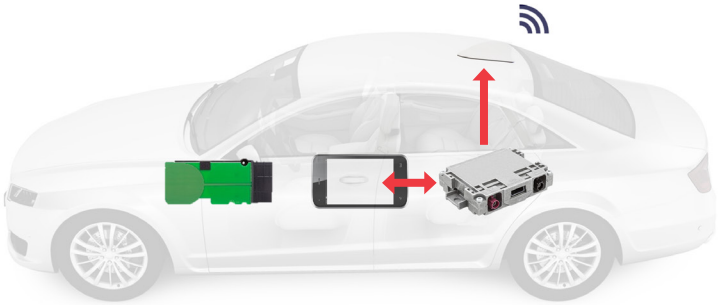
This is where proper innovative EMC shield technology combined with protected input circuitry enables a system to exceed automotive EMC requirements.

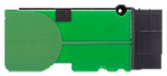
THE FUTURE OF WIRELESS IN-VEHICLE CHARGING

The latest wireless charging models for the auto industry are highly efficient compared to other systems – offering efficiency up to 62% (battery of the car to battery of the smartphone) at 5W with a rand of 4mm between the TX coil (WCh) and the RX coil (smartphones).

While wireless in-vehicle charging is becoming available for connected car solutions, its development and innovation continues. Next-generation devices available in the next two to three years will be able to simultaneously charge multiple devices and have downward compatibility. Additionally, other devices are to be used inductively – those with irregular, non-planar 3D surfaces such a game consoles, cameras, toys, and wearables are all conceivable.

Particularly exciting in the automotive wireless charging market is the integration of the Near Field Communication (NFC) standards that make other applications possible that have traditionally required high data security. Through NFC integration, wireless charging technology also can be used for authentication, simple pairing, sending point of interest, or as a car key – opening more possibilities for application in future connected cars.





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Frank Scholz has been involved in the pre-development of wireless charging systems at Molex Connected Vehicle Solutions becoming a product manager in 2013 in this category. Scholz has a background in radio frequencies and broadcasting technology previously working for Telefunken in Berlin. He holds an Engineering Degree in Telecommunication at the University of Applied Science of Karlsruhe.

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