Wireless charging solutions

Introducing cost-effective offerings for consumer and automotive

www.infineon.com/wirelesscharging

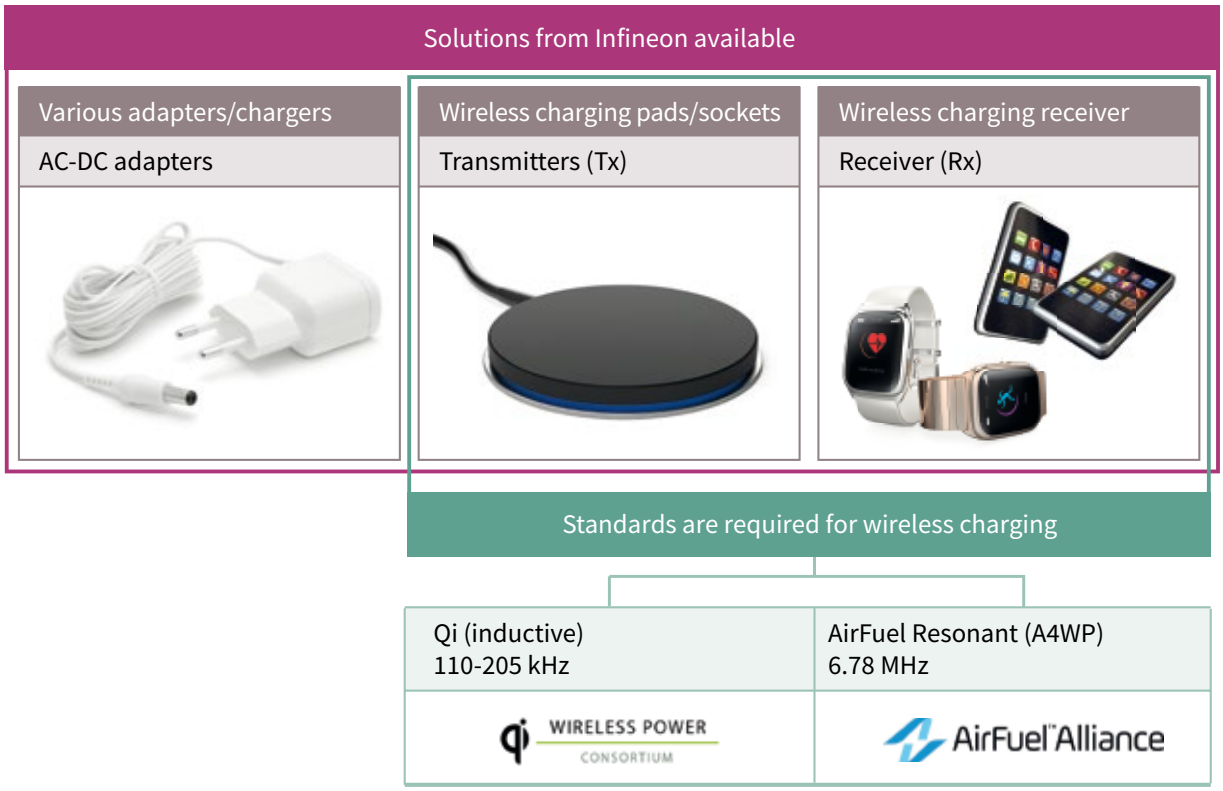
Wireless charging solutions

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 according 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.



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Different standards addressing wireless charging requirements

Currently two wireless charging standards stand out on the market: inductive and resonant. Qi (WPC) dominates the market today 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	Qi inductive 110-205 kHz	Resonant AirFuel (A4WP) 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		Communication on Bluetooth low energy

Why to use wireless charging?

Imagine your smartphone's battery is dead. Until now, you first must 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 plug 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

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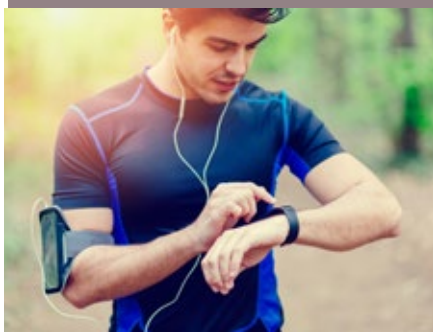
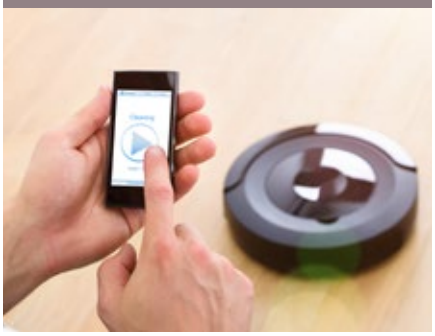
Applications that will benefit from wireless charging

Wearables

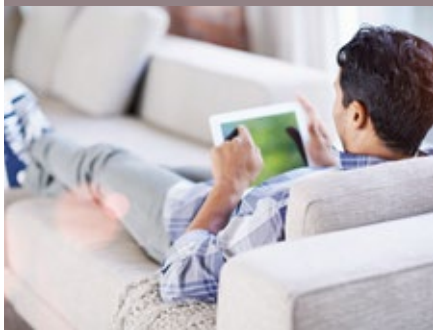


Mobile phone

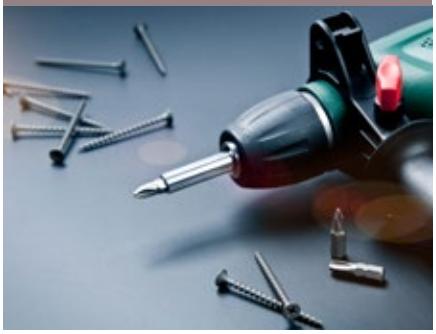
Service and household robots



Tablets

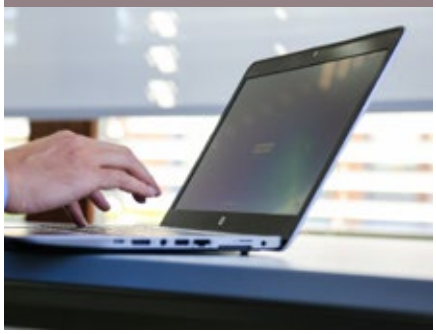


Power tools



Multicopter

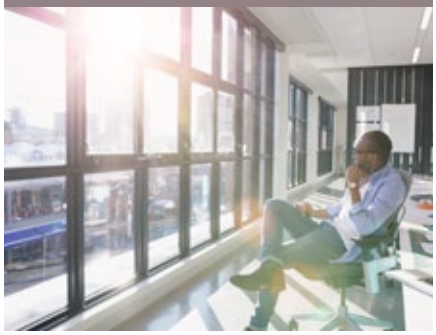
Notebooks



In-car charging

Public infrastructure

Internet of Things (IoT)



Medical

Smart home

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Choose Infineon to address your wireless charging requirements

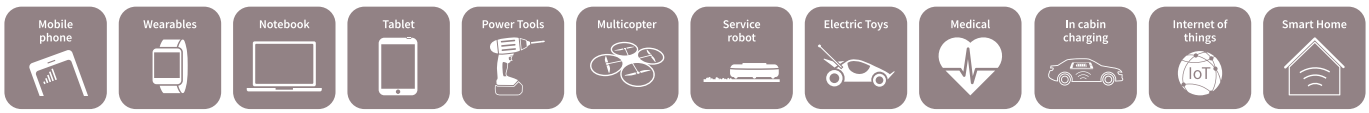
Having a reliable partner by your side is key to maximize the performance and consumer appeal of your wireless charging designs. At Infineon, we help you master every design challenges with our broad selection of semiconductors and reference designs.

Key benefits to choose Infineon

- Offering MOSFETs, driver ICs and microcontrollers with software
- Addressing both inductive and resonant standards
- Providing powerful and cost-effective solutions for high performance, smart, and safe 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 upcoming 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 mid voltage power MOSFETs – OptiMOS™ and StrongIRFET™
- Gate driver ICs – EiceDRIVER™ or OptiMOS™ driver
- 32-bit microcontrollers – XMC™ 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) – GaN e-mode HEMTs (600 V already available)
- Dedicated automotive power products – MOSFETs, DC-DC, LDO, PMIC with ASIL qualification
- Safety system expertise and high quality standards
- Voltage and buck regulators for component and bridge supply



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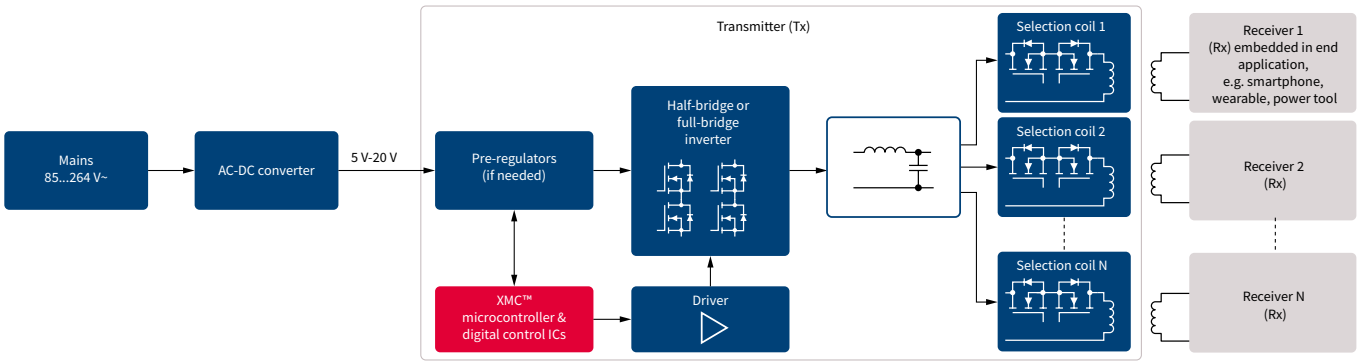
Inductive wireless charging for consumer applications

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™ versions 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 IR MOSFET™ devices in 2 mm 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 by with either an ARM® Cortex®-M0 core (XMC1000 family) or a Cortex®-M4 core with a floating point unit (XMC4000 family). We also develop solutions, including software, for selected applications.

System diagram: Inductive wireless charging



Sub-application	Voltage class	Package	Part number	$R_{DS(on)}$ max @ V_{GS} = 4.5 V [mQ]	Recommendation
Inverter MOSFETs	30 V	SuperSO8	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
			BSZ097N04LS G	14.2	Right fit
		PQFN 3.3 x 3.3 Dual	BSZ0909ND	25	Best performance
			BSZ0910ND	13	Best performance
		PQFN 2 x 2	IRFHS8342PbF	25	Right fit
			IRLHS6342PbF	15.5	Best performance
Coil selection switch	20 V	PQFN 2 x 2	IRLHS6242PbF	11.7 (=2.5 V drive capable)	Right fit
	25 V		IRFHS8242PbF	21	Right fit
	30 V		IRFHS8342PbF	25	Right fit
			IRLHS6342PbF	15.5 (=2.5 V drive capable)	Right fit
		PQFN 3.3 x 3.3	BSZ0994NS	8.6	Best performance
			BSZ0909NS	15	Right fit
Driver IC	PX3517, PX3519 or AURIS2301S, EiceDRIVER™ 1EDN and 2EDN				
Microcontroller	XMC1302, XMC1402, XMC4108, XMC1402-Q040X0200 SC				
Voltage regulators	IR3841MPbF, IFX20002,IFX90121ELV50, IFX81481ELV, IFX91041EJV50				

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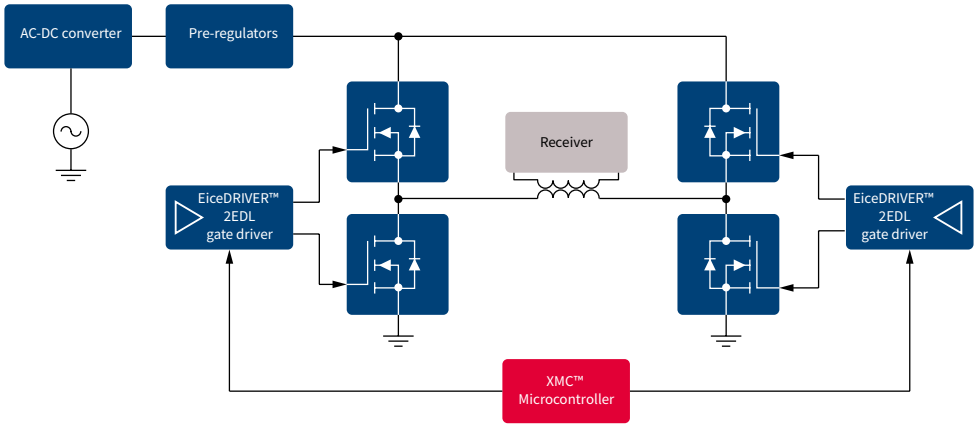
Resonant wireless charging for consumer applications

Infineon offers a superior power MOSFET technology to address frequency switching implementations, especially in the 30 V - 100 V areas for class D inverter designs and in the 150 V - 250 V voltage class for class E inverter designs. We provide 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 will soon bring 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 uses a pre-regulator (buck or buck/boost) to control the input voltage of your amplifier you can find OptiMOS™ solutions in the 20 V-400 V MOSFETs section. Here again, the XMC™ 32-bit industrial microcontrollers 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
Inverter 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
			BSZ0910ND	13	5.6	230	Class D
		SOT-23	IRLML0030pbf	33	2.75	84	Class D
	40 V	SOT-23	IRLML0040pbf	62	2.8	49	Class D
	60 V	SOT-23	IRLML0060pbf	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
	200 V		BSZ900N20NS3	78**	7.2**	52	Class E
			BSZ22DN20NS3	200**	3.5**	24	Class E
			BSZ12DN20NS3	111**	5.4**	39	Class E
	250 V		BSZ42DN25NS3	375**	3.6**	21	Class E
Driver ICs	EiceDRIVER™ 2EDL71*						
	EiceDRIVER™ 1EDN and 2EDN						
Microcontroller	XMC1302, XMC1402, XMC4108, XMC1402-Q040X0200 SC						
Voltage regulators	IR3841MPbF, IFX20002,IFX90121ELV50, IFX81481ELV, IFX91041EJV50						

* In development
** V_{GS} = 8 V

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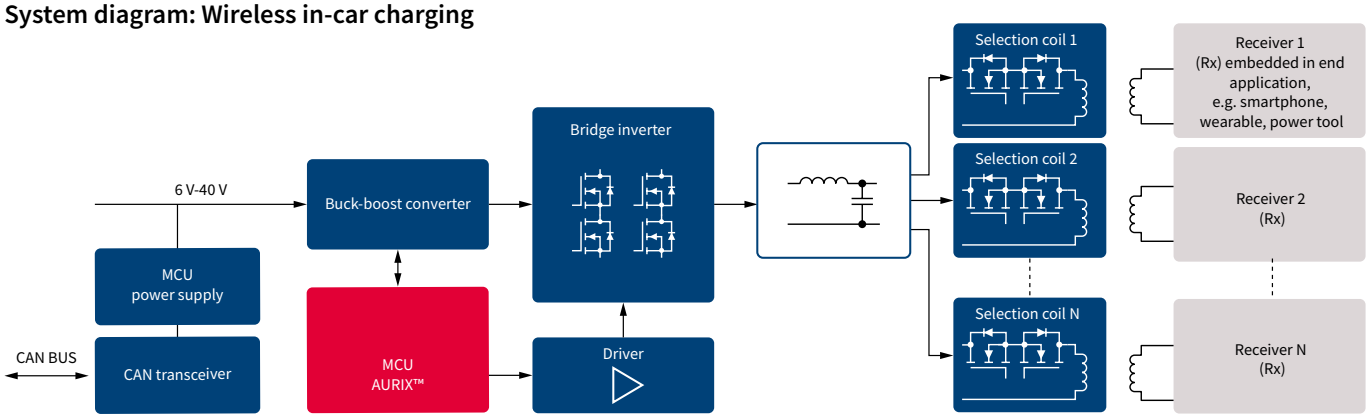
Inductive wireless in-car charging (automotive)

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™ microcontroller, voltage regulators, power MOSFET technologies, 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 easily supports 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: Wireless in-car charging



Automotive products for wireless charging	Voltage class	Package	Part number	$R_{DS(on)}$ max @ V_{GS} = 4.5 V [mQ]	Q_G typical [nC]
Inverter automotive grade MOSFETs	40 V	SuperSO8 5 x 6 Dual	IPG20N04S4-12A	15.5	9
		S3O8 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**	**$R_{DS(on)}$ max @ V_{GS} = 4.5 V [mQ]**	**$R_{DS(on)}$ max @ V_{GS} = 10 V [mQ]**
Coil selection switch	60 V	TDSON-8	IPG20N06S4L-11A	15.8	11.2
	100 V	SuperSO8 5 x 6 Dual	IPG20N10S4L-22A	28	22
			IPG20N10S4L-35A	45	35
			IPG16N10S4L-61A	78	61
MCU	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				

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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 safe 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 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
- Foreign Object Detection (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

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

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 [2]	133	56	TQFP-80	-40 ... +125	Including wireless charging IP
SAK-TC213S-8F133SC [1]	512	64 [2]	133	56	TQFP-100	-40 ... +125	Including wireless charging IP
SAK-TC222S-16F133SC [1]	1000	96 [2]	133	96	TQFP-80	-40 ... +125	Including wireless charging IP
SAK-TC223S-16F133SC [1]	1000	96 [2]	133	96	TQFP-100	-40 ... +125	Including wireless charging IP
SAK-TC224S-16F133SC [1]	1000	96 [2]	133	96	TQFP-144	-40 ... +125	Including wireless charging IP
SAK-TC233S-32F200SC [1]	2000	128 [2]	200	192	TQFP-100	-40 ... +125	Including wireless charging IP
SAK-TC234S-32F200SC [1]	2000	128 [2]	200	192	TQFP-144	-40 ... +125	Including wireless charging IP
SAK-TC237S-32F200SC [1]	2000	128	200	192	LFBGA-292	-40 ... +125	Including wireless charging IP

[1] On request
[2] EEPROM emulation (up to 125 k w/e cycles)

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Product highlights for consumer solutions

Wireless power controllers – XMC™

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

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

Key benefits

- Supports 15 W charging and existing standards, including fast charge smartphones
- Provides full power 15 W 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
- Foreign object detection capability can be extended beyond existing standards to improve detection
- Supports custom coils, and more than three coils

Key features

Features XMC1402-Q040X0200SC

- Supports inductive and resonant charging methods
- Power levels up to 60 W
- Multiple industry standard and cus-
- tom 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

Type	Flash [KB]	Frequency [MHz]	SRAM [KB]	Package	Temperatur range [°C]	Remarks
XMC1402-Q040X0200 SC	200	48	16	VQFN-40	-40 ... +105	Including wireless charging IP
XMC1402-Q040X0128 SC [1)]	128	48	16	VQFN-40	-40 ... +105	Including wireless charging IP
XMC1402-Q040X0064 SC [1)]	64	48	16	VQFN-40	-40 ... +105	Including wireless charging IP
XMC1402-Q048X0200 SC [1)]	200	48	16	VQFN-48	-40 ... +105	Including wireless charging IP
XMC1402-Q064X0200 SC [1)]	200	48	16	VQFN-64	-40 ... +105	Including wireless charging IP
XMC1402-F064X0200 SC [1)]	200	48	16	LQFP-64	-40 ... +105	Including wireless charging IP
XMC1403-Q040X0200 SC [1)]	200	48	16	VQFN-40	-40 ... +105	Including wireless charging IP
XMC1404-Q048X0200 SC [1)]	200	48	16	VQFN-48	-40 ... +105	Including wireless charging IP

[1)] On request

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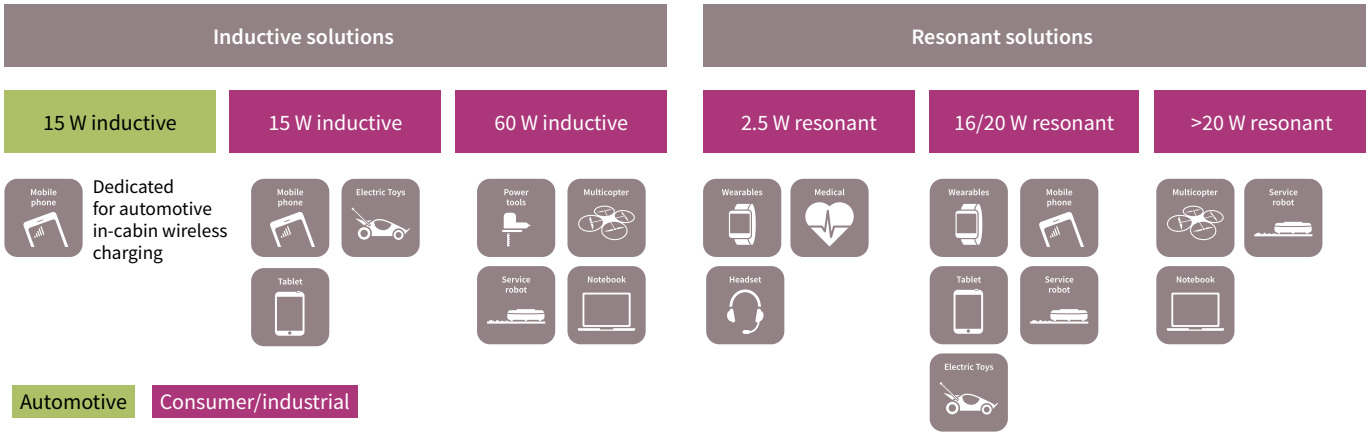
System solutions for wireless charging

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 us on www.infineon.com/wirelesscharging or get in contact with us via 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.

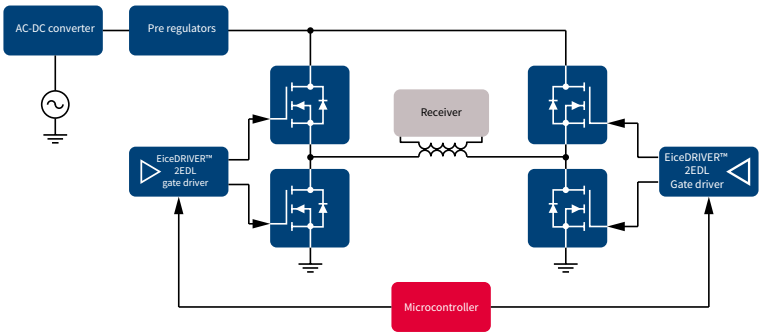
Application | Power range | Standard | Topology | Solution

This is our Infineon solution.
Please hover over each block with your mouse to see the recommended products.

Your selection

Smartphones
5 W
Resonant
Class D Fullbridge

Buy online now



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BSZ0909ND
Half-bridge in
PQFN 3.3 x 3.3 package

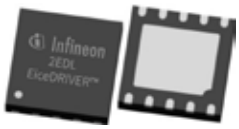
Order now

IRL80/100 IR MOSFET™
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



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Fast switching logic level half-bridge driver

Coming soon

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

Order now

PX3519 OptiMOS™ Driver
High speed driver for dual power MOSFETs

Order now

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

TLD5190
Automotive buck-boost controller

Order now

TLS203B0LDV
Automotive post LDO

Order now

TLE8366EV
Automotive DC-DC buck converter

Order now

AURIX™ TC2xx
Wireless power controller

Coming soon

TLF35584
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

AUIRS2301S
Fast MOSFET driver IC

Order now

Automotive | Consumer/industrial solution

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Where to buy

Infineon distribution partners and sales offices:
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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)

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Published by
Infineon Technologies Austria AG
9500 Villach, Austria

Order number: B111-I0449-V3-7600-EU-EC-P
Date: 03 / 2018