WIRELESS POWER System Considerations

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The Würth Group – A strong family

The Würth Group
- Over 69,000 employees*
- 11 billion € sales*
- More than 400 companies*
- In more than 80 countries*

The Würth Elektronik Group
- Over 7,200 employees*
- Sales of 688 million €*
- 3 Business Units (eiSos, CBT, ICS)*
- WE eiSos: one of the biggest European manufacturers of passive components
- In 50 countries*
- The largest production entity of the Würth Group
The Würth Elektronik Group

Electronic & Electromechanical Components
Printed Circuit Boards
Intelligent Systems

Standard
		eSos
		Passive Components
		Power Modules
		LEDs
		Electromechanical Components

Custom
		eCan
		Connectors
		Automotive
		Magnetics

Sales:

eSos: 475 mll. €
Agenda

Wireless Power System

- System Requirements
- Coil Specific Considerations
- Würth Elektronik Products & Advantages
Wireless Power Transmitter and Receiver

Pictures: Samsung website, Würth Elektronik
System Considerations

- Power level
- Freedom of positioning Rx
- Distance between Tx and Rx
- Electrical performance (efficiency, Q-factor, $R_{DC}$, shielding..)
Coil Types - Freedom of Positioning
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

\[ k = \frac{\phi_1}{\phi_{21}} \]
2D FEMM Analysis of WPT model-angular misalignment
Coupling factor $k$ and efficiency

**Loss factor**

$$\lambda = \frac{P_{\text{loss}}}{P_{R_x}}$$

**Efficiency**

$$\eta = \frac{P_{R_x}}{P_{T_x}}$$

Example:

$P_{T_x} = 5\text{W} \quad P_{R_x} = 4.5\text{W} \Rightarrow P_{\text{loss}} = 0.5\text{W}$

$$\lambda = 0.5\text{W}/4.5\text{W} = 0.11 \text{ (or 11\%)} \quad \text{and} \quad \eta = 89\%$$

$$\lambda_{\min} = \frac{2}{(kQ)^2}(1 + \sqrt{1 + (kQ)^2})$$

$$Q = Q_{T_x} \cdot Q_{R_x}$$

$k$ influenced by positioning of coils

$Q$ influenced by performance of coil
Improvement using ferromagnetic shielding

Without shielding

With shielding

Tx_Rx with shielding
EMI Measurement at Receiver Side
Performance analysis of WPT system based on Rx coil shielding material

Type 1 - low emissions
Magnetic Flux Density

\[ U = +\frac{d\Phi}{dt} \]

- **Tx coil 46mm diameter**
- **Rx coil 19mm diameter** \( 1:5 \)
- **Rx coil 10mm diameter** \( 1:20 \)

\[ A_{Rx}/A_{Tx} \]
Würth Elektronik Wireless Power Coils WE-WPCC

- 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 – 2/2017

20 Transmitter Coils

25 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
Mix and Match for Wireless Power Coils

Your tool to find the perfect coil combination for wireless power applications.

http://www.we-online.de/wirelesspower/mixandmatch
Summary

- Overall system performance depends on coil placement and coil performance

- Choice of coil combination can optimize performance (especially when interoperability is not needed)
Thank you