

June, 2019



Agenda

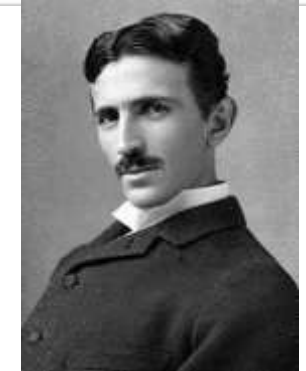
- Applications
- Technologies & Standards
- Coil Specific Considerations
- Würth Elektronik Products & Advantages

Wireless Power Transfer History



1893 first wireless powered lightbulb N. Tesla

1980's electrical toothbrush



2008 founding of Wireless Power Consortium (WPC) Qi Standard



WIRELESS POWER
CONSORTIUM

2011 first smart phones with integrated Qi receiver



2017 Apple joint WPC



2018 Wireless charging of EV's





Applications

Application Areas besides Consumer Products



Industrial



Automotive



Medical Technology

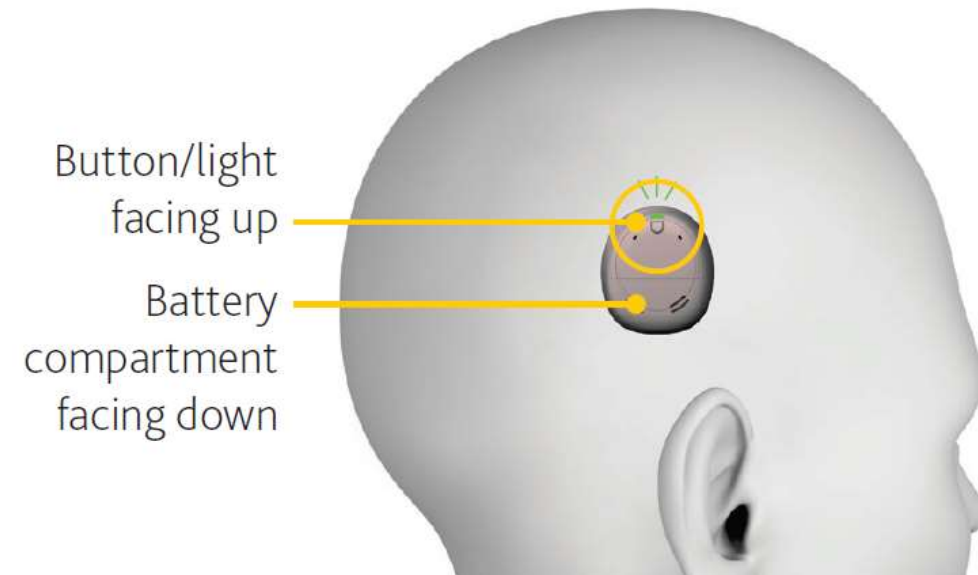


Furniture / Infrastructure

Applications of WE Customers



Attach your processor



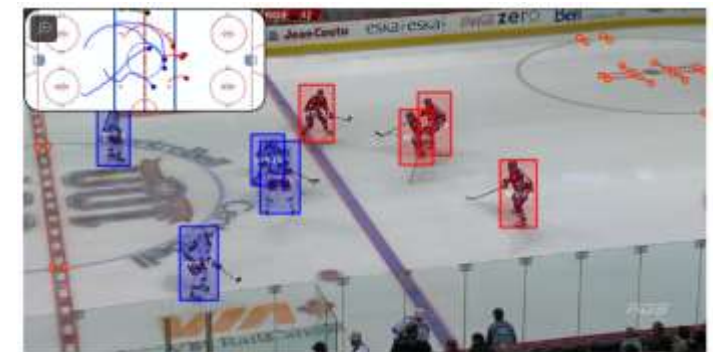
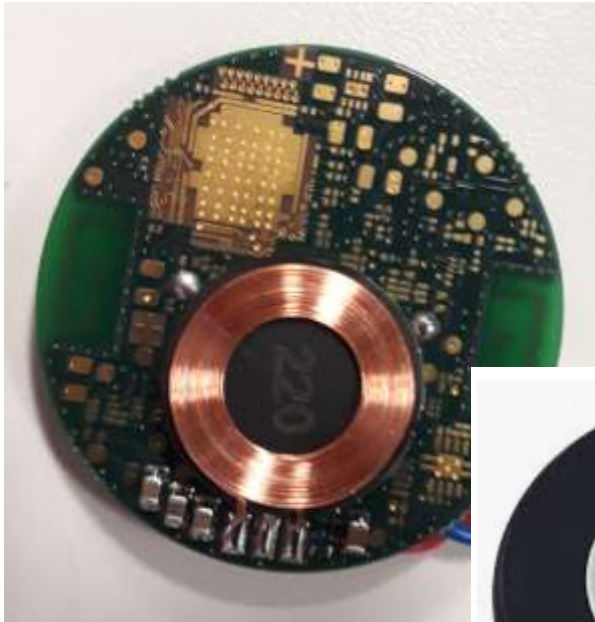
Applications of WE Customers



heinrichs weikamp gmbh
Charge diving computer



Jogmo World GmbH (Fraunhofer Institut Spin-off)



All NHL teams will use in season 2019/2020 the new puck with this new technology

More power

60 – 200 Watt



200 – 2400 Watt

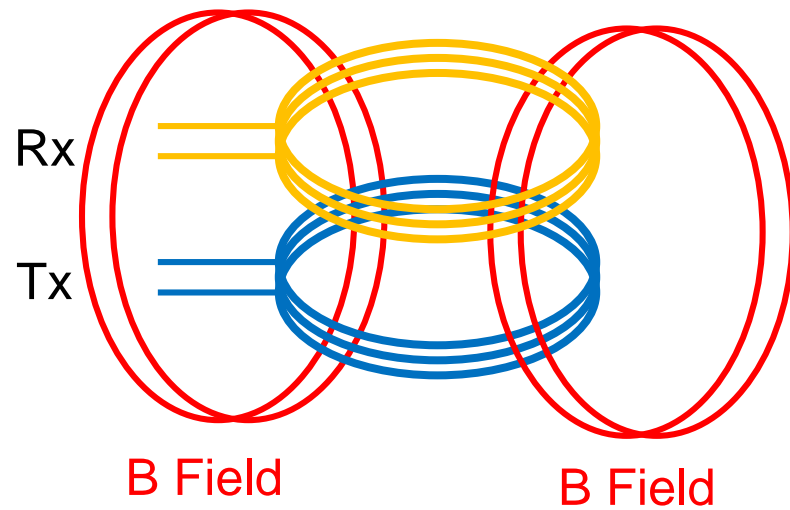


17 February 2017

2

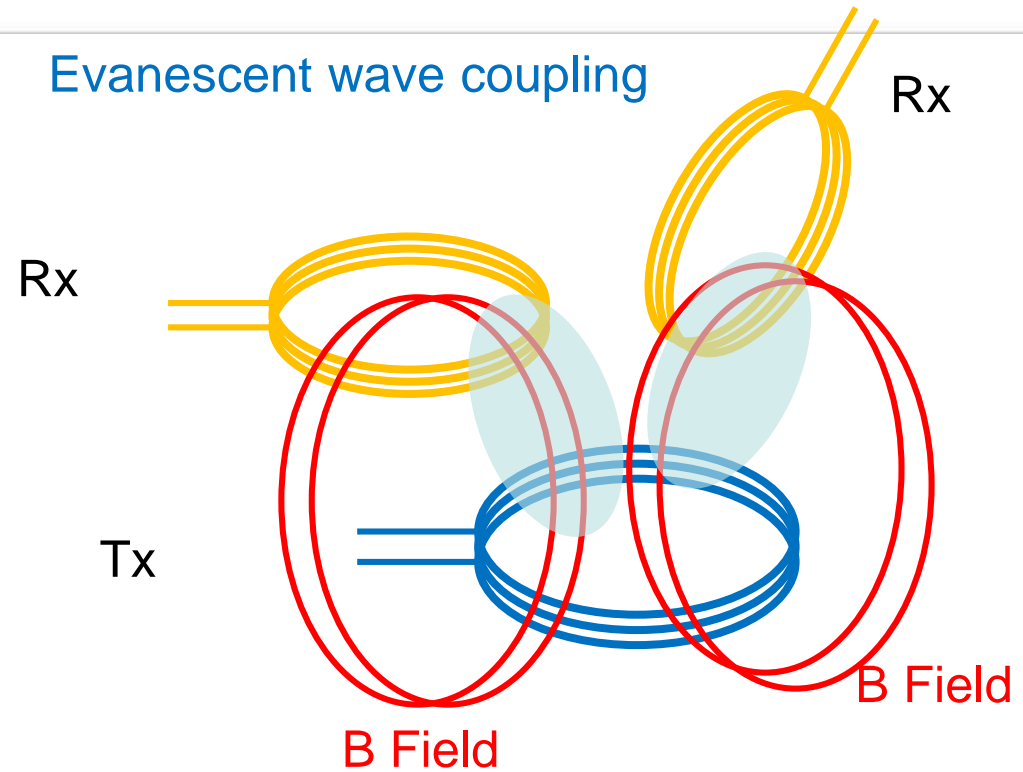
Technologies and Standards

Inductive and Resonant Coupling



inductive power transfer

Evanescent wave coupling

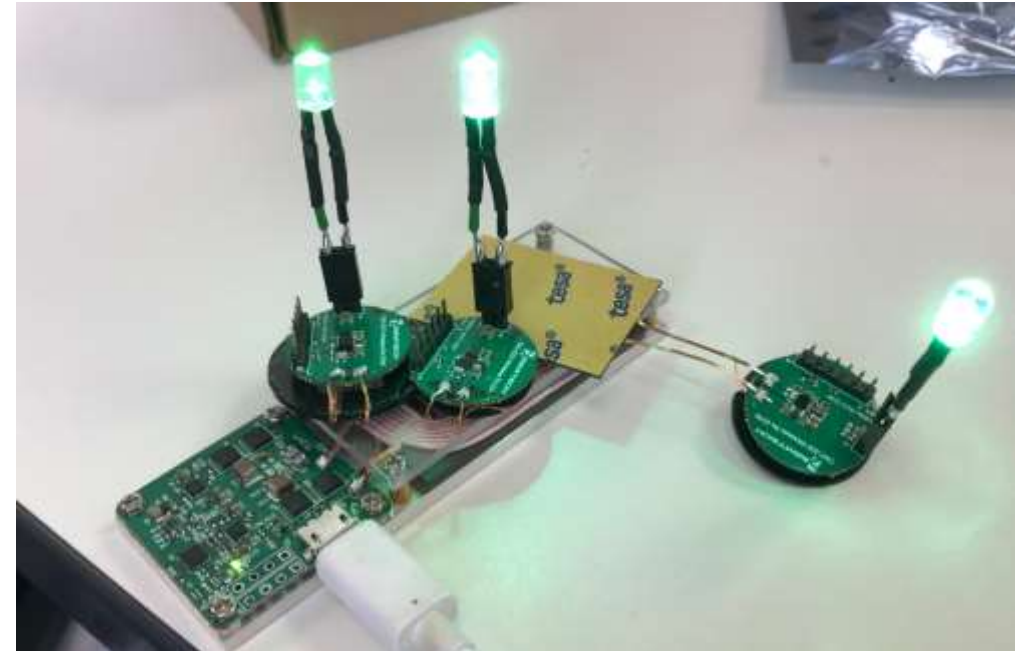


resonant power transfer

Examples



inductive power transfer



resonant power transfer

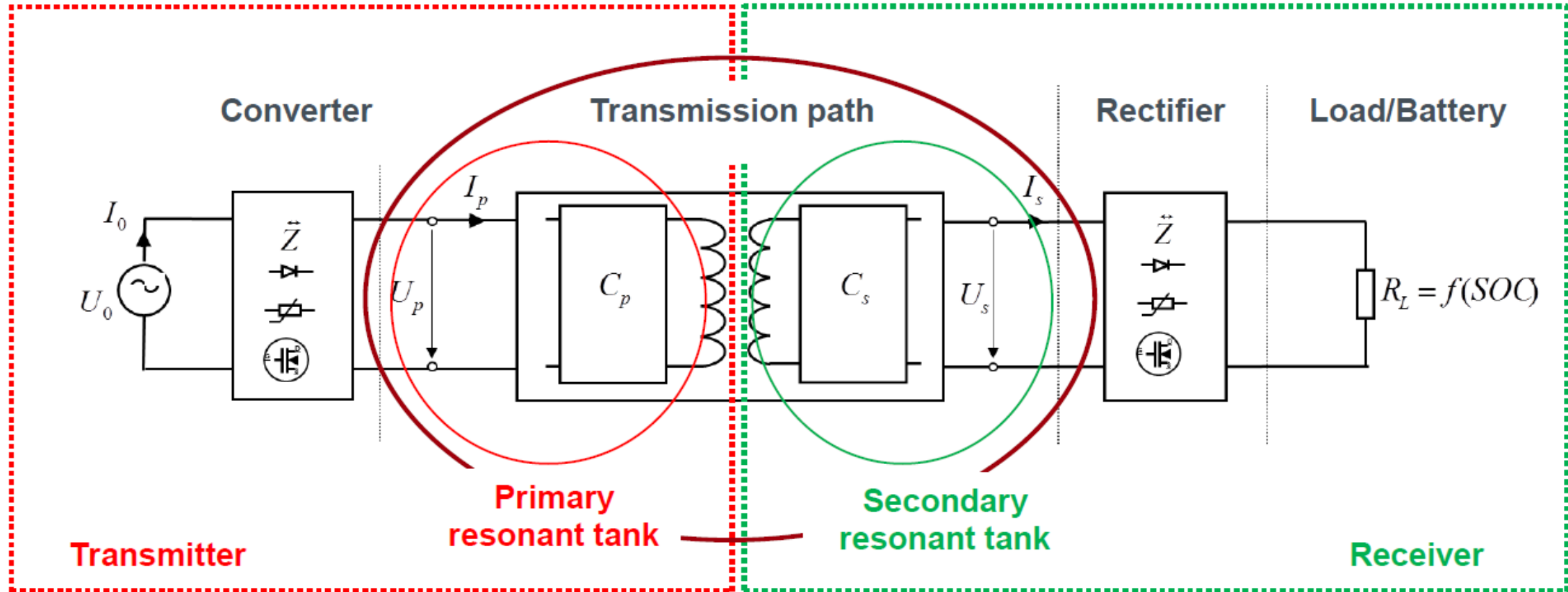
WIRELESS POWER Standards

- **Closely coupled**
 - Wireless Power Consortium (Qi)
 - Power transfer using resonant tank at very low frequency over short distances.
 - Resonant tank at **100 – 205 kHz**.
 - 2009 “Low Power” 5W
 - 2016 Extended Power Profile 15W
 - higher power classes planned

- **Loosely coupled** (and closely coupled)
 - AirFuel Alliance
 - Power transfer based on resonant tank at very high frequency over longer distances (40mm).
 - Ability to charge multiple devices at same time.
 - Resonant tank at **6.78MHz**. (ISM Band)
 - Capability up to *30W systems.



Terms and definition

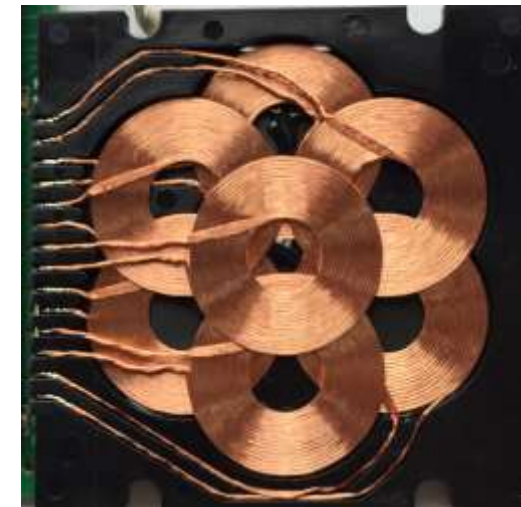
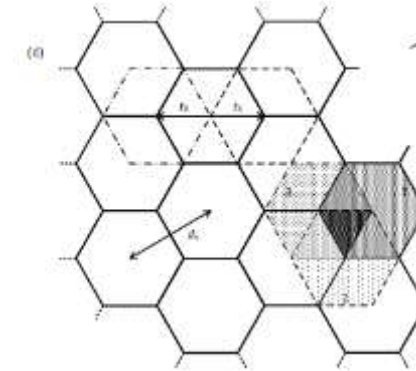
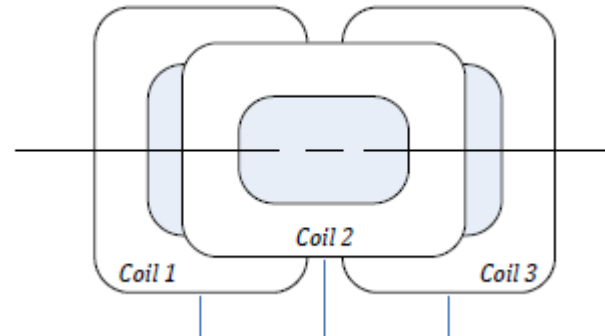
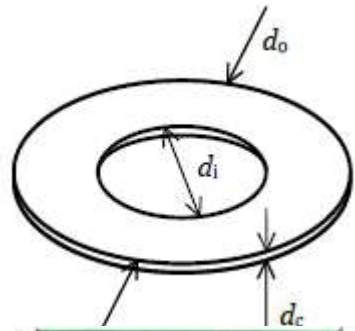


Coil Specific Considerations

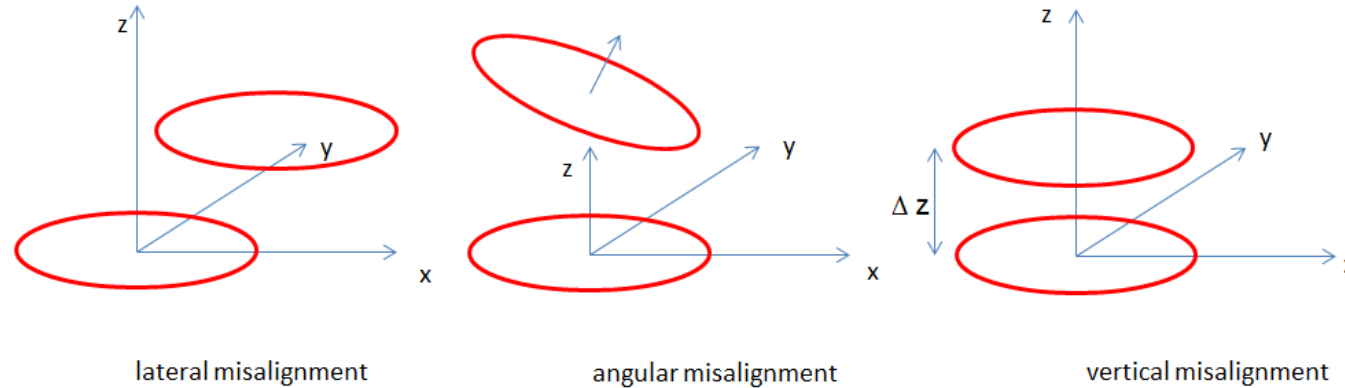
Coil System Requirements

- Power level
- Available space within Rx device
- Distance between Tx and Rx
- Freedom of positioning Rx
- Electrical performance (efficiency, Q-factor, R_{DC} , shielding..)
- Price

Coil Types - Freedom of Positioning



Coupling factor / alignment tolerances

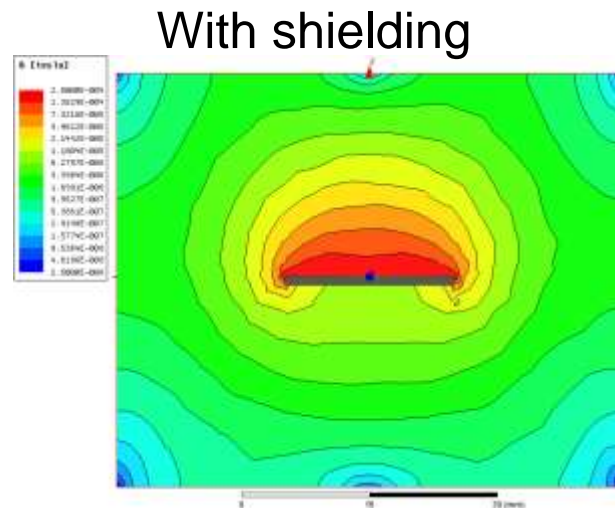
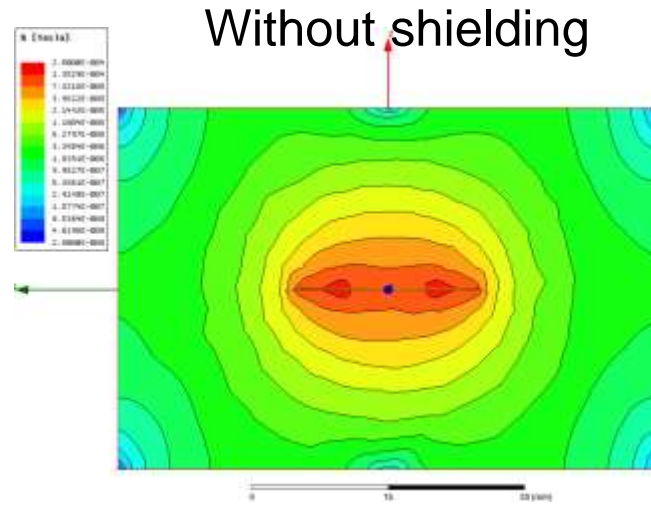


- Good coupling and maximum energy transmission depends on
- size of the effective area of the receiver coil in the magnetic field
 - the distance in the z direction

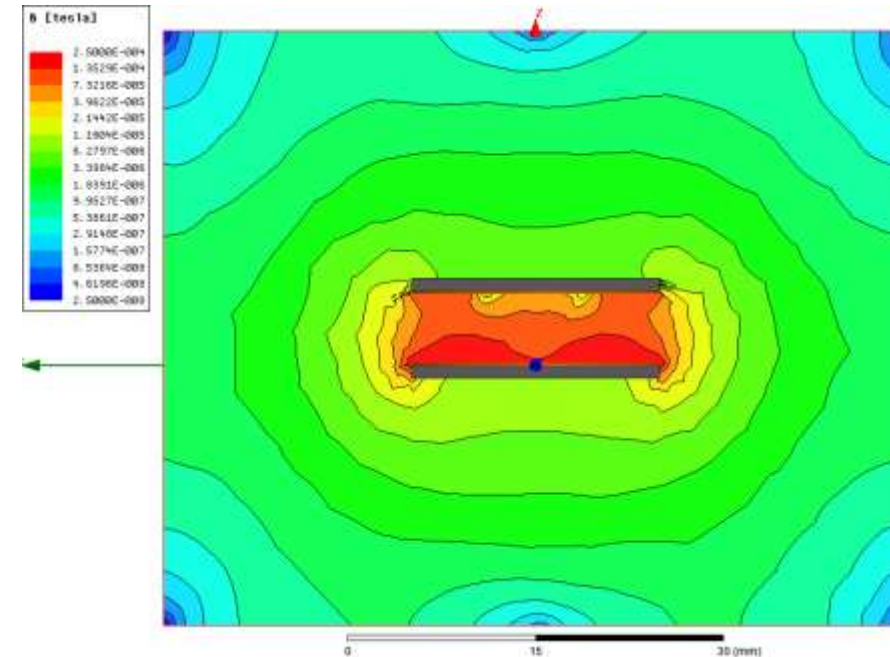
A coupling factor of 1 is ideal

$$k = \frac{\phi_1}{\phi_{21}}$$

Improvement using ferromagnetic shielding



Tx_Rx with shielding



Coupling Factor k depending on Coil Size Ratio

- Tx/Rx coil size impacts coupling factor k
- ϕ is defined by current and coils diameter

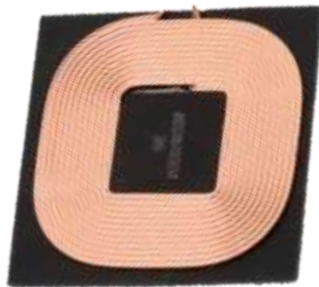
$$k = \frac{\phi_1}{\phi_{21}}$$

$$\Phi_{21} = B_1 A_2 = \left(\frac{\mu_0 I_1}{2R_1} \right) \pi R_2^2 = \frac{\mu_0 \pi I_1 R_2^2}{2R_1}$$



$$k = 0.81$$

$$A_{RX}/A_{TX} = 1:1$$



$$k = 0.75$$

$$A_{RX}/A_{TX} = 1:1.1$$



$$k = 0.61$$

$$A_{RX}/A_{TX} = 1:2$$



Examples from **WE** Mix&Match and RedExpert

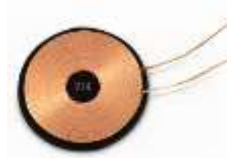
Tx/Rx size ratio impact

760 308 100 111 (A11)



$$k = 0.29$$

$$A_{RX}/A_{TX} = 1:6$$



760 308 101 214

760 308 101 104



$$k = 0.60$$

$$A_{RX}/A_{TX} = 1:1$$



760 308 101 214

Examples from **WE** Mix&Match and RedExpert

Receiver coils size is a key for success



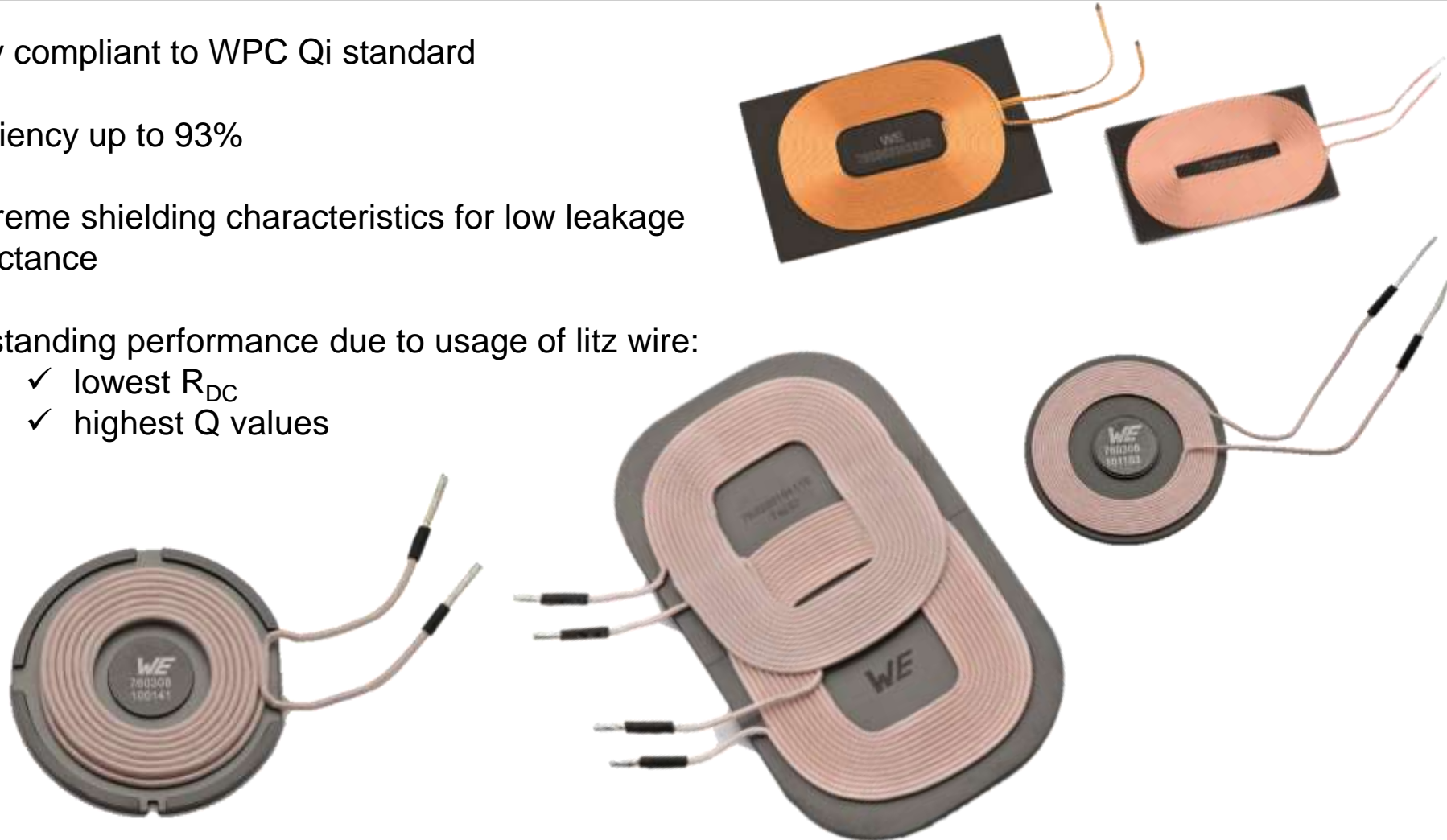
<https://www.ifixit.com/Teardown/iPhone+8+Teardown/97481>



WE Products

Würth Elektronik Wireless Power Coils WE-WPT

- Fully compliant to WPC Qi standard
- Efficiency up to 93%
- Supreme shielding characteristics for low leakage inductance
- Outstanding performance due to usage of litz wire:
 - ✓ lowest R_{DC}
 - ✓ highest Q values



WE Wireless Power Coils – 06/2019



32 Transmitter Coils



27 Receiver Coils



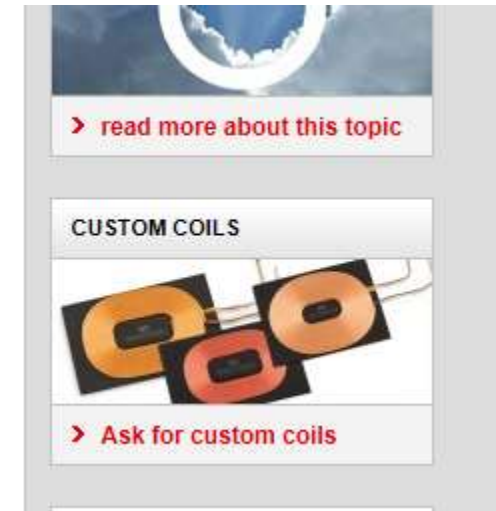
http://www.we-online.de/web/de/electronic_components/produkte_pb/demoboards/wireless_power/wireless_power_1.php

http://katalog.we-online.de/en/pbs/browse/Power_Magnetics/Wireless_Power_Transmission

Customer Specific Coils

- Yes, we do 😊 😊
- Use template on WPT website:

lution to
d integrate



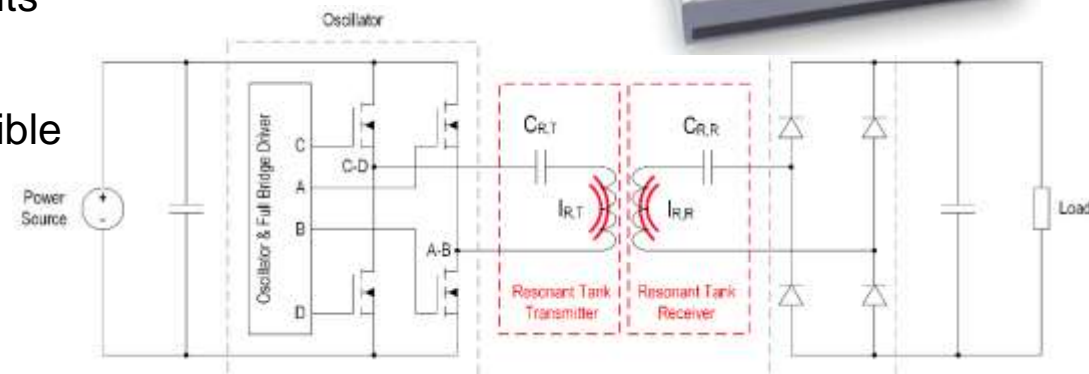
- http://www.we-online.de/web/en/electronic_components/produkte_pb/demoboards/wireless_power/wirelesspowercoilinquiryysheet.php
- **MOQ: 5.000**

NEW 200W WPT solution with data transfer

www.we-online.com/wirelesspower/200WKit



- The current profile is almost sinusoidal
- By changing the resonance frequency the output voltage can be regulated
- It is scalable from low to high power (10 W – 10kW)
- The MOSFETs switch close to the zero crossover point (ZVS)
→ efficiency > 90%
- It is scalable for many different voltages/currents
- Data transfer from receiver to transmitter possible



www.we-online.de/ANP070

Qi Medium Power 15W Development Kit with bi-directional data transfer



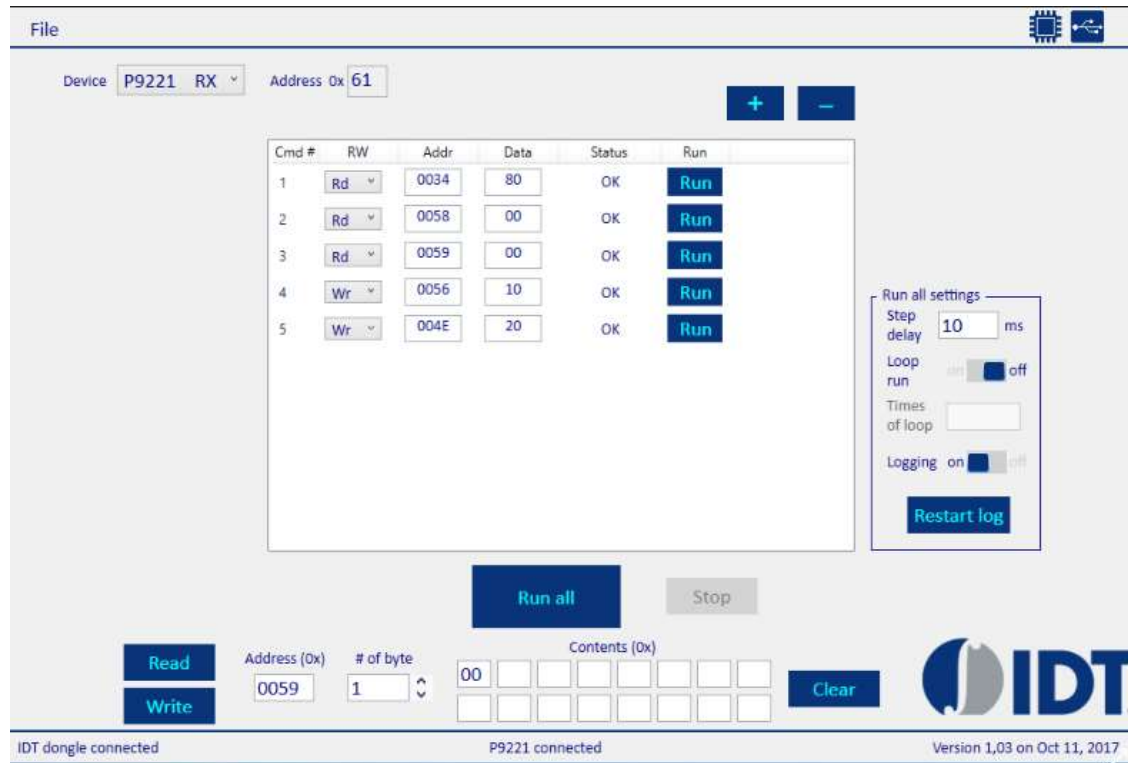
Transmitter 15W Qi ver. 1.2.3
Receiver 15W

Part No: 760308MP2

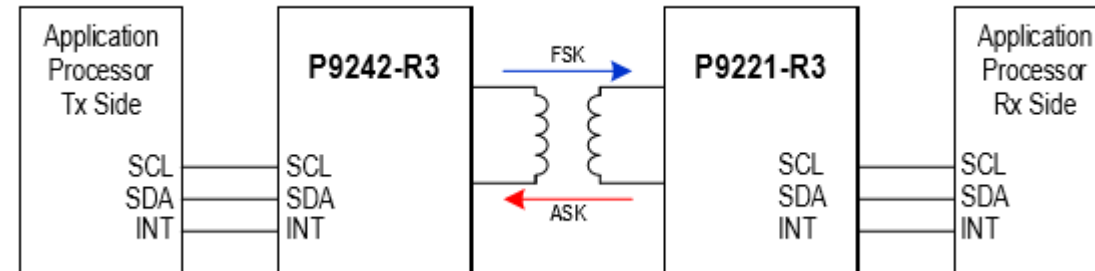
[Website: 15W - IDT](#)

[Website: Pre-Order](#)

Qi Medium Power 15W Development Kit with bi-directional data transfer (2)



The bi-directional data communication channel enables users to authenticate a wirelessly charged receiver device with a specific charging transmitter base or to transfer system data without any additional hardware



Information Material

Wireless Power Transfer Website

<http://www.we-online.com/wirelesspower>



Home Career Contact English

more than you expect

Search

Electronic & Electromechanical Components

Printed Circuit Boards

Intelligent Power and Control Systems

Würth Elektronik Group



Electronic & Electromechanical Components - Standard Parts

Products

Applications

Wireless Power

Welcome

Products

Product Catalog

New Products

Innovations

Application Notes

Component Libraries

Applications

AMBER PI

Digital Power

Energy Harvesting

USB 2.0

Wireless Power

Reference Designs

Mix and Match

Infographic

FAQ

Design Your EMC-



Wireless Power Coils WE-WPCC

Wireless Power Coils WE-WPCC WE-WPCC offer the best performance with highest Q-factor and lowest RDC values. Standardized coils, according to Wireless Power Consortium (WPC), and other off-the-shelf components from 50 mW to 200 W are available. Customized solutions for wireless power coils up to 11 kW are possible. Therefore we offer the industry's broadest portfolio of wireless power transfer coils.

> To product portfolio of Würth Elektronik

Würth Elektronik illustrates Wireless Power Transfer...

ROADTEST



Apply for our RoadTest with Element14 and ROHM Semiconductor and win one of our Wireless Power Design Kits.

> Apply now!

POWER THROUGH THE AIR



> read more about this topic

CUSTOM COILS



Mix and Match for Wireless Power Coil

<http://www.we-online.de/wirelesspower/mixandmatch>

Innovator award winning



Home Karriere Kontakt Deutsch

more than you expect

Suche

Elektronische & Elektromechanische Bauelemente

Leiterplatten

Intelligente Power- und Steuerungssysteme

Würth Elektronik Gruppe



Elektronische & Elektromechanische Bauelemente - Standard-Bauteile

Produkte

Applikationen

Wireless Power

Mix and Match

Willkommen

Produkte

Produktkatalog

Neuprodukte

Innovationen

Application Notes

Bauteilebibliotheken

Applikationen

AMBER PI

Digital Power

Energy Harvesting

USB 2.0

Wireless Power

Referenzdesigns

Mix and Match

Infografik

FAQ

Design Your EMC-Filter

Mix and Match für Wireless Power Spulen

Ihr Tool zum Finden der optimalen Spulenkombination für Ihre Wireless Power Anwendungen.

Durch Klick auf den ausgewählten Punkt werden Sie direkt auf unsere Online-Simulationssoftware [REDEXPERT](#) weitergeleitet und erhalten detaillierte Informationen zum ausgewählten Spulenpaar.

Bei Auswahl der Artikelnummern erfolgt eine Weiterleitung zum jeweiligen Produkt in unserem Online-Katalog.

| | | Receiver | | | | | | | | | | | | | | | | | | | | | | | |
|--|--|-----------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|----------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|--|
| | | 760 308 201 | 760 308 103 202 | 760 308 103 203 | 760 308 103 204 | 760 308 103 205 | 760 308 103 206 | 760 308 102 207 | 760 308 101 208 | 760 308 101 208A | 760 308 102 210 | 760 308 103 211 | 760 308 102 212 | 760 308 102 213 | 760 308 101 214 | 760 308 103 215 | 760 308 101 216 | 760 308 101 217 | 760 308 101 219 | 760 308 101 220 | 760 308 101 303 | 760 308 103 305 | 760 308 102 306 | 760 308 103 307 | |
| 760 308 101 Qi-A1 / 19 V | | | | | | | | | | | | | | | | | | | | | | | | | |
| 760 308 105 Qi-A5 / 5 V | | | | | | | | | | | | | | | | | | | | | | | | | |
| 760 308 106 Qi-A6 / 12 V | | | | | | | | | | | | | | | | | | | | | | | | | |
| 760 308 110 Qi-A10 / 19 V | | | | | | | | | | | | | | | | | | | | | | | | | |



REDEXPERT for Wireless Power Coil

<https://www.we-online.com/redexpert/wirelesspower>



Start Würth Elektronik Unternehmensgruppe Jörg Deutsch

more than you expect

Kabellose Energieübertragung **REDEXPERT**

43 Produkte

| | Qi | Artikel-Nr. | Serie | St... | Typ | Bauform | Spez | Kompati... | L @125... | Q @125... | I _R | I _{eat} | R _{oc} |
|--|----|--------------|---------|-------|-----|---------|------|------------------|-----------|-----------|----------------|------------------|-----------------|
| | ✓ | 760308110 | WE-WPCC | | TX | 5353 | PDF | Qi-A10 | 24,0 µH | 180 | 6,00 A | 10,0 A | |
| | ✓ | 760308111 | WE-WPCC | | TX | 5353 | PDF | Qi-A11 | 6,30 µH | 80,0 | 13,0 A | 16,0 A | |
| | ✓ | 760308100110 | WE-WPCC | | TX | Ø 50 | PDF | Qi-A10 | 24,0 µH | 180 | 6,00 A | 10,0 A | |
| | ✓ | 760308100111 | WE-WPCC | | TX | Ø 50 | PDF | Qi-A11 | 6,30 µH | 80,0 | 13,0 A | 16,0 A | |
| | ✓ | 760308104113 | WE-WPCC | | TX | 6052 | PDF | Qi-A13 | 12,0 µH | 120 | 7,00 A | 12,0 A | |
| | ✓ | 760308103202 | WE-WPCC | ● | RX | 4832 | PDF | works with... | 12,0 µH | 33,0 | 2,90 A | 6,00 A | |
| | ✓ | 760308103203 | WE-WPCC | ● | RX | 4832 | PDF | works with Qi... | 12,0 µH | 21,0 | 1,55 A | 3,00 A | |
| | ✓ | 760308101103 | WE-WPCC | | TX | Ø 30 | PDF | works with Qi | 6,50 µH | 35,0 | 3,00 A | 8,00 A | |

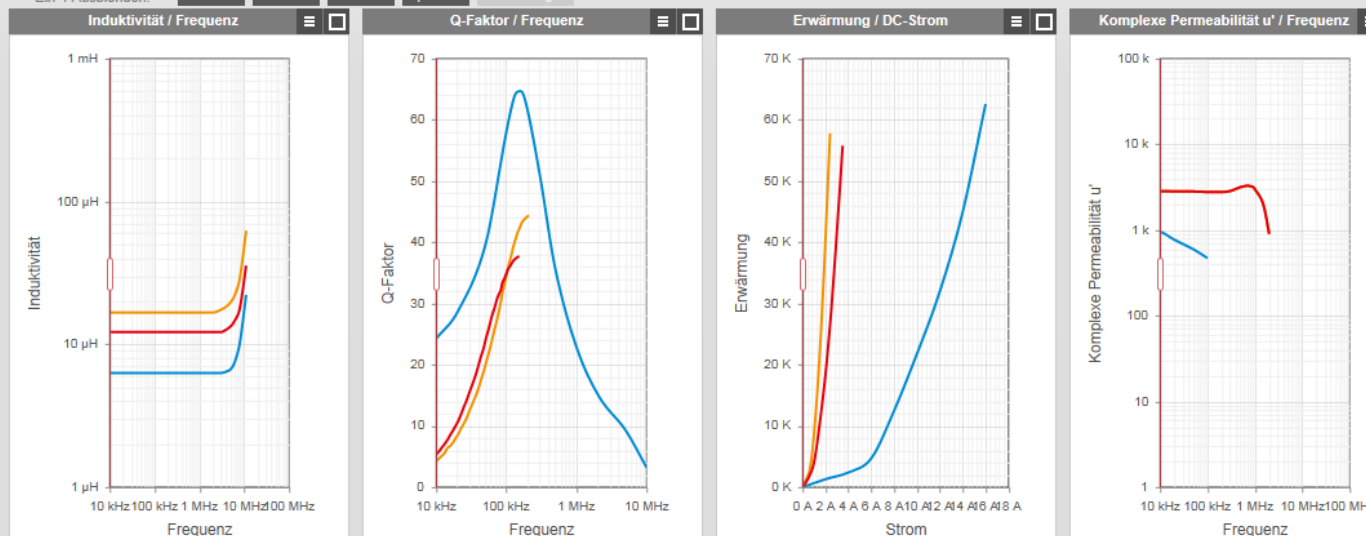
760308103204
 RX
 16,7 µH · 32,0

760308105
 TX
 6,30 µH · 55,0

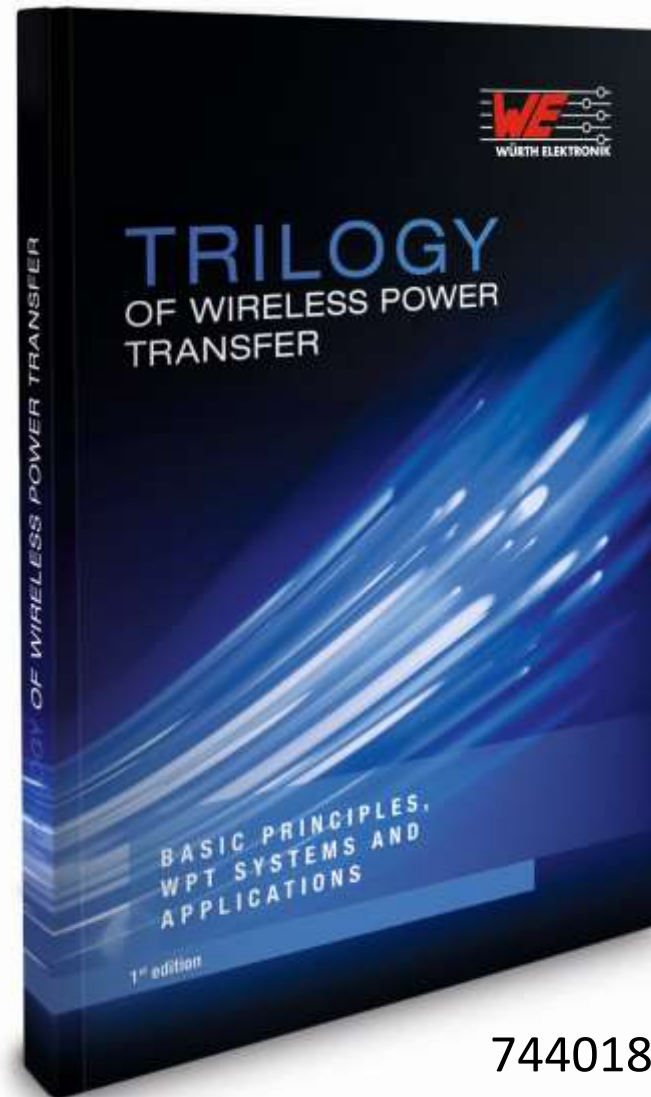
Zum Hinzufügen die Artikel hier platzieren

Muster ordern
 Mehr...

Ein- / Ausblenden: L vs. f Q vs. f ΔS vs. I μ' vs. f Abmessungen

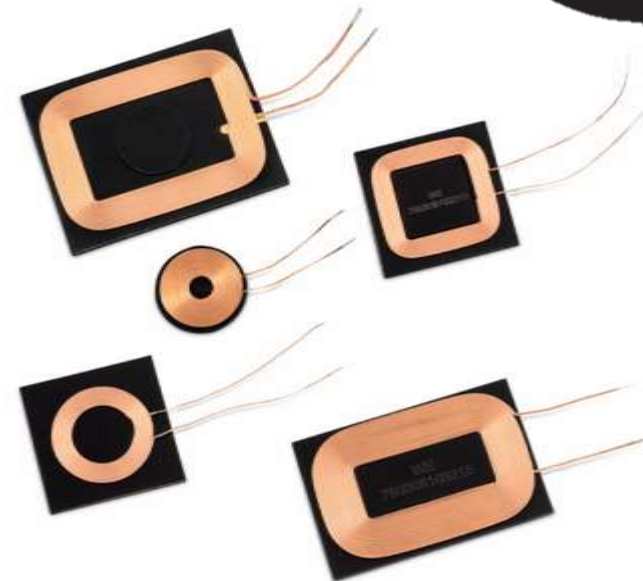


New! Trilogy of Wireless Power Transfer



744018

Thank you



qi