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Slotted FOD using a triple Induction Balance for the hidden Tx case

Combining FO detection and NF Communication

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innovation you

Content of the presentation

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  - Induction Balance principle
  - Triple Induction Balance set-up
  - Power chain cordless kitchen (1)
  - Triple Induction Balance system
  - Picture & Wave forms 1st experimental setup
- NFC & FOD
  - FOD coils & NFC antenna assembly
  - Power chain cordless kitchen (2)
  - Wave forms with NFC & FOD slots
  - Experimental results
- Conclusion

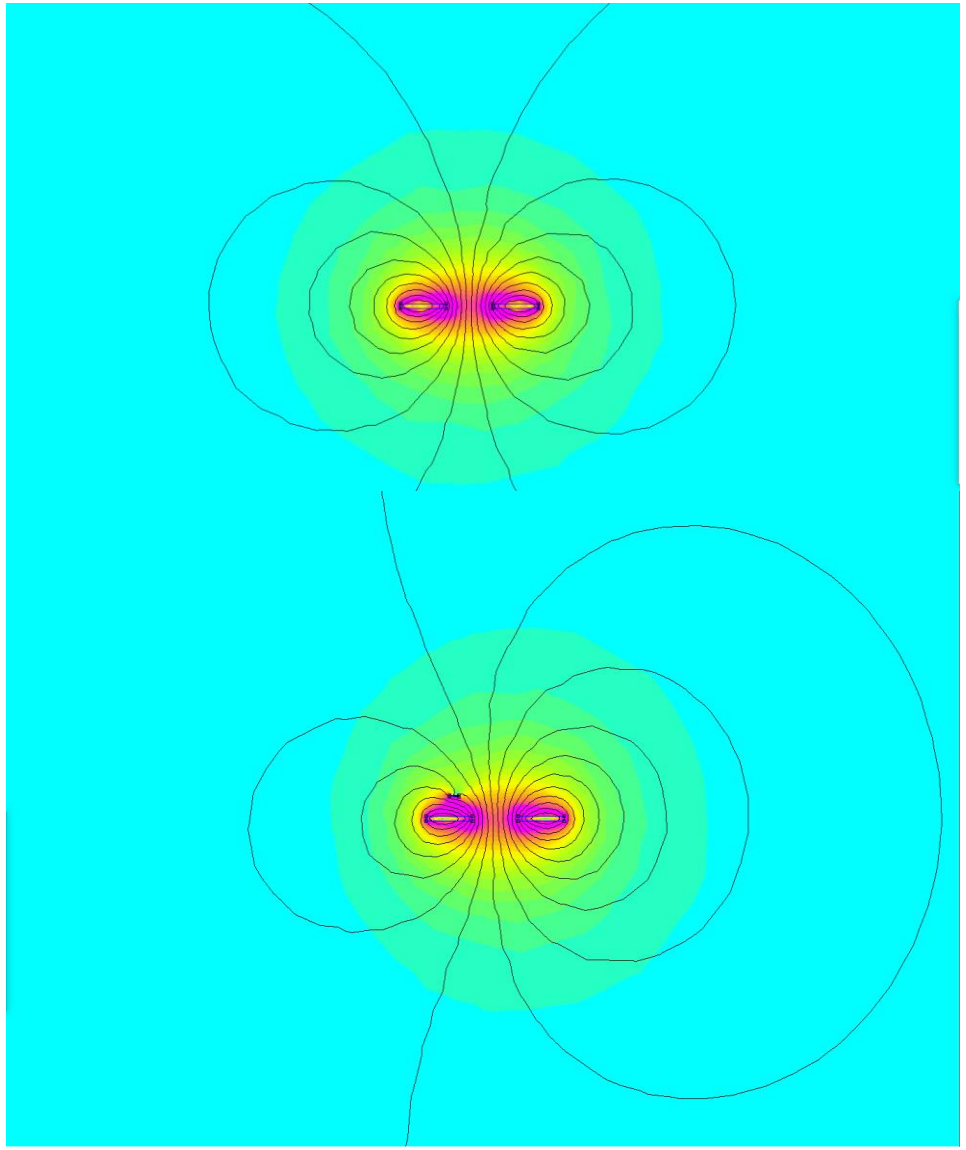
From WPC 1904:

- Philips proposed a FOD method, based on a triple Induction Balance, that can utilize a FOD slot
- The FOD slot alternates with the communications slot as described in the joint specification

Next step: NFC + FOD

- To combine slotted FOD with slotted NFC
- To demonstrate slotted FOD, based on the Induction Balance (IB) principle, in combination with NFC

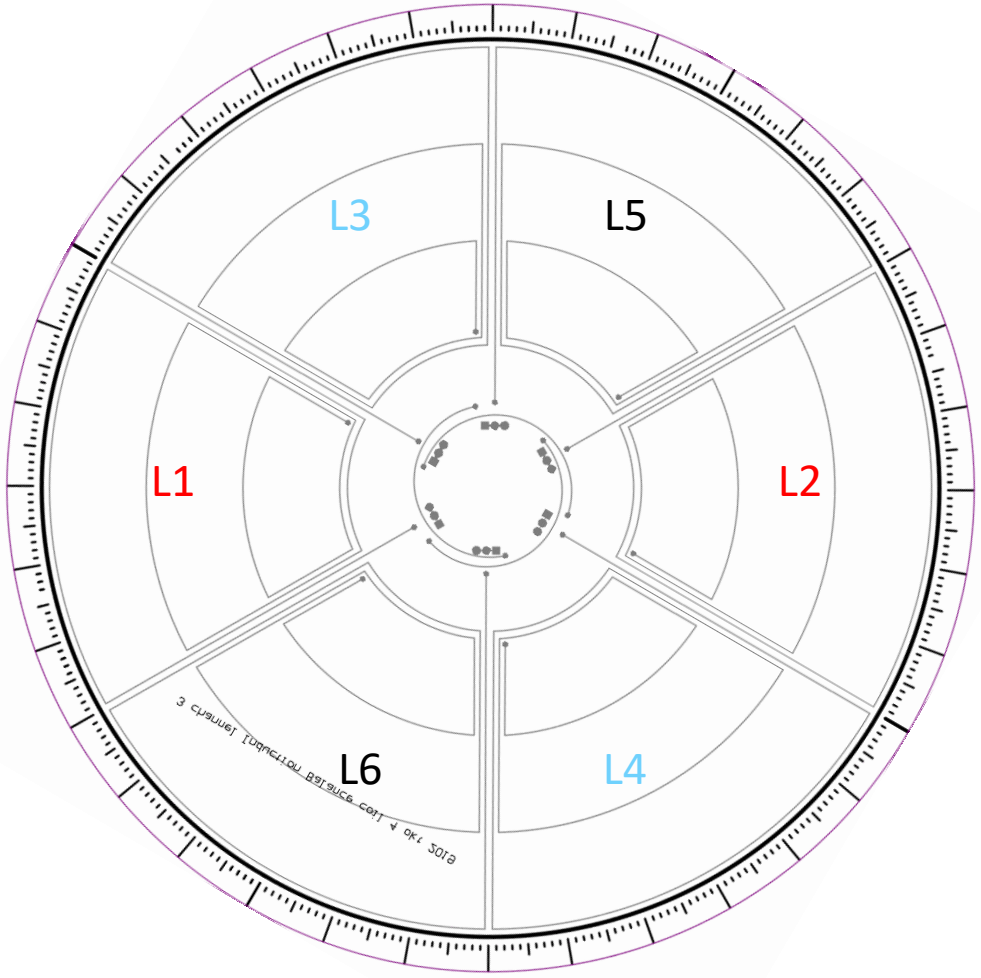
From WPC 1904: Induction Balance Principle



- Main magnetic field created by Tx coil

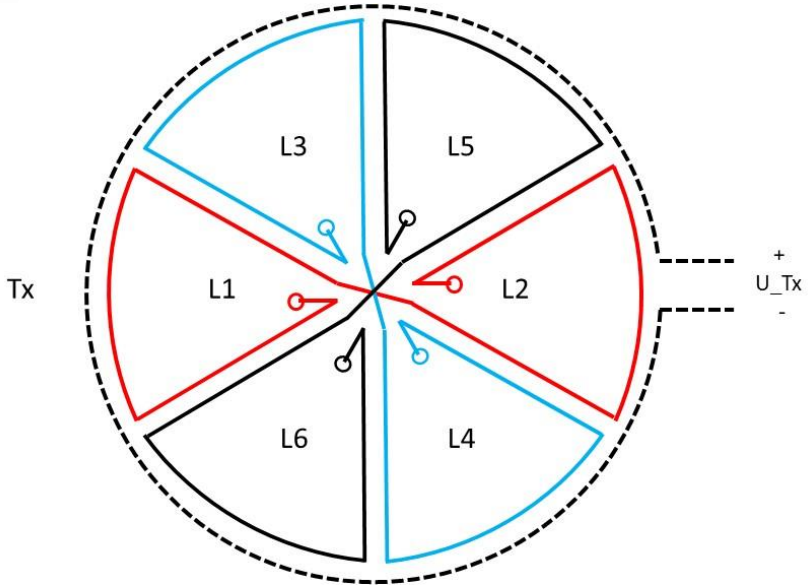
- Flux lines are bent due to the foreign object because:
  - Local change of permeability
  - Eddy currents induced in the Foreign Object
- Difference in flux density can measured by an Induction Balance

From WPC 1904: Triple Induction Balance set-up (1)



To avoid noise pick-up and a-symmetry:

- Terminals of FO detection coils L_1 to L_6 moved to centre of the Tx coil
- The current through the FO detection coils is measured, not the voltage across the terminals



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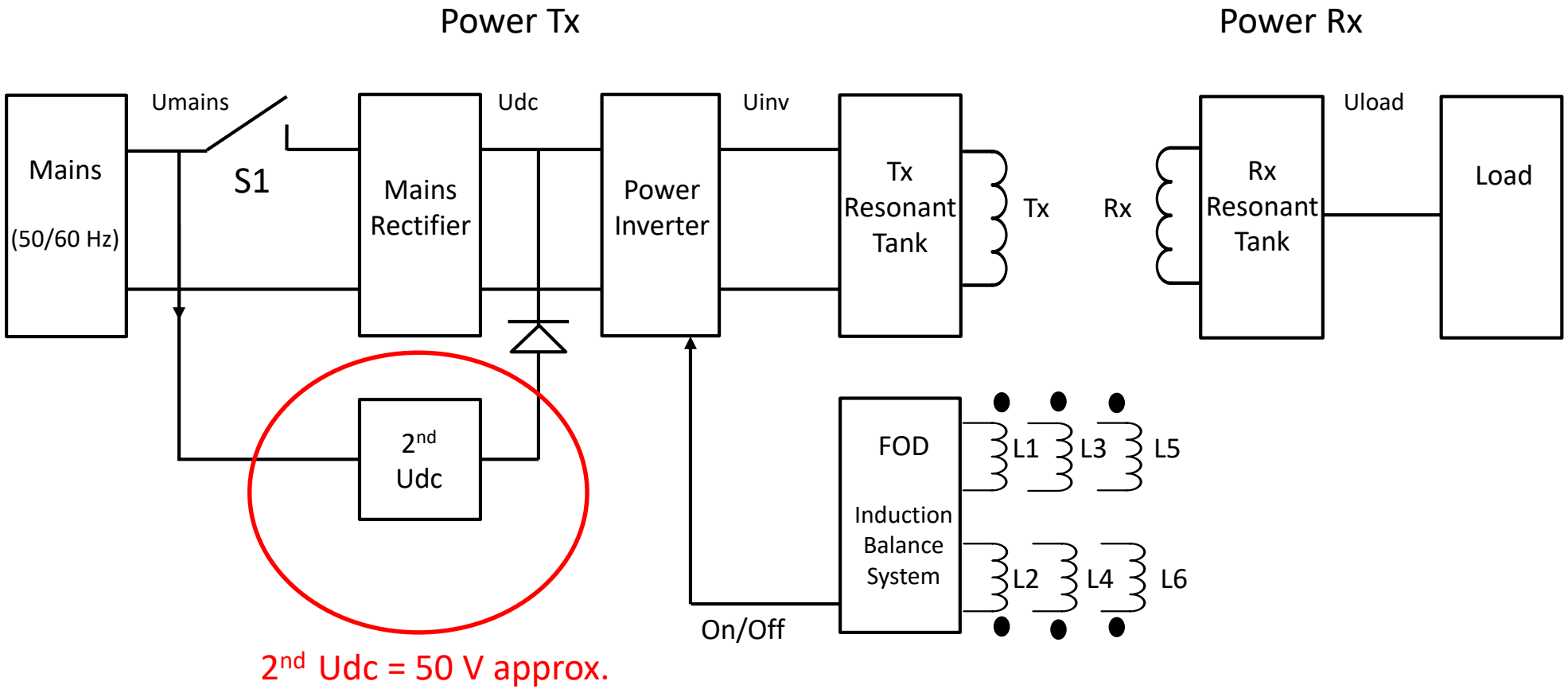
From WPC 1904: Power Chain for cordless kitchen



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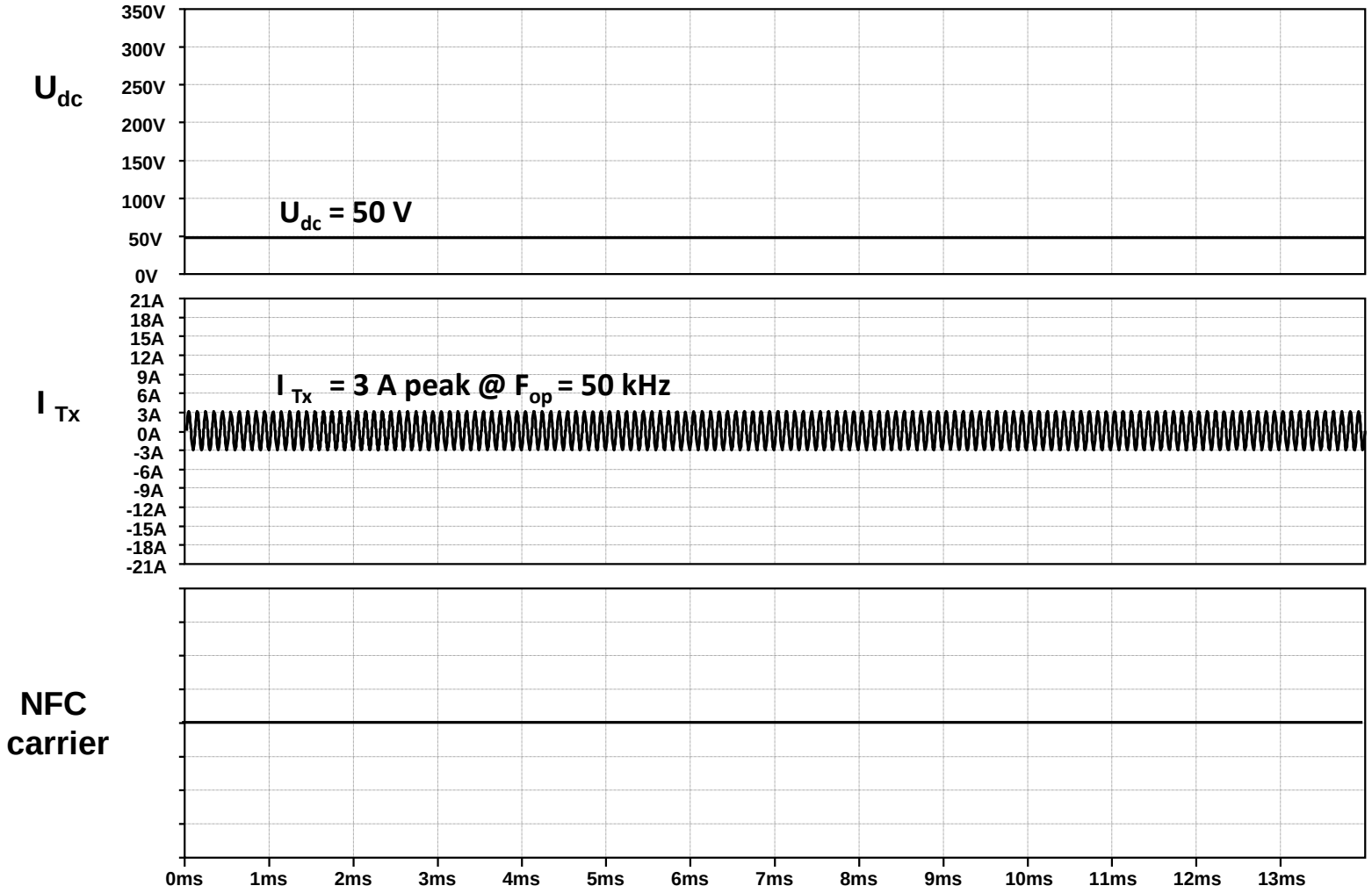
From WPC1904: Wave forms 1st experimental setup

S1 open



No NFC & FOD slot's yet, but:

- Inverter is active
- U_{dc} = 50 V -> constant FOD field
- PRx connected
- F_{res} = 25 kHz
- F_{op} = 50 kHz
- Power transfer at F_{op} = 50 kHz but has small effect on amplitude of I_{Tx}
- No NFC carrier
- Offset nulling and FOD functionality was demonstrated

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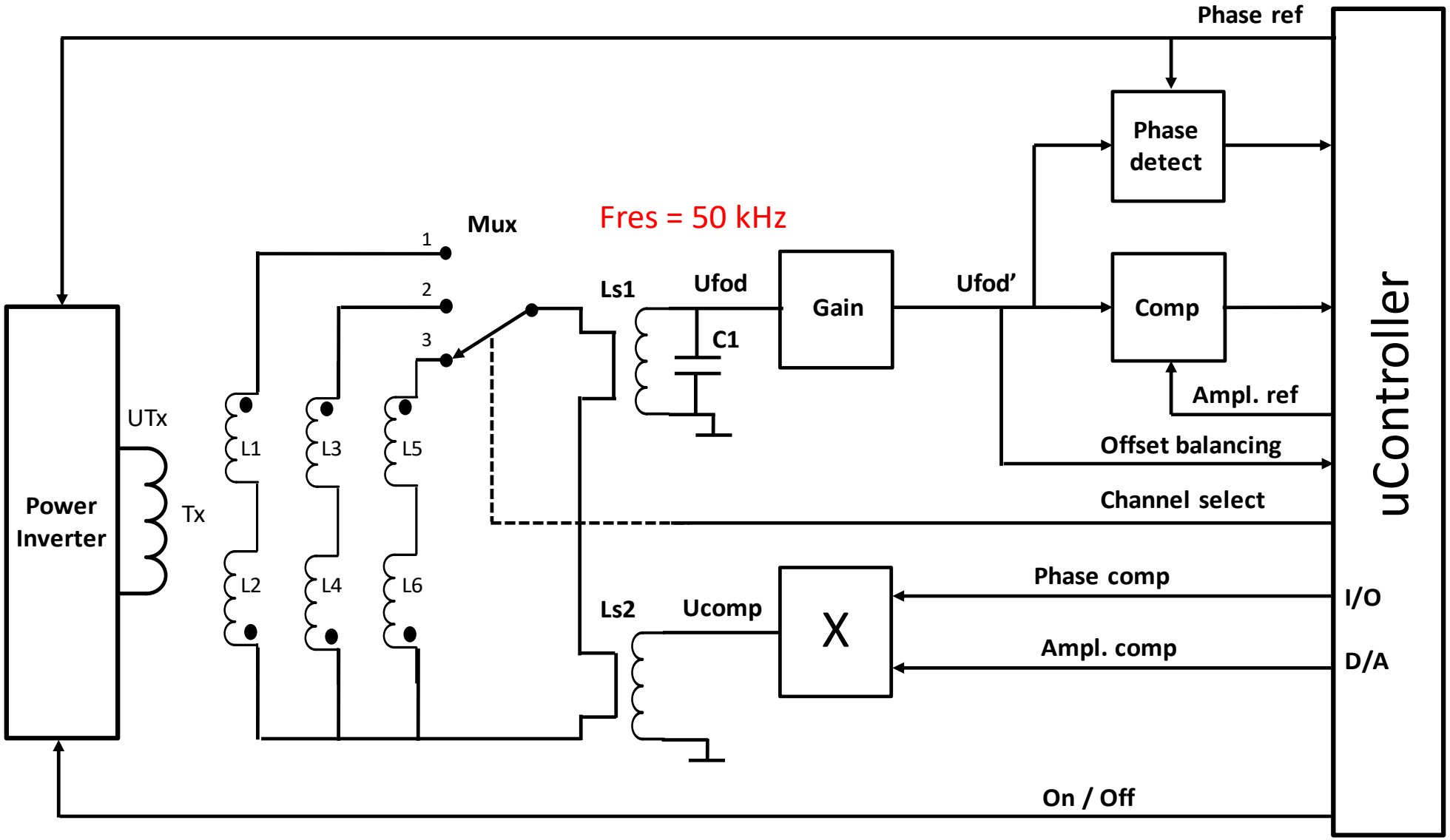
From WPC 1904: Triple Induction Balance system



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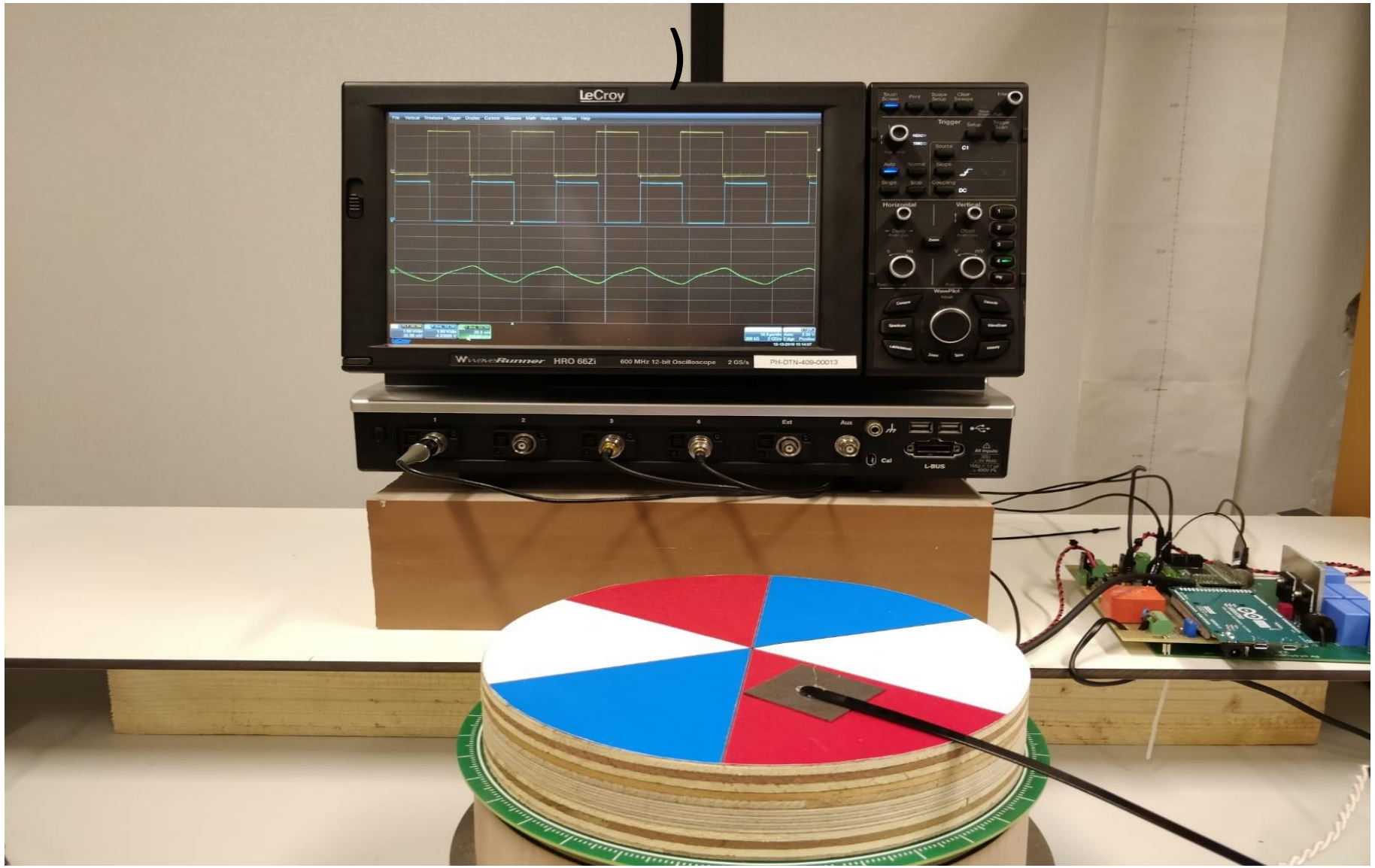
From WPC1904: Picture 1st experimental setup



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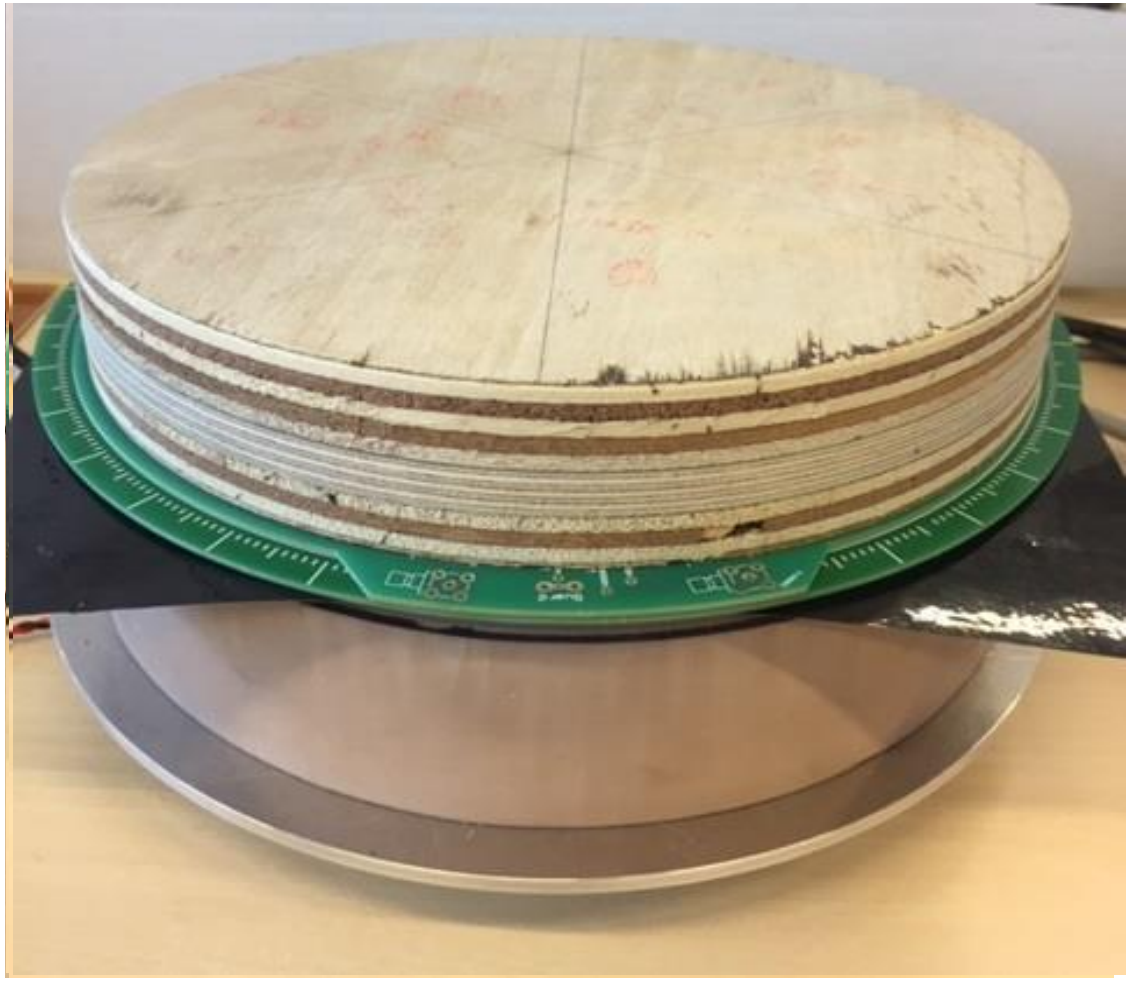
NFC & FOD: FOD coils & NFC antenna assembly (1)



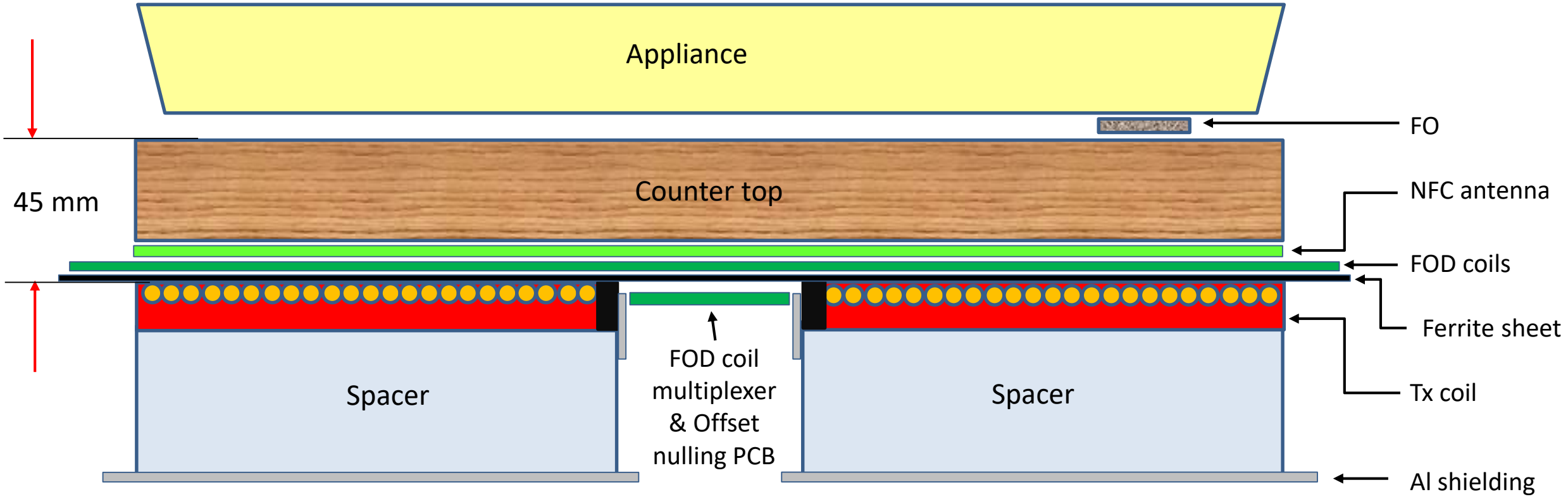
Magnetic coupling exist between FOD coils & NFC antenna -> Cross talk to be expected!!

- + 40 mm wooden “counter top” spacer

- + NFC Antenna
- + Triple induction balance FO detection coils
- + Ferrite sheet

- Al shield + spacer + Spiral Tx coil
  (because no ferrites used yet)

NFC & FOD: FOD coils & NFC antenna assembly (2)



Ferrite sheet to avoid de-tuning & damping of the NFC link by the Tx coil

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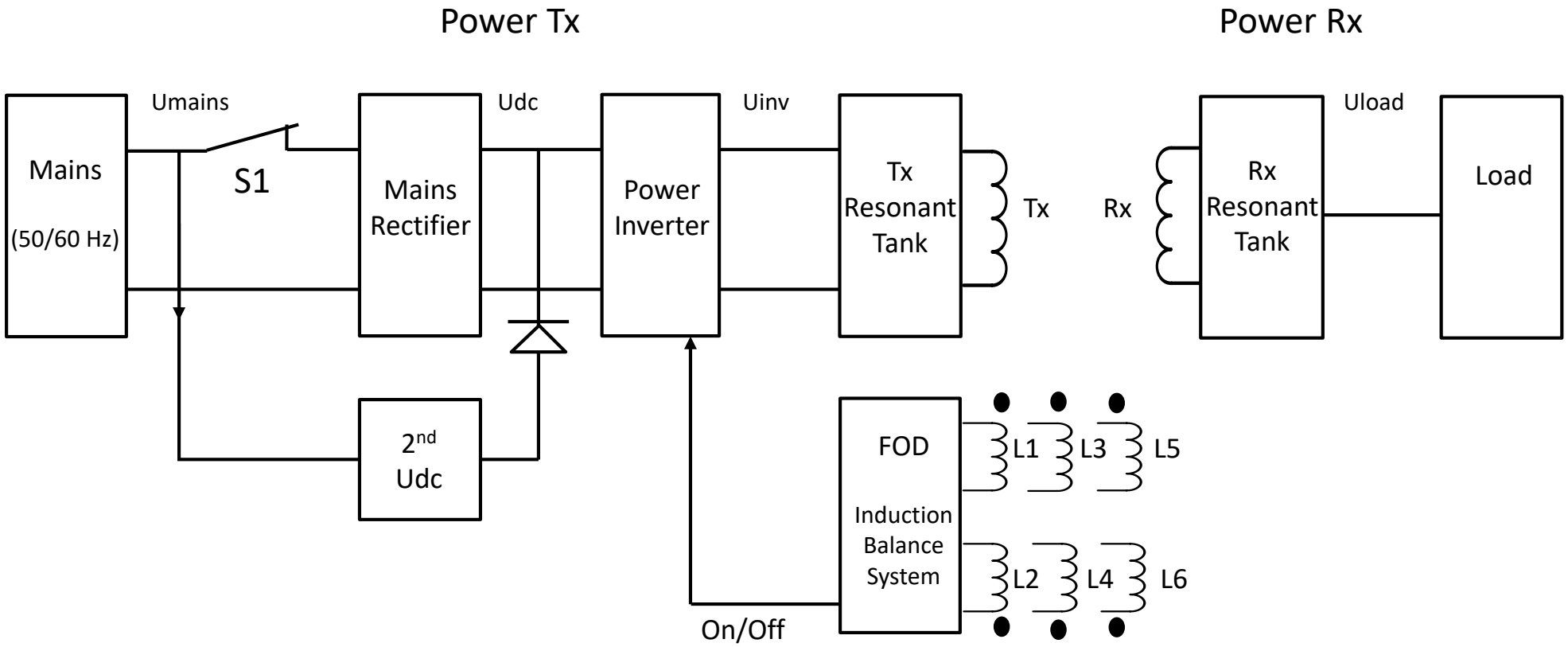
NFC & FOD: Power Chain for cordless kitchen

S1 = closed



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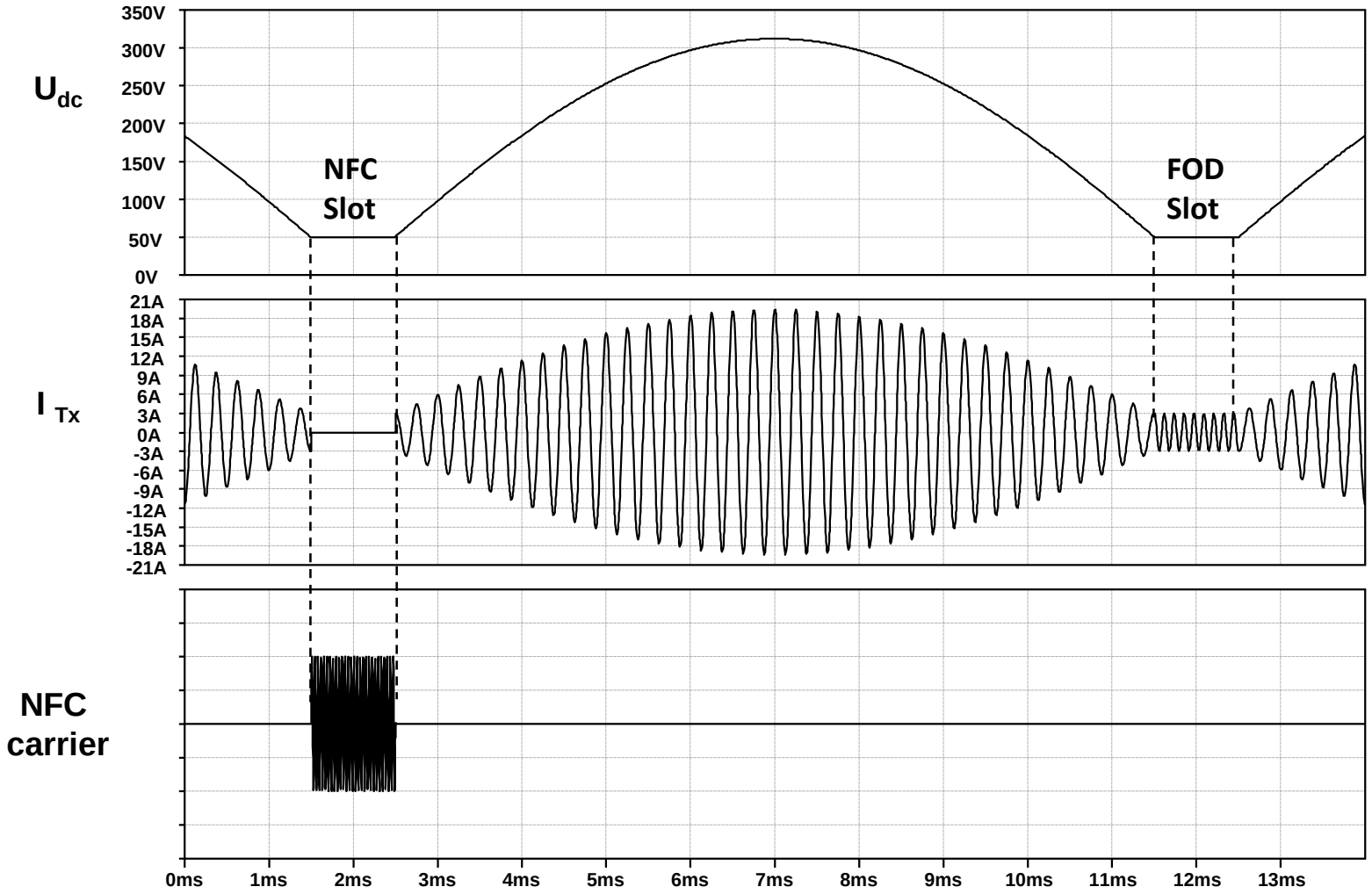
NFC & FOD: Wave forms with NFC & FOD slots

S1 = closed



During NFC slot:

- Inverter inactive
- No power transfer from PTx to PRx
- NFC between PTx and PRx

Between NFC & FOD slot

- Inverter active
- Power transfer at F_{op} = 22 – 35 kHz
- F_{res} = 25 kHz

During FOD slot:

- Inverter active
- U_{dc} = 50 V -> constant FOD field
- PRx connected
- F_{op} = 50 kHz
- Power transfer at F_{op} = 50 kHz but has small effect on amplitude of I_{Tx}

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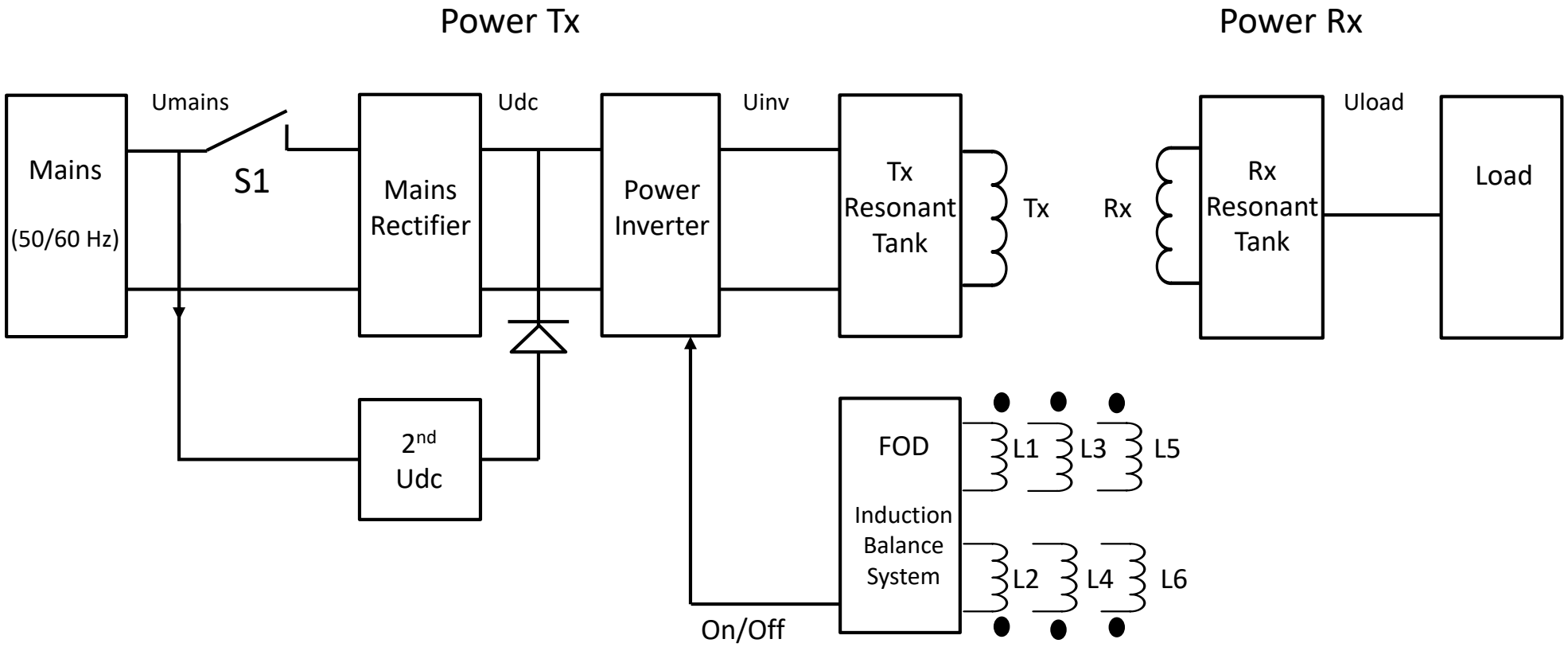
NFC & FOD: Power Chain for cordless kitchen

S1 = open



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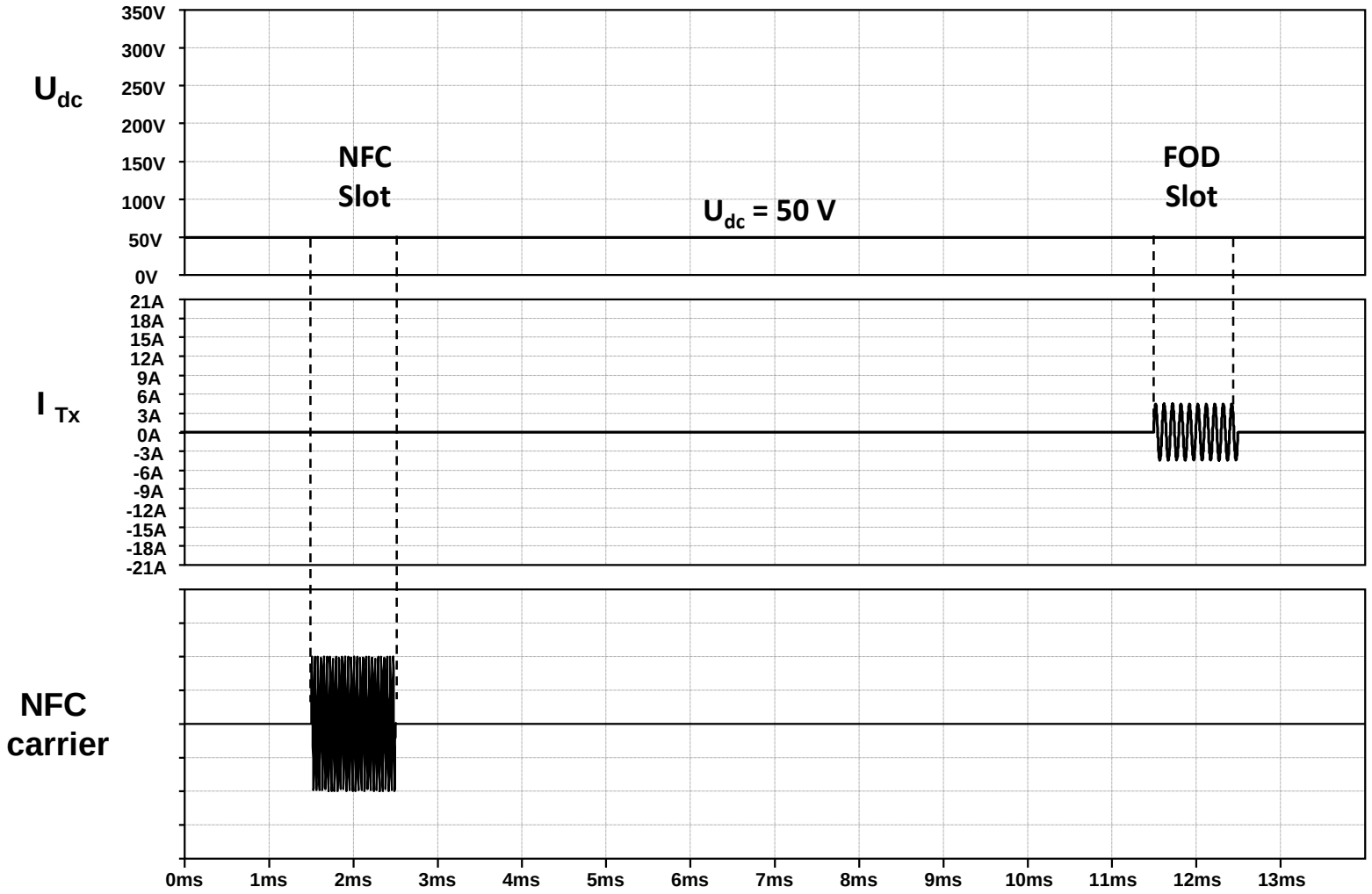
NFC & FOD: Wave forms with NFC & FOD slots

S1 = open



During NFC slot:

- Inverter inactive
- No power transfer from PTx to PRx
- NFC between PTx and PRx

Between NFC & FOD slot

- Inverter inactive
- No Power transfer
- F_{res} = 25 kHz

During FOD slot:

- Inverter active
- U_{dc} = 50 V -> constant FOD field
- PRx connected
- F_{op} = 50 kHz
- Power transfer at F_{op} = 50 kHz but has small effect on amplitude of I_{Tx}

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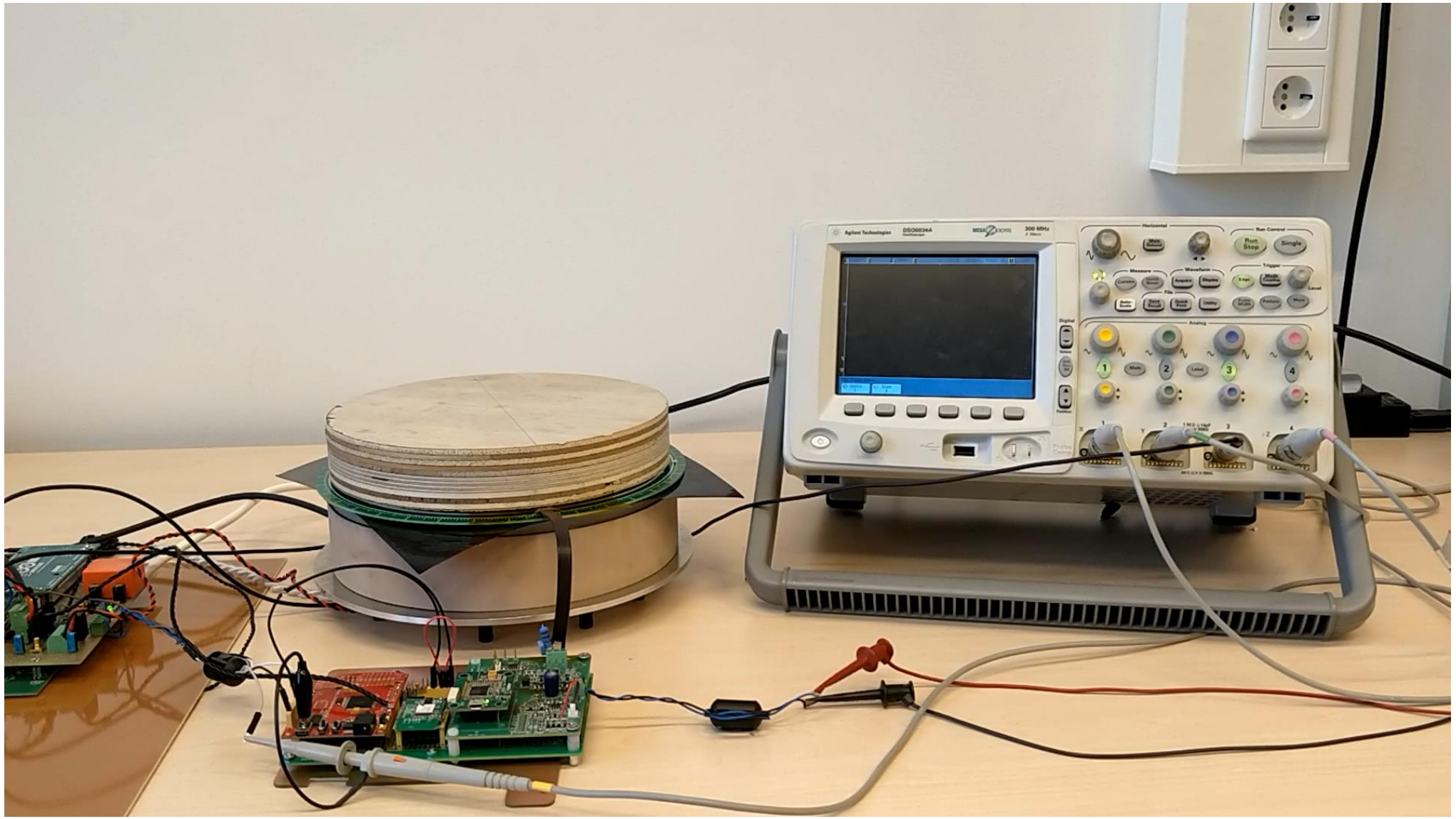
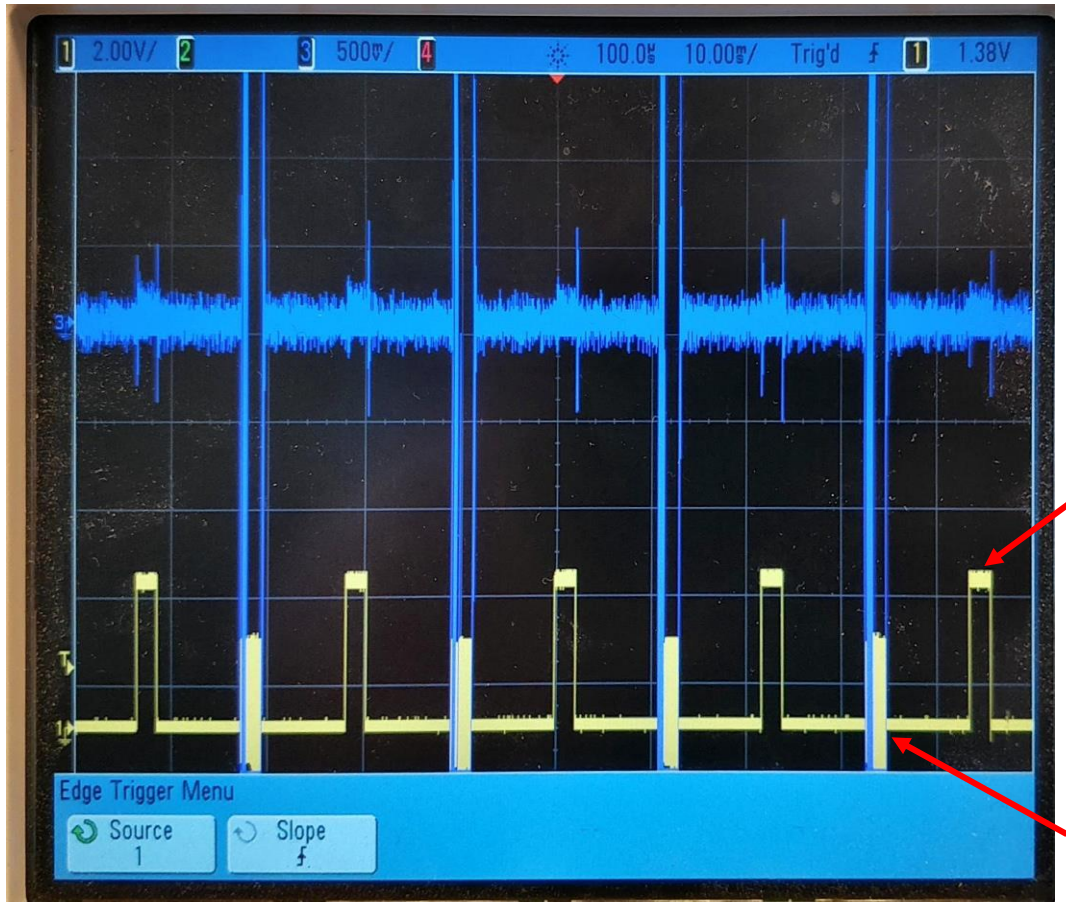
FOD & NFC: Experimental results (1)



FOD & NFC: Experimental results (2)



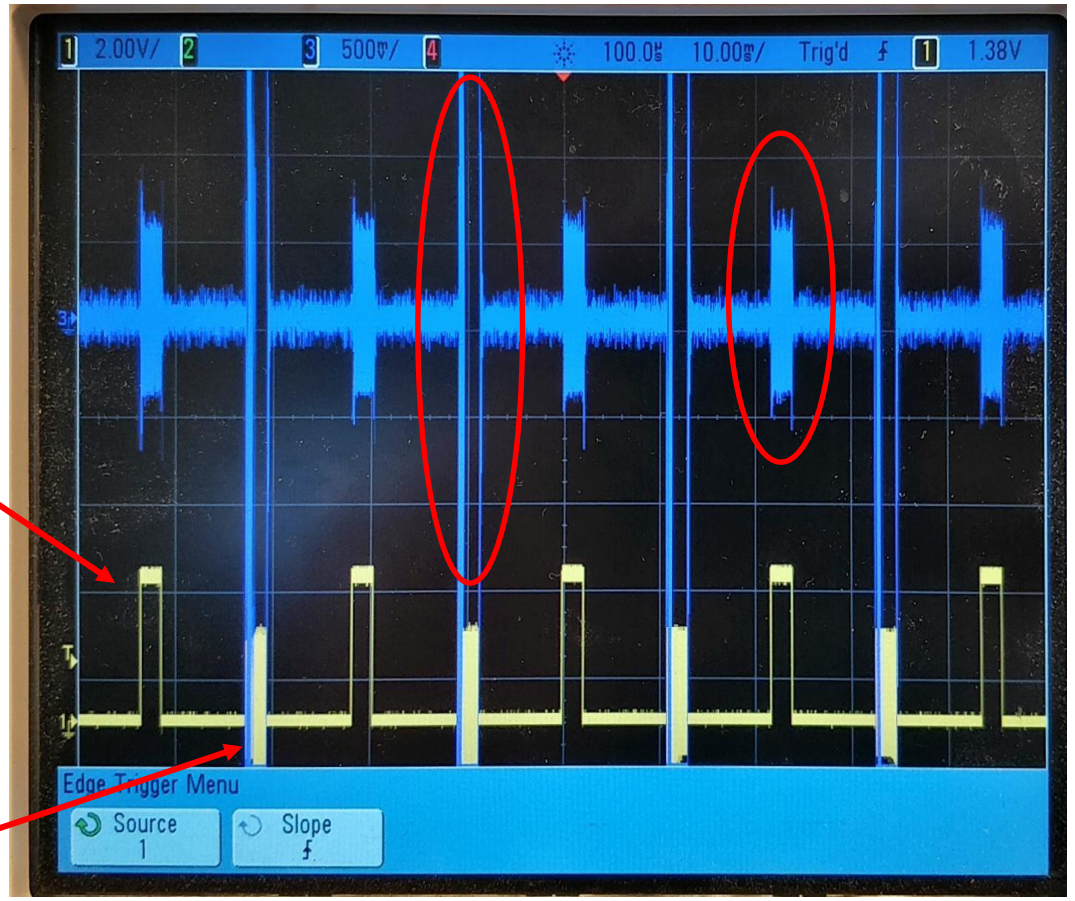
Ufod

FOD slot

NFC car.

Cross talk

U_{fod}



No FO

With FO

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Conclusion

- Philips demonstrates a FOD method, based on the Induction Balance principle, that utilizes FOD slot's
- In the current test setup the FOD slot alternates with the NFC slot with a repetition rate of F_{mains}
- The FOD slot repetition rate can be negotiated to alternate with the NFC slots as described in the joint specification
- The FOD coils and the NFC antenna can combined in a single assembly


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