DIGITAL WE DAYS 2023

ADVANCEMENTS IN WIRELESS POWER TRANSFER AND NFC TECHNOLOGY

WÜRTH ELEKTRONIK MORE THAN YOU EXPECT

TODAY'S SPEAKERS

PRESENTATION

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MODERATION

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INFORMATION ABOUT THE WEBINAR

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AGENDA

- ❖ How does WPT work?

- ❖ Recent advancements in Wireless Power Transfer (WPT) technology
    - ❖ Qi-2.0 Magnetic Power Profile (MPP)- Transmitter (Tx)

- ❖ How does Near field Communication Technology (NFC) work?

- ❖ Principle of NFC Technology
    - ❖ NFC operating Modes
    - ❖ NFC schemes

- ❖ NFC standards

- ❖ NFC and WPT combination system and implementation
    - ❖ NFC and WPT system software work flow
    - ❖ Results and short video of implementation
    - ❖ Future work

- ❖ NFC and WPT combination coil product portfolio from *WE*

ADVANCEMENTS IN WIRELESS POWER TRANSFER(WPT)

EXAMPLES OF WIRELESS POWER TRANSFER IN DAILY LIFE

Figure 4: Wireless charging of power tools.

Figure 3: Wireless charging of phones and smart watches

Figure 2: Electric Tooth brush wireless charging

Figure 1: Charging earpods wirelessly.

Image source-Google.com

WE

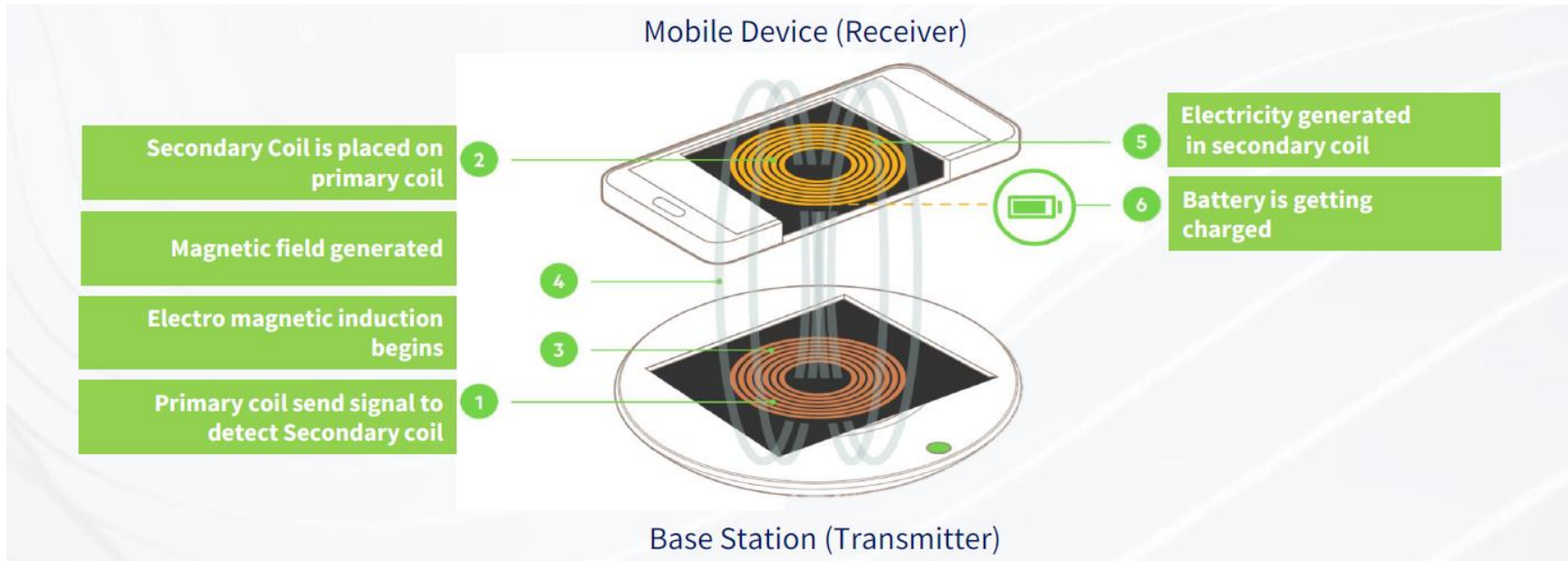# HOW DOES WIRELESS POWER TRANSFER WORK?

Figure 5: Wireless Power Transfer principle.

- ❖ Typical frequency range: 100 kHz – 200 kHz.
- ❖ Powers capable up to kW range depending on application.
- ❖ Low in-band communication possible with data rates up to 1kbit/s.
- ❖ Power transfers via inductive coupling at short distances (mm range).

Image source-granitelabs.com

ADVANTAGES AND DISADVANTAGES OF WPT

Advantages

- ❖ High power levels upto kW possible.

- ❖ No wear and tear of charging cords due to mechanical stress of daily plugging and unplugging.

- ❖ Enables easy designs with hermetically sealed devices that help to eliminate connectors or power ports.

Disadvantages

- ❖ Low data rates of only upto 1kbit/s possible.

- ❖ Inefficient for power Transfer over long distances.

WIRELESS POWER CONSORTIUM (WPC) AND QI STANDARD

What is WPC ?

❖ The WPC is an open collaborative standards development forum for many different types of wireless power applications.

❖ Qi (Chee) is one such standard developed for mobile phones and handheld devices, supporting upto 15W of power.

❖ Ki standard defines the transmitters that wirelessly deliver up to 2.2kW to smart cordless kitchen appliances.

Qi standard Specs

❖ Operating frequency at 87– 205 kHz

❖ 2009 Basic Power Profile (BPP) ≤ 5W

❖ 2016 Extended Power Profile (EPP) upto 15W

❖ 2023 Magnetic Power Profile (MPP) 15W

Figure 7: Qi standard symbol

Figure 8: Ki standard symbol

Image source-Wireless Power Consortium

QI2 WIRLESS CHARGING

❖ Qi2 is the new enhanced wireless charging standard by the Wireless Power Consortium (WPC).

What is new in Qi2?

❖ MPP – Magnetic Power Profile

❖ Magnets are used to align Tx and Rx coils.

❖ Qi2 can include products that have no magnets.

❖ Operating frequency is at 360kHz

❖ MPP Tx profile offers guaranteed 15W power delivery.

Figure 9: Qi2 standard symbol

Figure 10: Qi2 standard symbol to certify products that include magnets

Image source-Wireless Power Consortium

ADVANTAGES OF QI2

MPP Power Profile

Figure 10: Advantage of using Qi2 Power Profile over the Legacy Qi Power Profile

- ❖ 4 x faster authentication compared to Qi
- ❖ Magnets used on both sides ensure that both coils align within 2mm.
- ❖ Keyfob friendly– as they will have less interference with Qi2 due to 360Khz operating frequency.

Image source-graniteriverlabs.com

QI2 MAGNETIC POWER PROFILE (MPP)-TRANSMITTER (TX)

❖ The Magnetic Power Profile technology, Qi2 ensures devices and chargers align perfectly, improving energy efficiency.

    More efficient charging also means faster charging because energy is not lost in the charging process.

The MPP design of the PTx coil consists of :

❖ a top enclosure that defines the interface surface
❖ a coil module
❖ a bottom enclosure
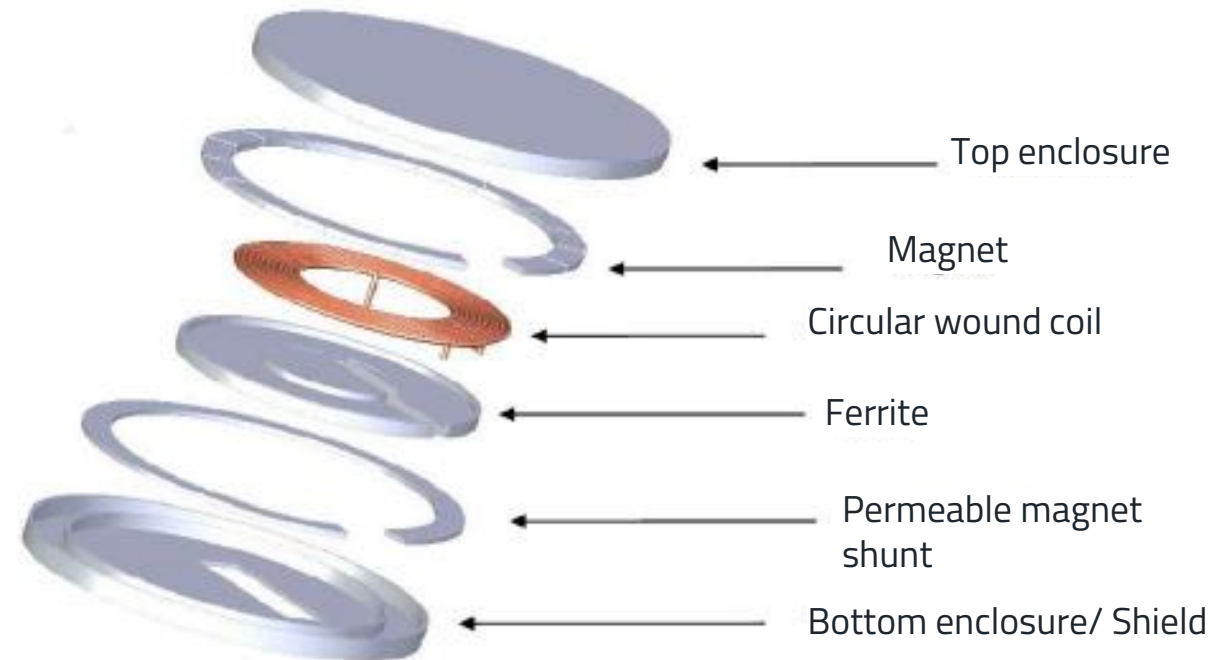❖ ferrite shield
❖ magnet ring
❖ permeable magnet shunt

Top enclosure

Magnet

Circular wound coil

Ferrite

Permeable magnet shunt

Bottom enclosure/ Shield

Figure *12: Exploded view of Ptx (750371632) WE-coil system model*

Image source: Würth Elektronik (WE) preliminary-datasheet 750371632

NEAR FIELD COMMUNICATION (NFC) TECHNOLOGY

HOW DOES NEAR FIELD COMMUNICATION (NFC) TECHNOLOGY WORK?

❖ NFC is a **short-range** (up to 2 cm), **standardized, high frequency contactless communication technology**, based on RFID.

❖ **13.56 MHz** frequency band .

❖ Wireless charging **powers up to 1W**

❖ Data rates from **106 kbit/s – 424 kbit/s**

Properties of NFC include:

❖ Remarkably Fast Startup

❖ Power Sensing

❖ Short Connection Time

❖ Small Data Payload

Figure 13: Examples where NFC technology is used in daily life.

Image source: NFC forum

PRINCIPLE OF NFC TECHNOLOGY
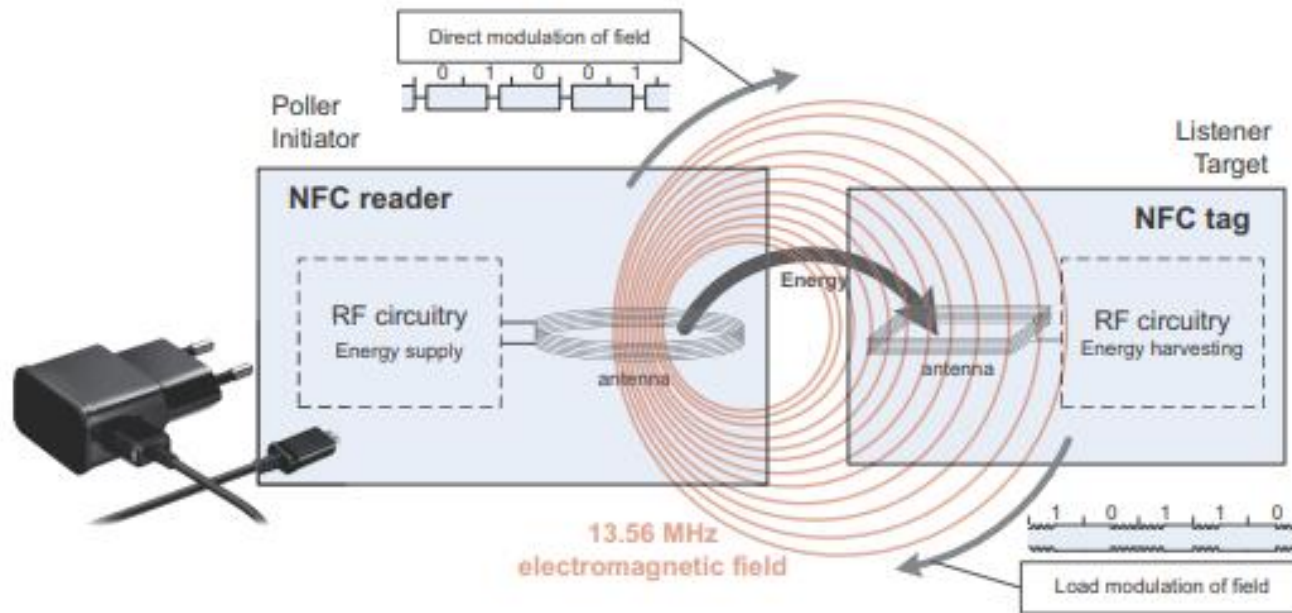
Figure 14: NFC Operation Principle.

❖ This is typically used for reading contactless tags or smart cards.

Image source: st.com, TN1216, ST25 NFC Guide

NEAR FIELD COMMUNICATION OPERATING MODES

❖ **Reader/Writer Mode:** The reader/writer mode is about the communication of an NFC enabled initiator (e. g. a mobile phone) with an NFC tag for the purpose of either reading or writing data from or to those tags.

❖ **Card emulation mode:** the NFC device behaves like an existing contactless card conforming to one of the standards.

❖ **Peer to Peer mode:** used to establish a two way communication between a pair of NFC enabled devices. Each NFC-enabled device serves as an endpoint, meaning the two systems can initiate a communication as equals, or peers.

EXAMPLE OF NEAR FIELD COMMUNICATION AND OPERATING MODES

Card Emulation

Emulates the behavior of a contactless card.

Peer to Peer

Exchanges data between NFC devices

Read/Write

Reads / Writes data from any tag or contactless card

Figure 15: NFC technology used in various applications

Image source: NXP Corporation, NFC Essentials, Presentation Mobile Knowledge, 2015

NEAR FIELD COMMUNICATION STANDARDS

	Type 1 ISO/IEC 14443A	Type 2 ISO/IEC 14443A	Type 3 JIS X 6319-4 (Felica)	Type 4 ISO/IEC 14443A/B	Type 5 ISO/IEC 15693 (18000-3)
Supported standard carrier frequency	13.56 MHz ±7 kHz	13.56 MHz ±7 kHz	13.56 MHz ±7 kHz	13.56 MHz ±7 kHz	13.56 MHz ±7 kHz
Data rate	106 kbit/s	106 kbit/s	212/424 kbit/s	106/212/424 kbit/s	26.48 kbit/s
Modulation (reader to tag)	ASK 100 %	ASK 100 %	ASK 10 %	Standard A + ASK 10 %	10 % or 100 % ASK
Data coding (reader to tag)	modified Miller	modified Miller	Manchester MSB first	NRZ-L (Std B)	Pulse position mod. 1 out of 256/1 out of 4
Modulation (tag to reader)	Load modulation sub-carrier (±848 kHz)	ASK 10 %	Load modulation with no sub-carrier	Standard A + Load mod. (BPSK) sub carrier (Std B)	Load modulation
Data coding (tag to reader)	Manchester	NRZ-L	Manchester	NRZ-L	Manchester
Anti-collision	No	Yes	Yes	Yes	Yes

Table 1: Different standards available for NFC technology   Image source: Google.com

❖ ISO/IEC 14443A Type 1 is used by WE.

NFC AND WPT COMBINATION COIL

WPT

Low in-band data rates of upto 1kbit/s. ☹

High transfer powers of some kW. ☺

NFC

Low transfer powers upto 1W. ☹

High data rates up to 424 kbit/s. ☺

WPT/NFC Combination

WPT AND NFC COMBINATION SYSTEM SETUP AND IMPLEMENTATION

❖ The typical WPT/NFC systems use slotted NFC, where the WPT is switched off when NFC is active.

❖ Here, Würth Elektronik has developed a **simultaneous** WPT/NFC system, where WPT and NFC technology operate at the same time without interruption.
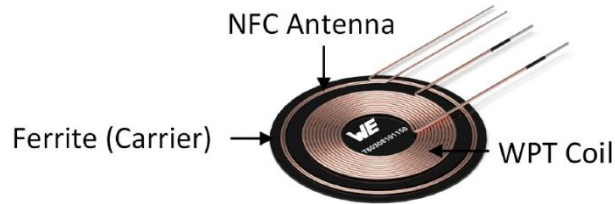
Figure 16: WPT and NFC combinationcoil from WE
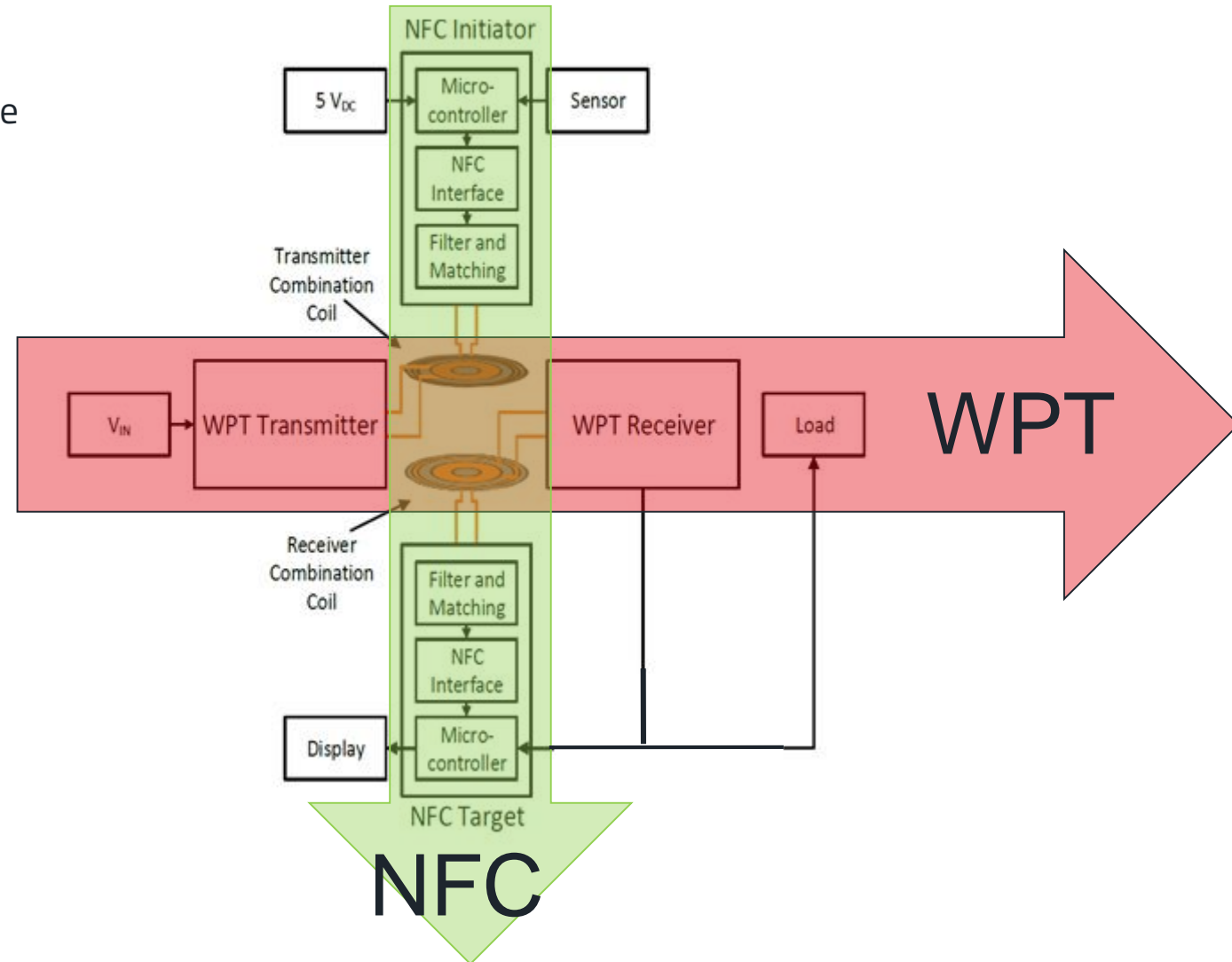
Figure 17: WPT and NFC combination sysytem block diagram

Image source: Würth Elektronik website

WPT AND NFC COMBINATION SYSTEM SETUP AND IMPLEMENTATION

NFC Initiator

- ❖ **Microcontroller Board** : Arduino Mega 2560 with the microcontroller ATMega2560 from Atmel.

- ❖ **NFC Interface** : Adafruit PN532 NFC/RFID shield, based on the PN532 chip set from NXP.

- ❖ **Sensor**: Adafruit VL53L0X time of flight (TOF) distance sensor, uses I2C and measures how long the light has taken to bounce back to the sensor.
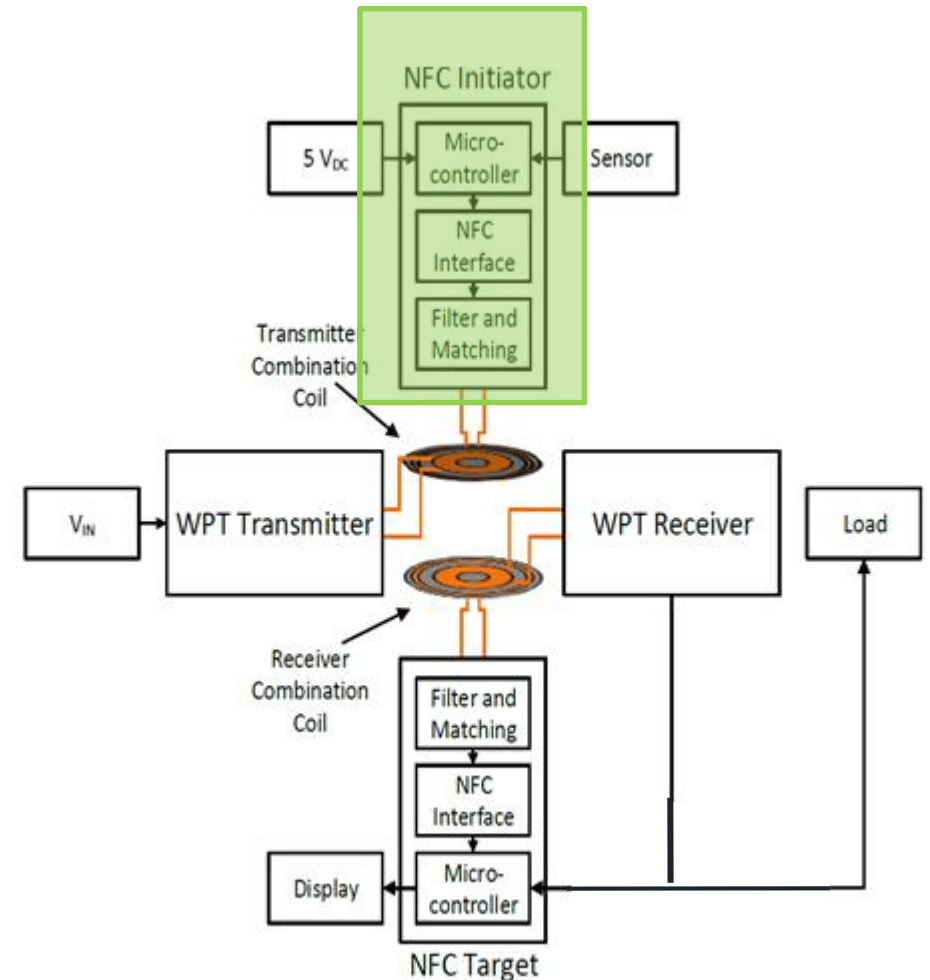
Figure 18: WPT and NFC combination sysytem block diagram

WPT AND NFC COMBINATION SYSTEM SETUP AND IMPLEMENTATION

NFC Target

❖ Microcontroller Board: Arduino Uno Rev. 3 with the microcontroller ATmega328P from Atmel.

❖ **NFC Interface** : Adafruit PN532 NFC/RFID shield, based on the PN532 chip set from NXP.

❖ **Display**: RGB LCD shield kit display from Adafruit, also uses I2C.
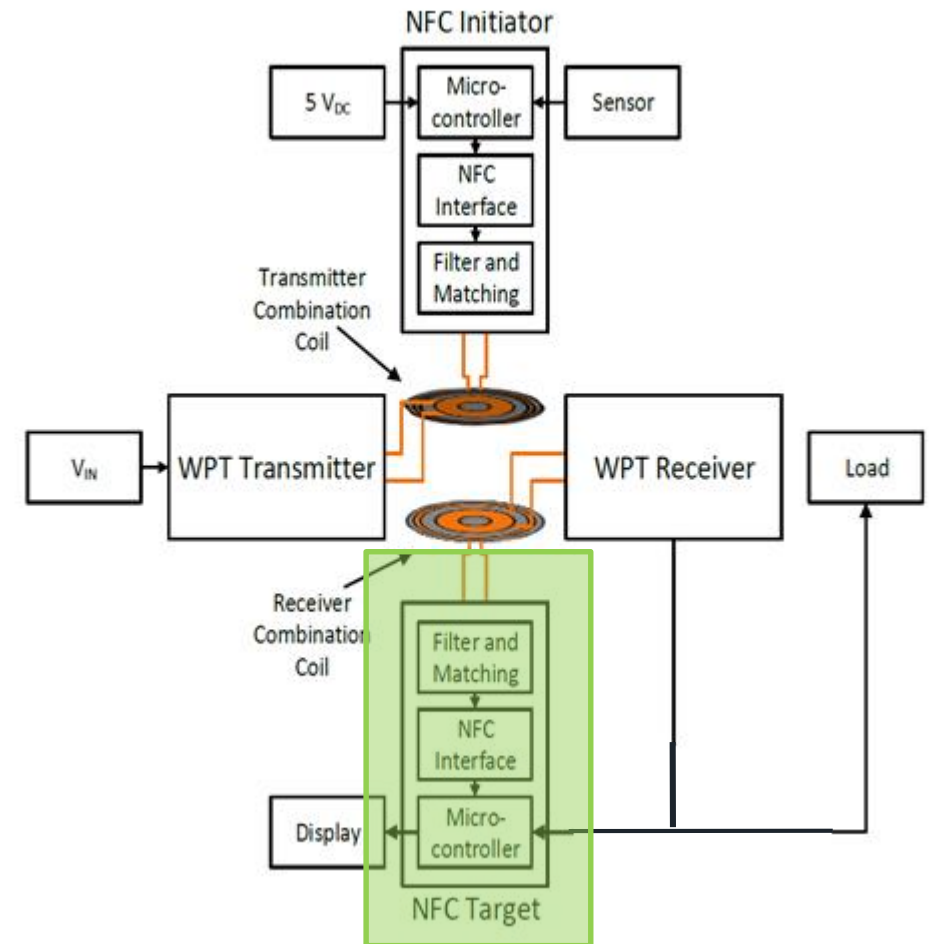
Figure 19: WPT and NFC combination sysytem block diagram
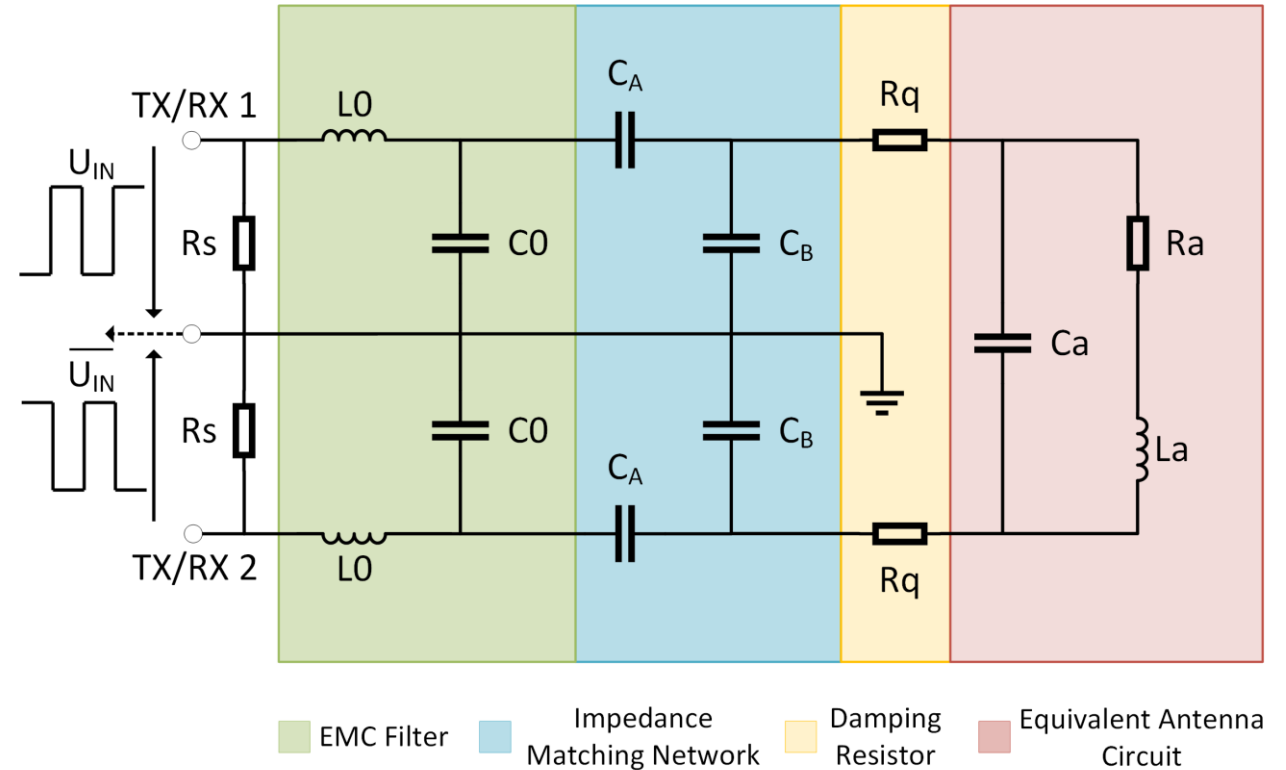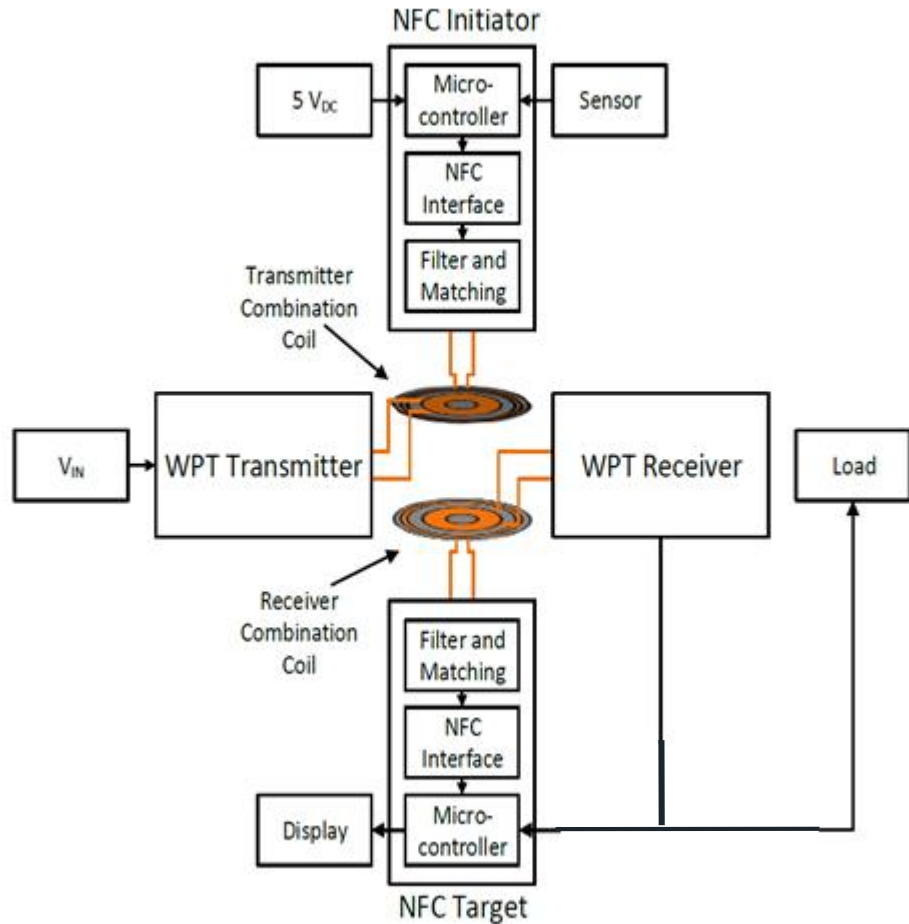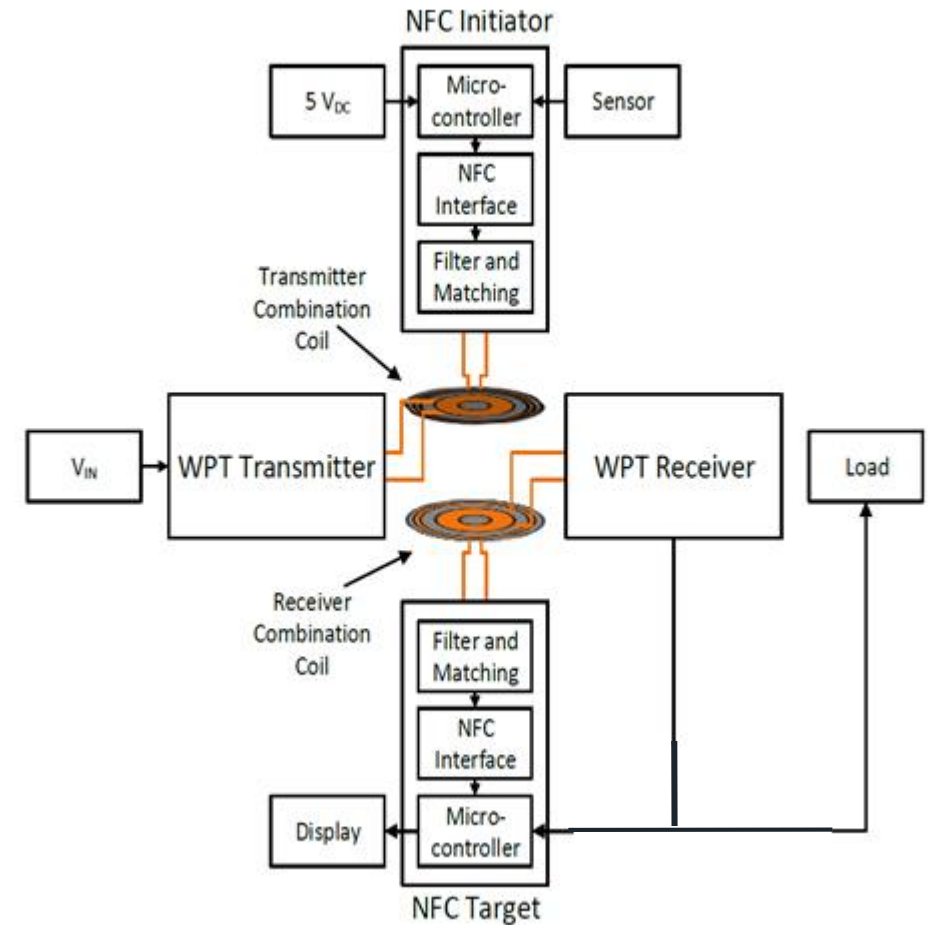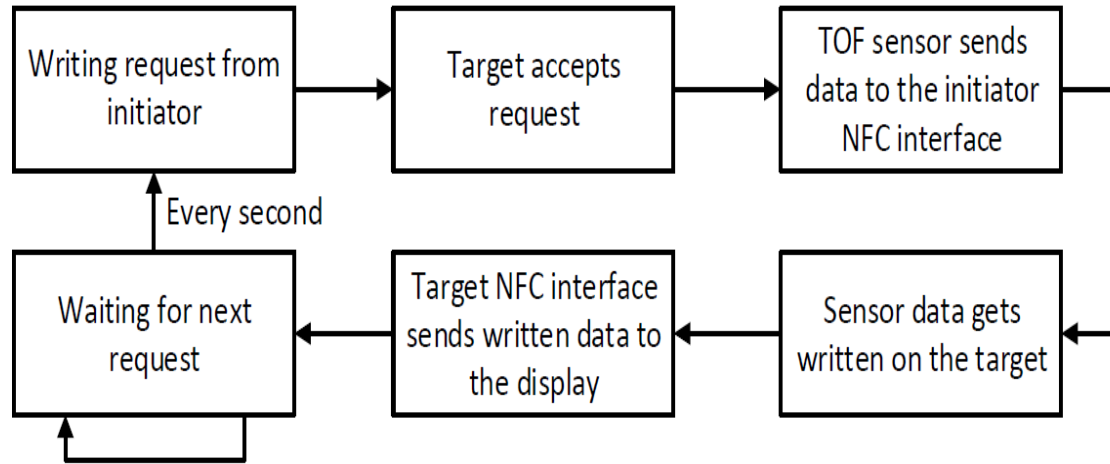
WPT AND NFC COMBINATION SYSTEM SETUP AND IMPLEMENTATION

Figure 20: Filter and matching circuit . Refer WE App note 84

NFC SOFTWARE WORKFLOW

RESULTS OF WPT WITH NFC IMPLEMENTATION

| WPT Type	Tx and Rx Combination coil	Distance of separation	Power level
760308EMP Kit	760308101150	6mm	54W
NFC data rate=106 kbits/s; error rate: <5% ; reflection coefficient: -35dB			

FUTURE WORK FOR WUERTH ELECTRONIC (*WE)*

❖Optimizing the system to achieve NFC data rate of 424 kbit/s.

❖NFC add on board compatible to use with a WPT system.

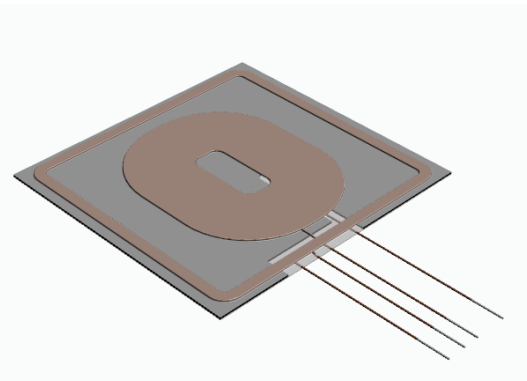# WPT/NFC PRODUCT PORTFOLIO IN *WE*

WE part number	WPT		NFC	
	L_1 [µH]	Q_1	L_2 [µH]	Q_2
760308103305	8.8	30	1.4	47
760308102306	8	19	1.4	47
760308103307	7.8	19	1.6	47
760308101312	24	125	0.7	30
760308101150	6.3	100	1.2	80

Table 2 : WPT and NFC combination coils from WE portfolio.

WPT coils

NFC antennas
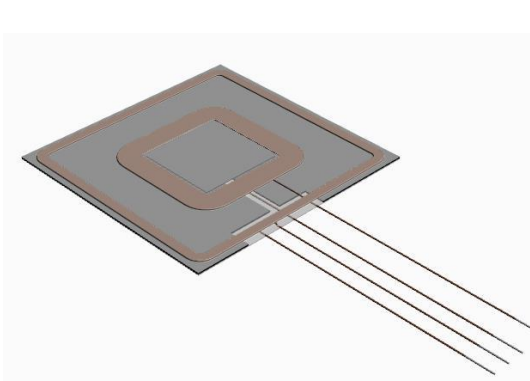
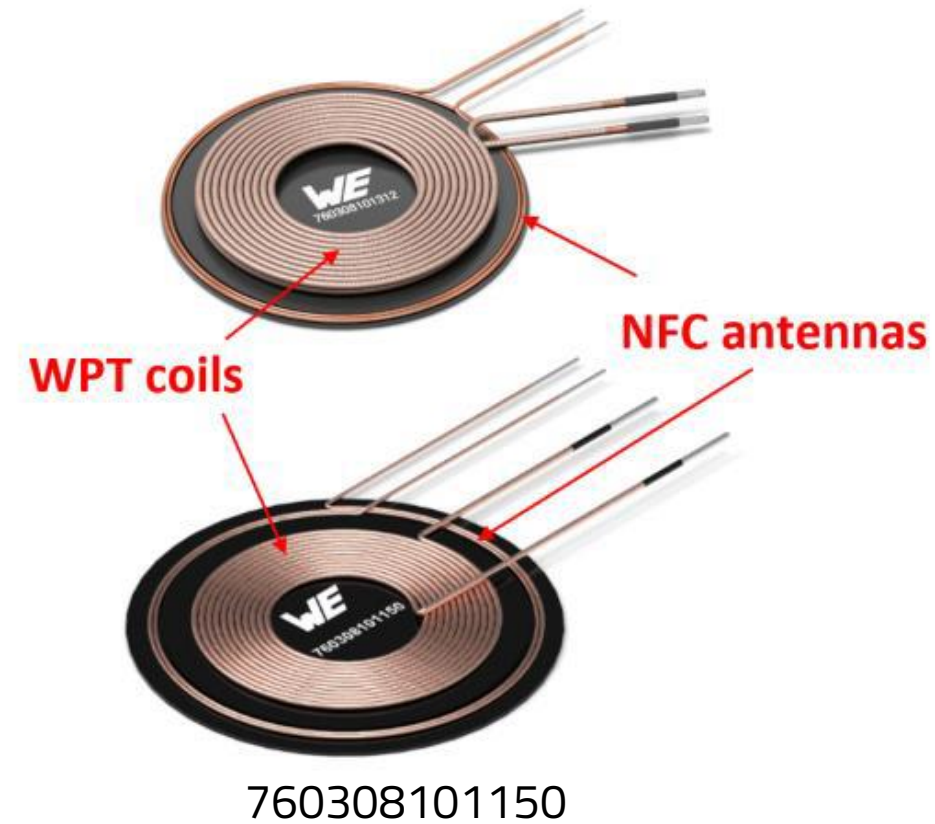760308102306　　760308103305　　760308103307　　760308101150
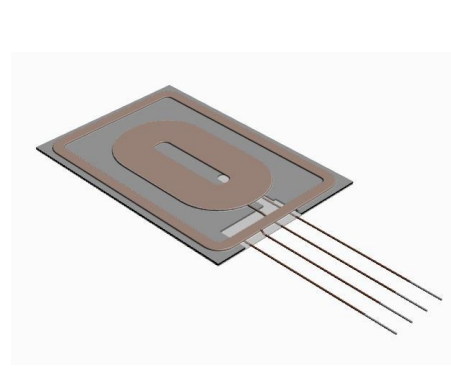
WIRELESS POWER/ NFC USEFUL LINKS

➢Impedance Matching for Near Field Communication Applications (we-online.com)

➢Proprietary wireless power transfer solution for high performance including data transmission (we-online.com)

➢High Power Wireless Power Transfer for the Industrial Environment (we-online.com)

➢Wireless Power Charging Coil Changing Considerations (we-online.com)

➢Wireless Energy Transmission - Coils as Key Components (we-online.com)

Questions

& Answers

We are here for you now!
Ask us directly via our chat or via E-Mail.

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