WIRELESS CHARGING FOR IN VEHICLE AUTOMOTIVE APPLICATIONS

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Agenda

In Vehicle Wireless Charging Trends

Qi Deployment in the Automotive Market

NFC & Wireless Charging Security and Connectivity

Designing in Auto Environment

15W NXP Solution
IN VEHICLE WIRELESS CHARGING
Charging while Driving

Avoiding Battery Drain

Eliminating Cables

Improving Safety

Improving Reception

?
### Qi Deployment on the Auto Market

<table>
<thead>
<tr>
<th>Audi</th>
<th>Honda</th>
<th>BMW</th>
<th>KIA</th>
<th>VW</th>
<th>Hyundai</th>
<th>Seat</th>
<th>Skoda</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q7, A4</td>
<td>Accord, Civic, CRV</td>
<td>5 Series, 7 Series</td>
<td>K5 JK, K7, Sportage</td>
<td>Tiguan</td>
<td>Avante, Ecqus</td>
<td>Ateca</td>
<td>Superb, Octavia</td>
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*Image of Audi Q7 and BMW 7 Series.*
Need For More Power

Battery capacity is continuously increasing

More power is essential to keep short charging time

Extended power profile

15W
WIRELESS CHARGING & NFC
Wireless Charging & NFC Security and Connectivity

A seamless secure connection between smart device and smart car

Multitude of use cases from comfort features to safety

Everything in one place

Mercedes

Chrysler

Toyota
Wireless Charging & NFC Use Cases in Car

Safety
- Detection and protection of payment cards, passports, IDs, etc..

Personalization
- Customize various vehicle settings using NFC as a secure service interface to find the comfort that is all your own

BT/Wi-Fi Pairing
- Simple and secure Bluetooth and Wi-Fi pairing

Diagnostics
- Get diagnostic information using NFC as secure service interface e.g. vehicle diagnostics, fuel management

In-car payment
- Use NFC inside of the car as the payment terminal to pay for gas, extra updates, services, ...
DESIGNING IN AUTOMOTIVE ENVIRONMENT
Environment

Harsh operating temperature profile
- Efficiency and heating
- Integrated power supply
- Small package
- Difficult heat dissipation
- Active cooling

Free positioning – car is moving device is moving

Vibration profiles
EMC Restrictions

Strict regulations for automotive environment

Capacitive switch – avoidance of digital ping

- Spectrum magnitude [dBu]

Desired EMC performance
(Rail Voltage control, EMC filter)

Bad EMC performance
(Duty Cycle control, no EMC filter)
Interference with Keyless Systems and AM Radio

Remote key (system operates inside existing Qi frequency range)

Radio AM/FM band (AM band)

Interferences cause bad user experience
Safety

Foreign object heating
- Magnetic field flow between Tx and Rx
- Eddy currents in magnetic active materials

Fast position changes
- Unexpected change of position
- Regulation loop is not fast enough to react
15W WIRELESS CHARGING AUTO SOLUTION
15W Automotive Wireless Charging Transmitter

Free positioning

Fast charging

Digital demodulation

Back compliant with WPC low power spec

NFC

AEC-Q100 grade 2 qualification
15W Automotive Wireless Charging Transmitter

- 9-16V Input Voltage range
- Possible drop to 6V during ignition
- Low standby power
- Qi compliant library
- Customer proprietary protocols
- CAN/LIN
EMC Problem Resolution

EMC filter

Full bridge

Rail voltage control

Fixed frequency 125kHz
  - Worldwide enabled band

Capacitive switch
  - Avoidance of digital ping
Interference with Keyless Systems and AM Radio

NXP solution enables frequency modification to avoid interference

Remote key (system operates inside existing Qi frequency range)

Radio AM/FM band (AM band)
Safety

Foreign Object Detection (FOD)

- Q-Factor – comparison of expected and measured resonance curve (conductive material shift resonance frequency)
- Power loss method – monitoring of unexpected losses in the system
- Surface temperature measurement

Over voltage/current/temperature protection with peripherals

- Comparators connected directly to PWM module
- 100% safe even when the core is busy
Application Flexibility

User can fully control all aspects of library from application, develop proprietary features, easily adapt to new situations and react immediately to potential needs

- Open architecture
- Custom FOD
- Additional application
- Full control of library parameters
- System/user interfaces definition
- Proprietary monitoring/protections
- Proprietary messages between Tx and Rx
Wireless Charging ICs

Our wireless charging products are industry compliant system solutions supported by the Wireless Power Consortium (WPC) and the Power Matter Alliance (PMA) standards for both transmitter and receiver wireless charging applications. These products offer a broad range of choices based on the needs of the end application. NXP® offers solutions from low power 5-Watt to medium power 15-Watt for the consumer, industrial, and automotive markets consisting of the transmit/receiver controller IC, associated software, evaluation boards and reference designs. The software contains all of the functionality to implement the core charging function, while also providing an API for customization and adding additional features. The transmitter/receiver ICs are highly optimized devices providing the wireless charge controller functionality in the system, as well as additional IOs and memory for customization.