New dimensions for multifunctional car keys

4D transponder coil with integrated NFC or wireless charging coils
Car keys of the future: Data-driven with added functionality

Main interface between car owner and car with increasing functionality

- Ignition / starting
- Access / entry
- Security / immobilizer
- Remote keyless entry / PEPS

PLUS

- Data storage
- Data display
- Data transfer
- Non-automotive functions
TDK products for current generation of car keys

COMMUNICATION CAPABILITIES
- LF and UHF bands

KEY REQUIREMENTS
- Miniaturization
- Functional in any position
- Reliability
- Robustness

One-stop shopping for all necessary passive components
TDK components for future car key generations

NEW

4D transponder coils
• integrated NFC or integrated WPT

Wireless charging coil

Bluetooth wireless

Flexible solar battery
In development

EDLC/Li-ion battery
In development

CAPABILITIES
• LF and UHF bands
• NFC (near-field communication)
• Bluetooth LE
• UWB (ultra wideband)
• WPT (wireless power transfer)

KEY REQUIREMENTS
• Miniaturization
• Packaging
• Reliability
• Robustness

The world’s first 4D coils with integrated NFC or wireless power transfer capability
The new 4D transponder coil with integrated NFC or wireless power transfer

**FEATURES**
- Thermally stable ferrite core with special core geometry
- Flame-retardant molding
- Laser-welded
- Long receiving distance at 125 kHz
- Qualified to AEC-Q200
- High sensitivity in all orientations (X/Y/Z)
- 4th coil for NFC or wireless power transfer

**KEY DATA**

<table>
<thead>
<tr>
<th>Axis</th>
<th>X</th>
<th>Y</th>
<th>Z</th>
<th>NFC (Z axis)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated inductance [mH]</td>
<td>6.75</td>
<td>6.75</td>
<td>13.20</td>
<td>0.85 µH</td>
</tr>
<tr>
<td>$Q_{typ}$ [110%/+15%]</td>
<td>23.5</td>
<td>24.5</td>
<td>18.5</td>
<td>-</td>
</tr>
<tr>
<td>$S_{typ}$ [mV/µT]</td>
<td>77</td>
<td>73</td>
<td>77</td>
<td>-</td>
</tr>
<tr>
<td>$F_{res}$ [kHz]</td>
<td>430</td>
<td>450</td>
<td>290</td>
<td>60 MHz</td>
</tr>
<tr>
<td>$R_{DC,max}$ [Ω]</td>
<td>92</td>
<td>95</td>
<td>335</td>
<td>2.3</td>
</tr>
</tbody>
</table>

**APPLICATIONS**
- **NEW**: NFC applications
- **NEW**: Wireless power transfer
- Passive entry, passive start (PEPS)
- LF antenna coil for wake-up and immobilizer

12.5 mm x 11.5 mm x 3.6 mm
4D transponder coil with integrated NFC for advanced communication capabilities

**VEHICLE**

- 125 kHz Inductive transmitter
- μC
- UHF/BT LE receiver

**KEY (with added NFC function)**

- 4D transponder coil
- Back-up transponder (e.g. immobilizer)
- 125 kHz 3D inductive receiver
- Wake up pattern detector
- μC
- Power management
- UHF transmitter
- NFC μC
- NFC terminal (car, shop, home)

**Additional details**

- 125 kHz
- Inductive transmitter
- UHF/BT LE receiver
- Wake up pattern detector
- Power management
- NFC terminal (car, shop, home)
Benefits of the 4D coil with integrated NFC

Emergency opening without metal keys or cylinders

Easy read-out of car status and diagnostics data stored on key

Non-automotive access and payment systems

Car key with NFC enables new application possibilities
4D transponder coil with integrated WPT enables easy and high-efficiency wireless charging.

**CAR KEY**
- Customized battery (e.g. ATL)
- Rechargeable battery
- Customized Rx module
- 4D transponder coil B82454C*
- LF 3D coil
- WPT Rx coil
- WPT e.g. 100 kHz (Qi frequency)

**VEHICLE**
- WPT Tx module
- Tx coil
- Customized WPT solution: Module + Tx coil

Power transfer
5 V, 100 mA = 0.5 W
Roadmap for 3D and 4D transponder coils

3D coils

- Standard 3D transponder coil
  - 125 kHz
  - 22 kHz
  - 12.5 mm x 11.5 mm x 3.6 mm

- Miniaturized 3D transponder coil
  - 9 mm x 9 mm x 3 mm

4D coils

- 4D transponder coils
  - with integrated NFC
  - with integrated WPT
  - 12.5 mm x 11.5 mm x 3.6 mm

- Miniaturized 4D transponder coil
  - 9 mm x 9 mm x 3 mm

Samples available Q3 2019

Driving enhanced performance and miniaturization of automotive and non-automotive access systems