



## Wireless charging solutions

Cost-effective and secure offerings for consumer, industrial and automotive applications



# Powering today and tomorrow

Mastering all power technologies based on silicon, silicon carbide, and gallium nitride

Infineon is the leader in the power semiconductor market, mastering all power technologies and offering the broadest product and technology portfolio of silicon (such as SJ MOSFETs, IGBTs), silicon carbide (such as Schottky diodes, MOSFETs) and gallium nitride-based (e-mode HEMTs) devices, covering bare die, discretes and module solutions.

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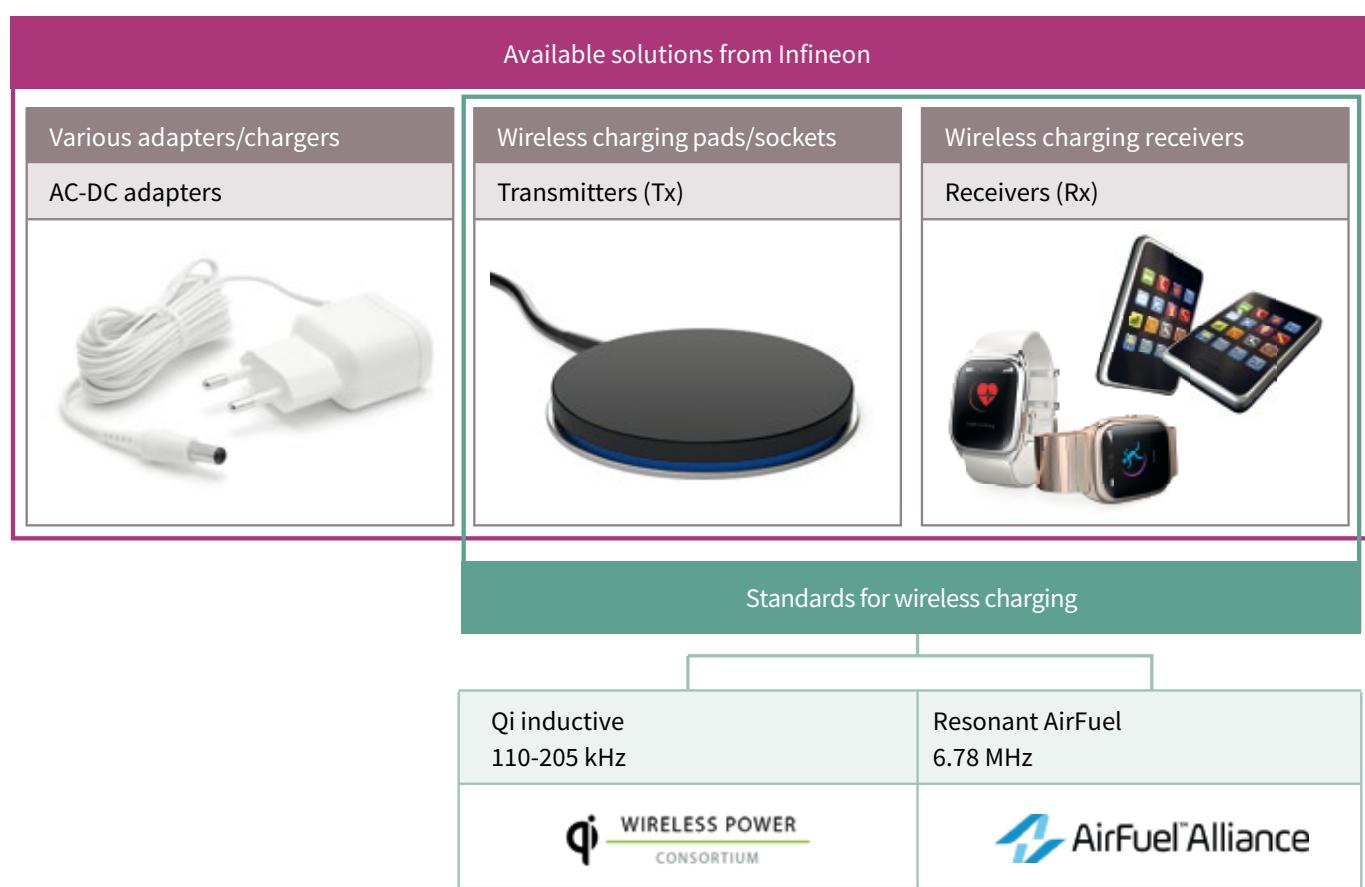
# Wireless charging solutions

Over the last few years, wireless charging has been increasingly gaining traction in the market and is expected to continue to heavily influence our daily lives. Infineon offers a broad portfolio of efficient, high-quality products and solutions to serve the key requirements of the dominant market standards: inductive (Qi (WPC)) and resonant (AirFuel). Whether you charge a smartphone (e.g. at home or in the car), a handful of wearables, a power tool, a laptop or a service robot, Infineon's components and solutions help you overcome a wide range of common wireless power transfer challenges for consumer, industrial and automotive wireless charging designs.

## What is wireless charging?

Wireless charging uses electromagnetic fields to transfer power from a transmitter to a receiver application to charge the battery. This erases the need for physical connectors and cables to transfer power – one of many benefits of this technology.

The wireless charging market is dominated by two standards: inductive (Qi) and resonant (resonant AirFuel). Infineon offers solutions for both standards and is an active member of the leading wireless charging alliances - the Wireless Power Consortium (WPC) and AirFuel Alliance.



## Different standards addressing wireless charging requirements

Currently two wireless charging standards stand out on the market: inductive and resonant. Qi (WPC) is dominating the market in the smartphone segment as measured by volume. Their widespread use can be attributed to their cost-efficiency. For the resonant that operates at 6.78 MHz, the advantages include better user-friendliness because it allows the user to freely place the device in the vicinity of the transmitter (typically up to 30 mm of vertical freedom), and it charges multiple devices of different size and power in parallel. Find below some details about the standards.

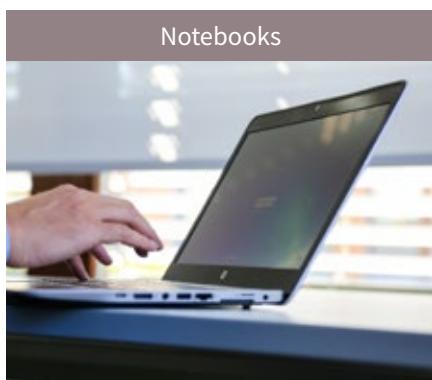
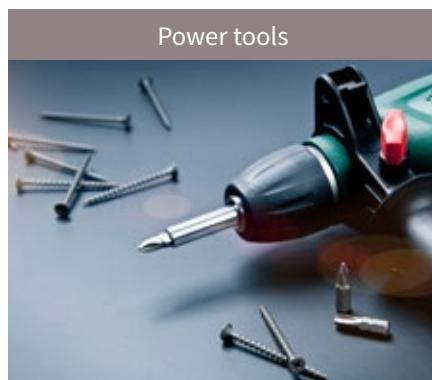
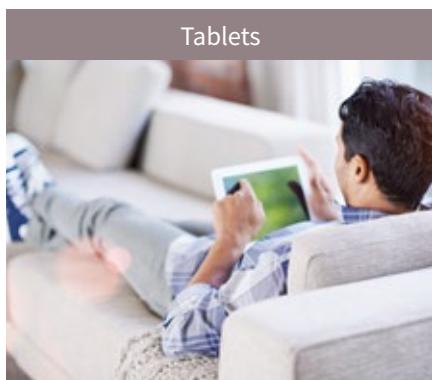
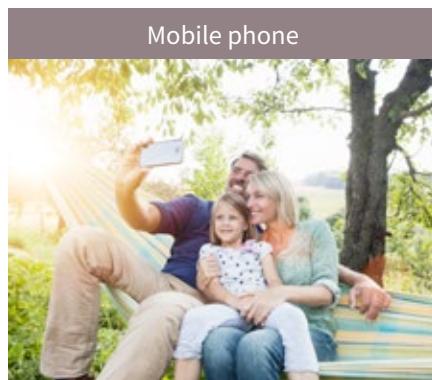
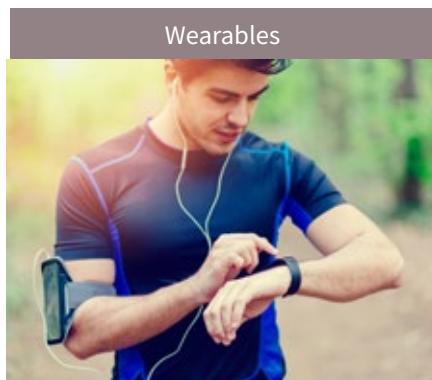
	Inductive single-coil	Inductive multi-coil	Magnetic resonance
Standard	Qi inductive 110-205 kHz		Resonant AirFuel 6.78 MHz
Positioning of receiver application	Exact positioning	Positioning more flexible (X and Y direction)	Free positioning (up to >30 mm vertical freedom)
Number of devices charged	Charges only one device	Charges one device but with better user experience	Charges multiple devices
Rx-Tx communication		In-band communication	Bluetooth low energy or in-band communication

## Why to use wireless charging

Imagine your smartphone's battery is dead. Until now, you first had to find the charging cable, then connect it to your phone and finally plug it into an outlet. The process works, but it can be a nuisance, especially if your cable is playing hide and seek or if you have incompatible connectors. Wireless charging removes the hassle of re-fueling your devices.

Greater user experience				
				
Easy charging without plugging in your device	Charging in public places or in the car	Charging several devices at the same time	No tangled wires and damaged cables	No more different chargers

## Applications that benefit from wireless charging



## Choose Infineon to address your wireless charging requirements

Having a reliable partner by your side is the key to maximize the performance and consumer appeal of your wireless charging designs. At Infineon, we help you master every design challenge with our broad selection of semiconductors and reference designs.

### Key benefits to choose Infineon

- › Offering MOSFETs, drivers ICs, voltage regulators, MCUs or wireless power controllers with software IP
- › Addressing both inductive and resonant standards
- › Providing powerful and cost-effective solutions for high performance, smart, and secure wireless charging solutions supported by Infineon's unique wireless power controllers
- › Reducing customers' bill-of-material owing to cost effective packages, leading silicon technology, and new technologies (e.g. GaN e-mode HEMTs)
- › Providing solutions for applications beyond smartphones
- › Meeting charging requirements by ensuring better user experience for consumers
- › Offering innovative and unique reference designs for better transmitter and receiver performance

### Infineon's key enabling products for consumer and automotive solutions

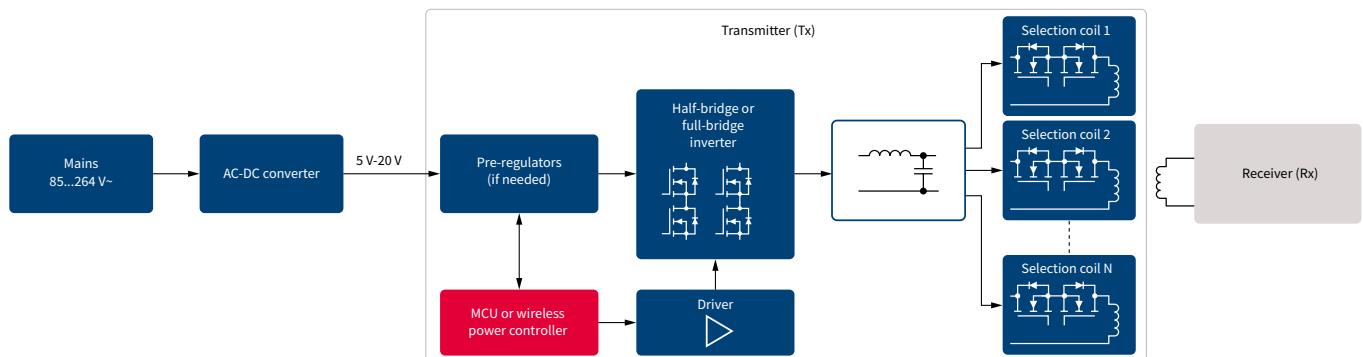
- › Low and medium voltage power MOSFETs – OptiMOS™ and StrongIRFET™
- › Gate driver ICs – EiceDRIVER™ or DC-DC low voltage gate driver
- › 32-bit microcontrollers – XMC™ and AURIX™
- › Wireless power controller (including software IP) – XMC™-SC and AURIX™
- › P-channel and N-channel small signal power MOSFETs
- › High voltage power MOSFETs – CoolMOS™ superjunction MOSFETs
- › PWM/flyback controllers and integrated power stage ICs – CoolSET™
- › Gallium nitride (GaN) – CoolGaN™ e-mode HEMTs
- › Dedicated automotive power products – MOSFETs, DC-DC, LDO, PMIC with ASIL qualification
- › Voltage and buck regulators for component and bridge supply
- › Authentication – OPTIGA™ Trust UWP



# Inductive wireless charging for consumer applications

Equipping your half- or full-bridge with components from the OptiMOS™ 30 V product family will pay off with superior power transfer performance, especially for the emerging higher power (15 W+) transmitter applications. Single and dual N-channel OptiMOS™ products with excellent  $R_{DS(on)}$  and charge characteristics are available in small footprint packages for your wireless power transmitter design. For multi-coil designs, there are ready to use IRMOSFET™ devices in 2 x 2 mm packages. In addition, Infineon's XMC™ 32-bit industrial microcontrollers provide the flexibility to charge "just about anything". Our portfolio supports individual needs with either an ARM® Cortex®-M0 core (XMC1000 family) or a Cortex®-M4 core with a floating point unit (XMC4000 family). We also have wireless power controllers – XMC™-SC, including software IP, for selected applications in our portfolio.

## System diagram: Inductive wireless charging



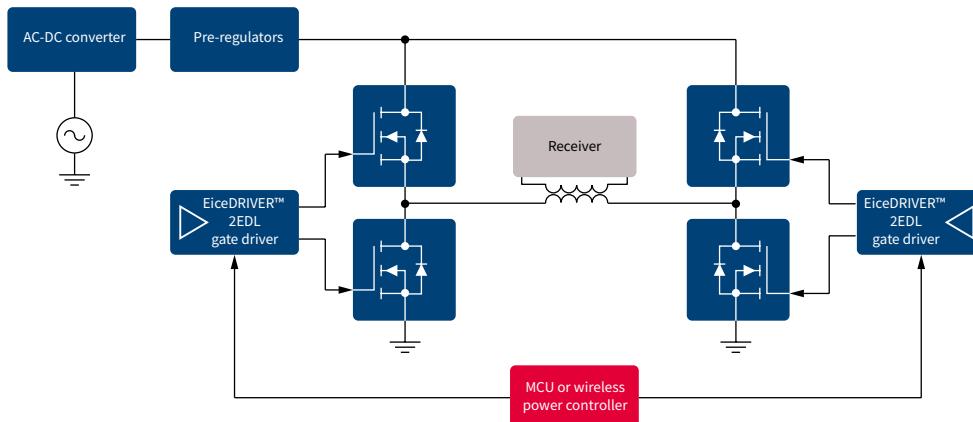
Sub-application	Voltage class	Package	Part number	$R_{DS(on)} \text{ max } @ V_{GS} = 4.5 \text{ V [mQ]}$	Recommendation
MOSFETs	20 V	PQFN 2 x 2	IRLHS6242	11.7 (= 2.5 V drive capable)	Right fit
	25 V		IRFHS8242	21	Right fit
	30 V	Super SO8	BSC0996NS	11.8	Right fit
			BSC0993ND	7	Best performance
		PQFN 3.3 x 3.3	BSZ0589NS	4.4	Best performance
			BSZ0994NS	8.6	Right fit
			BSZ0909NS	15	Right fit
		PQFN 3.3 x 3.3 dual	BSZ0909ND	25	Best performance
			BSZ0910ND	13	Best performance
		PQFN 2 x 2	IRFHS8342	25	Right fit
	40 V	PQFN 3.3 x 3.3	BSZ097N04LS	14.2	Best performance
Driver IC	PX3519, IRS2301S, WCDSC006*				
Microcontroller or wireless power controller	XMC™ MCU and wireless power controller XMC™-SC* (including software IP)				
Voltage regulators	IR3841M, IFX20002, IFX91041EJV50, IFX90121ELV50, IFX81481ELV				
Small signal MOSFETs	Please check <a href="#">online</a>				
Authentication	SLS32AIA020Ux – OPTIGA™ Trust UWP (USON10 3x3 package)				

\*coming soon

# Resonant wireless charging for consumer applications

Infineon offers a superior power MOSFET technology to address frequency switching implementations, especially in the 30 - 100 V areas for class D inverter designs and in the 150 - 250 V voltage class for class E inverter designs. We provide the leading products in the industry when it comes to fast switching and have the best figure-of-merit for gate charge times  $R_{DS(on)}$  and for  $C_{oss}$  thus enabling our customer to achieve 6.78 MHz inverter designs using robust silicon MOSFET technology. There are even more targeted products in the pipeline and Infineon is bringing its own GaN technology to market with a significant performance increase over silicon MOSFETs. Infineon offers the “coolest” driver ICs in the industry, already available as low side drivers for class E implementations and very soon as level-shifted half-bridge driver for class D topologies. If your transmitter design includes a pre-regulator (buck or buck/boost) to control the input voltage of your amplifier, we offer our OptiMOS™ solutions in different voltage classes ranging from 12 V to 400 V. Here again, the XMCTM industrial microcontroller and the XMCTM-SC wireless power controller, including software IP, are a great fit to charge “just about anything”.

## System diagram: Resonant wireless charging – class D, full-bridge



Please note also other topologies can be applied:  
Class D half-bridge, Class E differential or Class E single-ended.

Sub-application	Voltage class	Package	Part number	$R_{DS(on)}$ max @ $V_{GS} = 4.5$ [mΩ]	$Q_g$ typical [nC]	$C_{oss}$ typical [pF]	Topology		
MOSFETs	30 V	PQFN 2 x 2 dual	IRLHS6376PBF	48	2.8	32	Class D		
		PQFN 3.3 x 3.3 dual	BSZ0909ND	25	1.8	120	Class D		
		SOT 23	BSZ0910ND	13	5.6	230	Class D		
	40 V	SOT 23	IRLML0040	62	2.8	49	Class D		
	60 V	SOT 23	IRLML0060	98	2.6	37	Class D		
	80 V	PQFN 2 x 2	IRL80HS120	32	3.5	68	Class D/E		
	100 V	PQFN 2 x 2	IRL100HS121	42	2.7	62	Class D/E		
	150 V	PQFN 3.3 x 3.3	BSZ900N15NS3	75**	4.1**	46	Class E		
			BSZ520N15NS3	42**	7.2**	80	Class E		
			BSZ900N20NS3	78**	7.2**	52	Class E		
			BSZ22DN20NS3	200**	3.5**	24	Class E		
			BSZ12DN20NS3	111**	5.4**	39	Class E		
			BSZ42DN25NS3	375**	3.6**	21	Class E		
Driver ICs									
EiceDRIVER™ 2EDL71*, 1EDN7512, 2EDN7524									
EiceDRIVER™ GaN HEMT driver IC 1EDS5663H, 1EDF5673F, 1EDF5673K									
GaN e-mode HEMTs									
CoolGaN™ 600V e-mode GaN HEMT IGT60R190D1S (HDSOF-8-3)									
Microcontroller									
XMCTM MCU and wireless power controller XMCTM-SC* (including software IP)									
Voltage regulators									
IR3841M, IFX20002, IFX91041EJV50, IFX90121ELV50, IFX81481ELV									
Small signal MOSFETs									
Please check online									

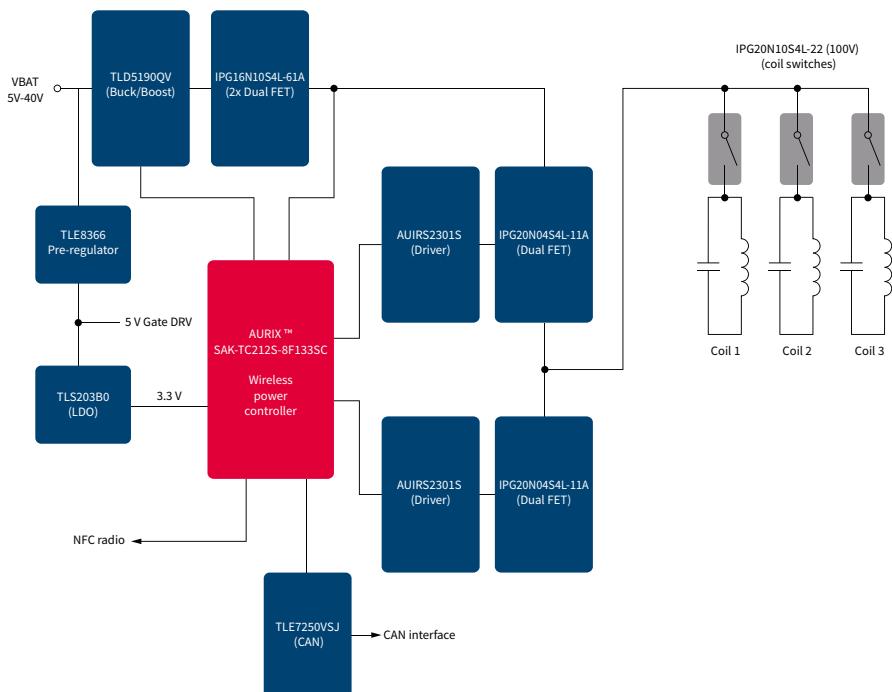
\*coming soon

\*\*  $V_{GS} = 8$  V

# Inductive wireless in-car charging (automotive)

The next-generation of in-cabin wireless charging systems must meet strict automotive safety, security, environmental, and regulatory requirements while still enabling industry-leading charging performance and efficiency. Infineon's AURIX™ microcontrollers, voltage regulators, power MOSFETs, and network ICs will easily support these requirements with a complete charging solution. With 15 W charging that meets existing standards, including fast charge smartphones, the solution readily adapts to future changes with a software update. A new innovative foreign object detection (FOD) system or our unique improved power drive architecture that provides unparalleled EMI performance are just some benefits to address the design challenges in the automotive wireless charging market. Discover our complete offerings for in-cabin charging on a system level on our webpage - something you will not find just anywhere.

**System diagram: AURIX™ based wireless charger – 3 coil**



Automotive products for wireless charging	Voltage class	Package	Part number	$R_{DS(on)} \text{ max } @ V_{GS} = 4.5 \text{ V } [\text{m}\Omega]$	$Q_g \text{ typical } [\text{nC}]$
Inverter automotive grade MOSFETs	40 V	SuperSO8 5 x 6 Dual	IPG20N04S4-12A	15.5	9
		S308 3.3 x 3.3	IPZ40N04S5L-4R8	6.7	11
			IPZ40N04S5L-7R4	10.7	6.5
Automotive products for wireless charging	Voltage class	Package	Part number	$R_{DS(on)} \text{ max } @ V_{GS} = 4.5 \text{ V } [\text{m}\Omega]$	$R_{DS(on)} \text{ max } @ V_{GS} = 10 \text{ V } [\text{m}\Omega]$
Coil selection switch	60 V	TDSON-8	IPG20N06S4L-11A	15.8	11.2
		SuperSO8 5 x 6 Dual	IPG20N10S4L-22A	28	22
			IPG20N10S4L-35A	45	35
			IPG16N10S4L-61A	78	61
Microcontroller and wireless power controller	AURIX™ SAK-TC212S-4F100N, SAK-TC212S-8F133SC				
Power supply	TLD5190 – buck-boost controller/TLE8366, TLS4120x, TLS203x, TLF35584 – safety MCU supply + CAN supply				
CAN	TLE7250SJ – high performance CAN transceiver				
Drivers	AUIRS2301S				

# Authentication for USB-C and Qi wireless charging

## A turnkey security solution

Manufacturers of wireless charging devices notice a threateningly fast increase of poor quality chargers, cables, and accessories congesting the market not compliant with requirements for protecting data and preventing major damage of the host devices. The only way to fight this phenomenon is to utilize standards for achieving a uniform level of safety, security and conformity. Condition will be the exchange of verification information right at the point of devices being connected, before any data or energy is transferred.

### Certified authentication standards

With both USB Type-C and the WPC Qi authentication standard, the USB Implementers Forum (USB-IF) and the Wireless Power Consortium (WPC) are enabling certified authentication standards which will be adopted by the leading industry players in the consumer and the industrial field.

### OPTIGA™ Trust UWP - turnkey device security solution

In response to the above described development, Infineon adds a new member to its OPTIGA™ Trust family – the OPTIGA™ Trust UWP. Based on the USB-C and the WPC Qi standard, it protects devices from being charged with the incorrect load, which could result in damage.

#### Key features

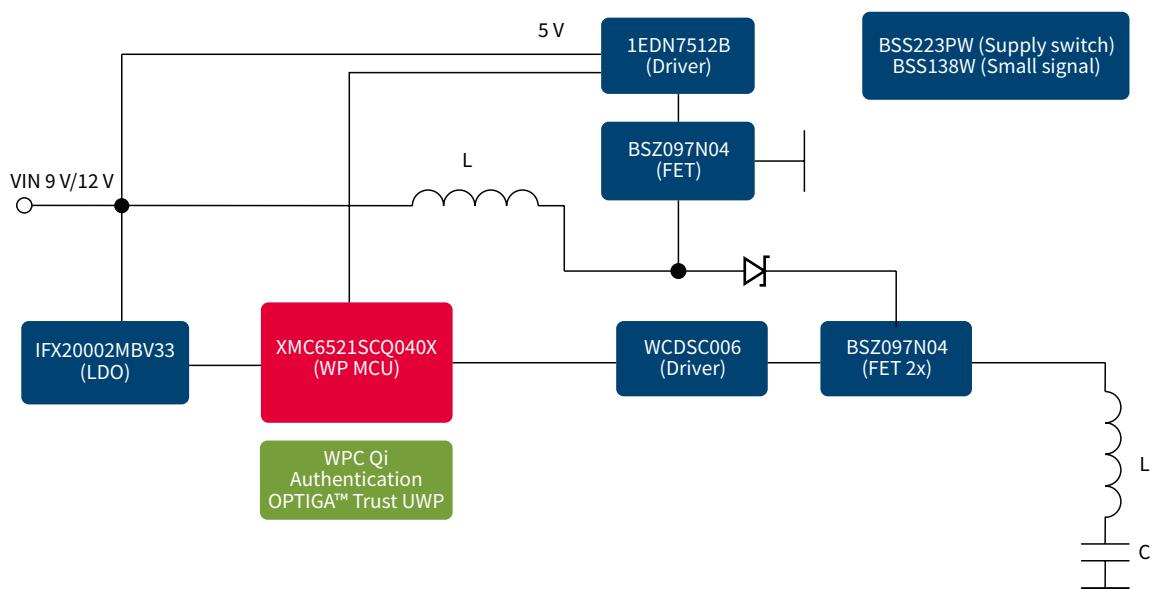
- › Global turnkey solution for USB-C authentication and wireless charging to Qi (WPC) open standard
- › Common criteria certified, EAL6+ (high) hardware
- › Authentication based on ECDSA NIST-P256
- › Cryptographic supporting: ECC256, SHA-256
- › X509v3 certificate format support USB-C
- › Certificate and key format supporting Qi standard
- › PKI
- › I2C serial interface
- › Up to 10 kB user memory
- › USON10-2 package (3x3 mm)
- › Extended temperature range option
- › Full system integration support including fully integrated evaluation kit (plus host software)

#### Key benefits

- › Safeguarding Qi security for consumers and devices globally
- › Built-in IoT protection (CC/EAL6+)
- › Full turnkey solution HW / host / certification / timing implementation WPC Qi-certified



**Example: Qi transmitter for charging smartphones including OPTIGA™ Trust UWP**



# Product highlights for automotive in-cabin solutions

## Wireless power controllers – AURIX™

Infineon's AURIX™ wireless power controller, based on the TriCore™, provides a flexible platform for high performance, smart, and secure wireless charging applications.

The AURIX™ wireless power controller helps the next-generation in-cabin wireless charging systems meet strict automotive safety, security, environmental and regulatory requirements, while still enabling industry-leading charging performance and efficiency. This controller works seamlessly with Infineon's power and interface devices to provide a complete charging solution for smartphones and other connected devices.

### Key features

- › Features SAK-TC212S-8F133SC
- › TriCore™ with 133 MHz
- › TriCore™ DSP functionality
- › 0.5 MB flash w/ECC protection
- › 64 KB EEPROM at 125 k cycles
- › Up to 56 KB RAM w/ECC protection
- › 16x DMA channels
- › 24x 12-bit SAR ADC converter
- › Powerful generic timer module (GTM)
- › 4x SENT sensor interfaces
- › State-of-the-art connectivity: 2x LIN, 4x QSPI, 3x CAN including data rate enhanced CAN FD
- › Single voltage supply 3.3 V
- › TQFP-80 package
- › On-demand:
  - 100/144 pin package
  - TC22xSC, TC23xSC

### Key benefits

- › Supports 15 W charging and all existing standards, including 7.5 W and fast charge smartphones
- › Easily supports future standards with a software update
- › Single MCU supports wireless charging, system application, CAN and external NFC interface
- › Infineon power drive stage which improves EMI performance 10 – 15 dB over existing solutions
- › Foreign object detection (FOD) with improved accuracy quality-factor monitoring
- › FOD capability can be extended beyond existing standards to improve detection
- › Supports custom coils, and more than three coils
- › Supports charging two devices using a single controller
- › Full power charging with a 6 – 19 V input supply
- › Built in security functionality that meets latest automotive requirements

### Transmitter features

- › Supports 15 W power output
- › Multiple industry standard and custom charging profiles using the same hardware architecture
- › Single and multi-coil architectures
- › Full-bridge support
- › Fixed frequency transmitter types
- › Buck/boost topology for support of full automotive power supply range



Type	eFlash [KB]	Data flash [KB]	Frequency [MHz]	SRAM [KB]	Package	Temperatur range [°C]	Remarks
SAK-TC212S-8F133SC	512	64 <sup>2)</sup>	133	56	TQFP-80	-40 ... +125	Including wireless charging IP
SAK-TC213S-8F133SC <sup>1)</sup>	512	64 <sup>2)</sup>	133	56	TQFP-100	-40 ... +125	Including wireless charging IP
SAK-TC222S-16F133SC <sup>1)</sup>	1000	96 <sup>2)</sup>	133	96	TQFP-80	-40 ... +125	Including wireless charging IP
SAK-TC223S-16F133SC <sup>1)</sup>	1000	96 <sup>2)</sup>	133	96	TQFP-100	-40 ... +125	Including wireless charging IP
SAK-TC224S-16F133SC <sup>1)</sup>	1000	96 <sup>2)</sup>	133	96	TQFP-144	-40 ... +125	Including wireless charging IP
SAK-TC233S-32F200SC <sup>1)</sup>	2000	128 <sup>2)</sup>	200	192	TQFP-100	-40 ... +125	Including wireless charging IP
SAK-TC234S-32F200SC <sup>1)</sup>	2000	128 <sup>2)</sup>	200	192	TQFP-144	-40 ... +125	Including wireless charging IP
SAK-TC237S-32F200SC <sup>1)</sup>	2000	128	200	192	LFBGA-292	-40 ... +125	Including wireless charging IP

<sup>1)</sup> On request<sup>2)</sup> EEPROM emulation (up to 125 k w/e cycles)

# Product highlights for consumer solutions

## Wireless power controllers – XMC™-SC

Infineon's XMC™-SC wireless power controller, based on the ARM® Cortex®-M0 core, provides a powerful and cost-effective platform for high performance, smart and secure wireless charging applications.

The XMC™-SC wireless power controller helps the next-generation wireless charging systems meet strict safety, environmental, and regulatory requirements, while still enabling industry-leading charging performance and efficiency. This controller works seamlessly with Infineon's power devices in a scalable architecture to provide a complete charging solution for everything from a fast charge smartphone, to a 20 W robot, to a 60 W drone and beyond.

### Key features

- › Supports inductive and resonant charging methods
- › Power levels up to 80 W
- › Multiple industry standard and custom charging profiles using the same hardware architecture
- › Single- and multi-coil transmitters
- › Half- and full-bridge support
- › Variable and fixed frequency transmitter types
- › Buck and boost topologies
- › Integrated flash for parameter storage
- › Voltage supply 1.8–5.5 V
- › Space saving VQFN-40 package

### Key benefits

- › Supports 15 W charging and existing standards, including fast charge smartphones
- › Provides full power without exotic thermal management
- › Achieves charging rates equivalent to wired charging
- › Supports custom charging profiles and industry standards on the same hardware
- › Foreign object detection (FOD) with improved accuracy quality-factor monitoring
- › FOD capability can be extended beyond existing standards to improve detection
- › Supports custom coils, and more than three coils





**BSZ0909ND**  
Half-bridge in  
PQFN 3.3 x 3.3 package

[Order now](#)



**IRL80/100 IRMOSFET™**  
PQFN 2 x 2 for half-bridge  
and full-bridge

[Order now](#)



**BSZ0910ND**  
Half-bridge in  
PQFN 3.3 x 3.3 package

[Order now](#)



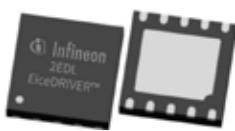
**WCDSC006**  
Fast half-bridge driver for  
high-and low-side MOSFETs

[Coming soon](#)



**EiceDRIVER™ 1EDN**  
Rugged, cool and  
fast 1-channel low-side  
4/8 A gate driver ICs

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**EiceDRIVER™ 2EDL71**  
Fast switching logic level  
half-bridge driver

[Coming soon](#)



**BSZ0994NS**  
OptiMOS™ in  
PQFN 3.3 x 3.3 package

[Order now](#)



**BSC0996NS**  
OptiMOS™ in  
SuperSO8 package

[Order now](#)



**BSZ097N04LS G**  
OptiMOS™ in  
PQFN 3.3 x 3.3 package

[Order now](#)



**IGT60R190D1S**  
CoolGaN™ 600 V e-mode  
HEMT in HDSOF-8-3

[Order now](#)



**Wireless power controllers**  
Available in VQFN-24  
and VQFN-40 packages

[Coming soon](#)



**SLS32AIA020Ux**  
OPTIGA™ Trust UWP  
USON10 3x3 package

[Coming soon](#)



**TLD5190**  
Automotive buck-boost  
controller

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**TLS203B0LDV**  
Automotive post LDO

[Order now](#)



**TLE8366EV**  
Automotive DC-DC buck  
converter

[Coming soon](#)



**AURIX™ TC2xx**  
Wireless power  
controller

[Coming soon](#)



**TLF35584QK**  
Automotive ASIL D  
system supply IC

[Order now](#)



**TLE7250SJ**  
CAN transceiver

[Order now](#)



**IPG20N10S4L-22A**  
100 V Automotive  
MOSFET for coil selection

[Order now](#)

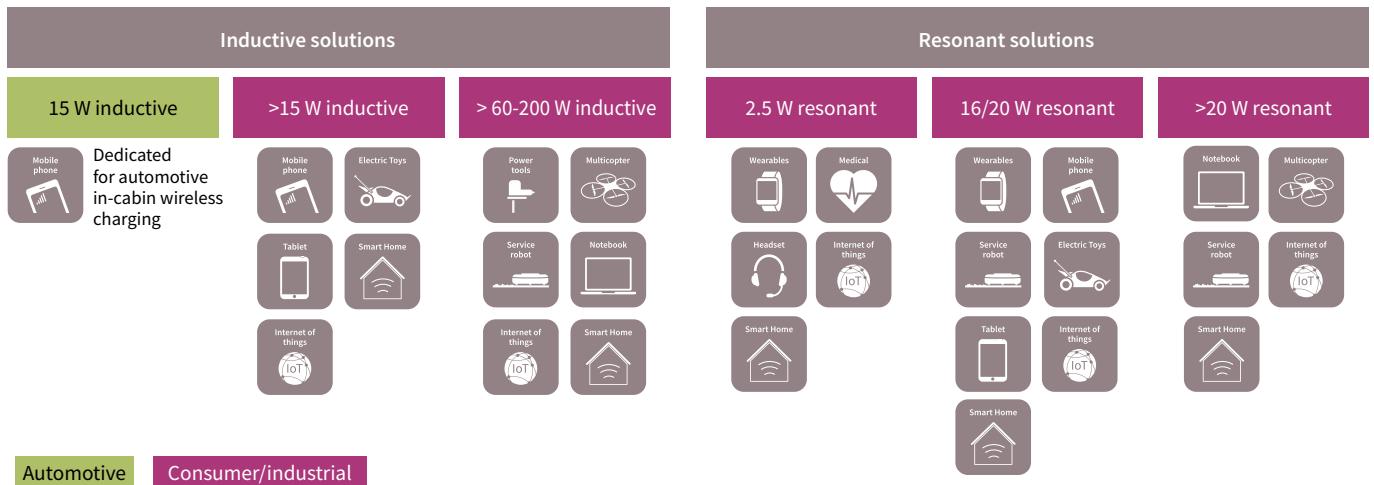


**IPG20N04S4L-11A**  
40 V automotive MOSFET  
for H-bridge

[Order now](#)

# System solutions for wireless charging

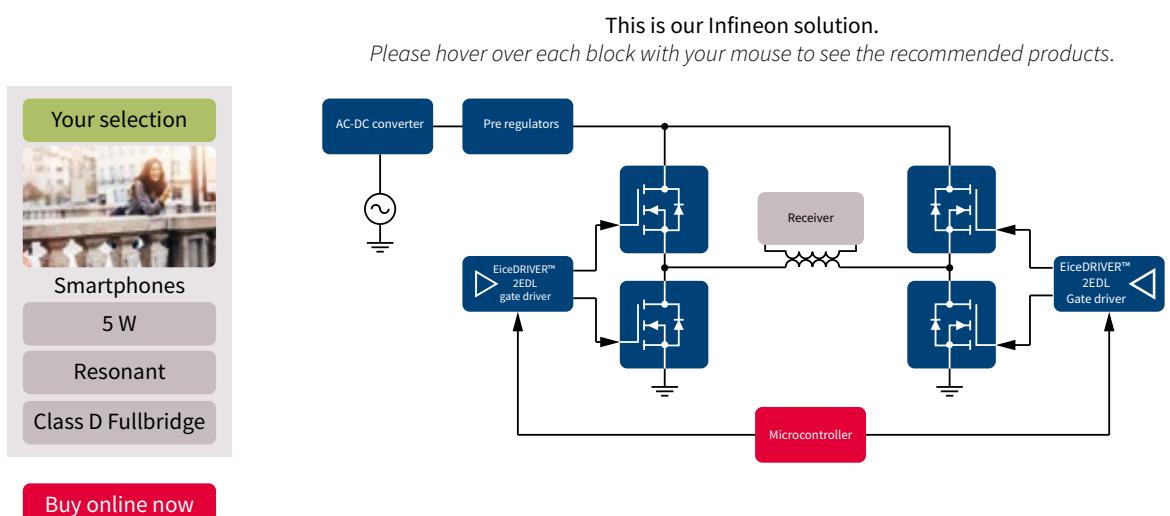
Master your design challenges with Infineon. With our broad range of designs customers have the possibility to make wireless charging available for different kinds of applications. For more information on the availability of our boards please visit [www.infineon.com/wirelesscharging](http://www.infineon.com/wirelesscharging) or get in contact with us via [www.infineon.com/support](http://www.infineon.com/support).



Find the right solutions for your wireless charging designs in four steps

Infineon's **selection tool for wireless charging** designs that allows you to find the right solutions for your designs in just four steps. Select the application, power range, standard and the topology you want to apply and get an overview of Infineon's most recommended offerings for your design.

**Application** **Power range** **Standard** **Topology** **Solution**



## Notes

# A world leader in semiconductor solutions



## Our vision

We are the link between the  
real and the digital world.

## Our values

We commit  
We partner  
We innovate  
We perform

## Our mission

We make life  
easier, safer  
and greener.

Part of your life. Part of tomorrow.

# Where to buy

Infineon distribution partners and sales offices:

[www.infineon.com/WhereToBuy](http://www.infineon.com/WhereToBuy)

# Service hotline

Infineon offers its toll-free 0800/4001 service hotline as one central number, available 24/7 in English, Mandarin and German.

- › Germany ..... 0800 951 951 951 (German/English)
- › China, mainland ..... 4001 200 951 (Mandarin/English)
- › India ..... 000 800 4402 951 (English)
- › USA ..... 1-866 951 9519 (English/German)
- › Other countries ..... 00\* 800 951 951 951 (English/German)
- › Direct access ..... +49 89 234-0 (interconnection fee, German/English)

\* Please note: Some countries may require you to dial a code other than "00" to access this international number.  
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