

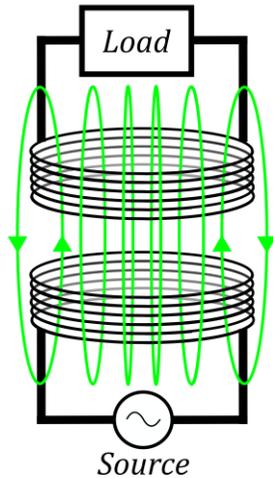


Capacitive wireless power transfer for multiple receivers

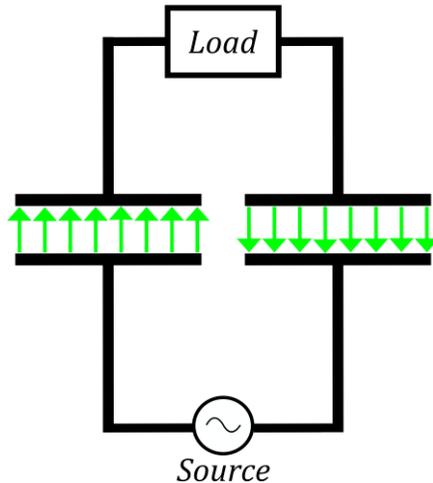
Aris van Ieperen

Introduction & Motivation

■ IPT



■ CPT



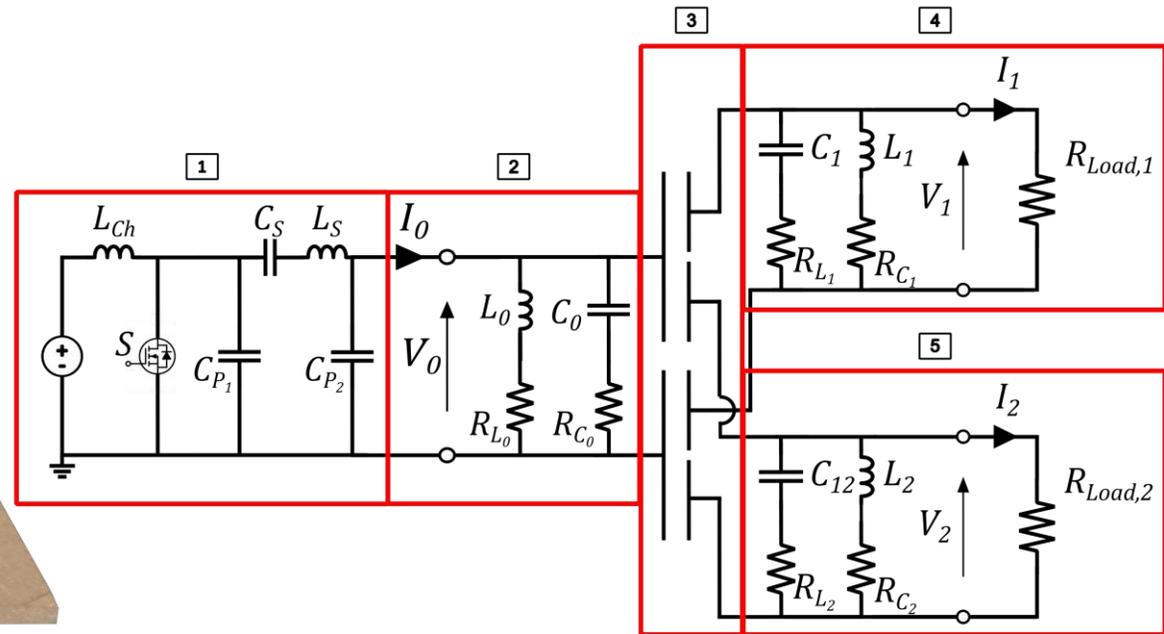
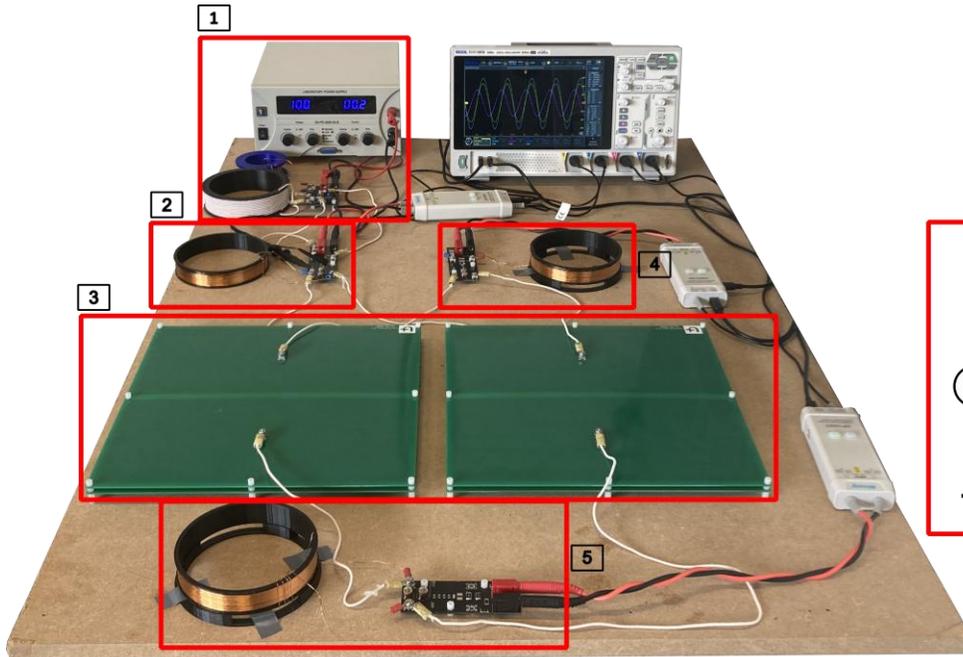
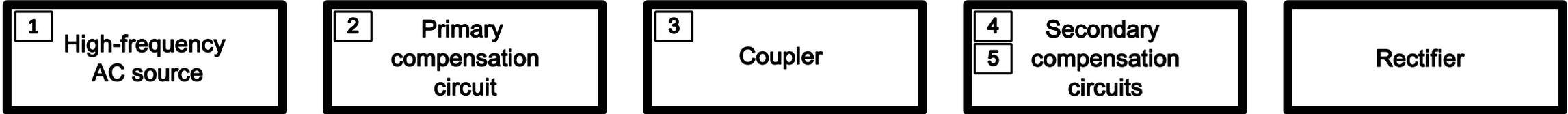
- Needs close alignment
- Bulky structures
- Affected by metal objects

- Naturally more tolerant to misalignment
- Potentially cheaper
- Not affected by metal objects

Introduction & Motivation

- **Multi-port**
- **Industrial context (EV charging, robotics, sensor networks)**
 - Applications: factory automation, mobile robotics, sensor networks
 - Need for efficient, safe, and EMI-compliant solutions
 - Importance of adaptive systems that maintain performance under changing conditions
- **Experimental setup**
 - Coupling estimation
 - Automatic tuning
 - Control strategies for multi-port CPT

System overview

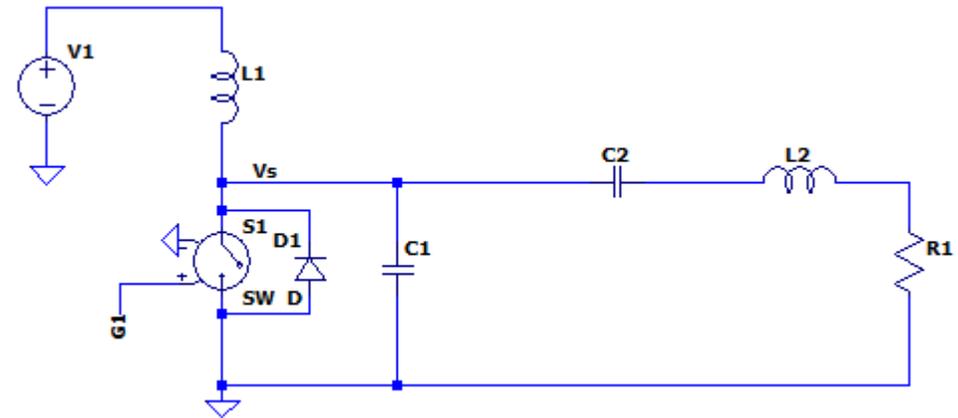


Specifications

- **Single transmitter, two receivers**
- **Resonant system**
- **1 MHz**
- **10s of Watts**

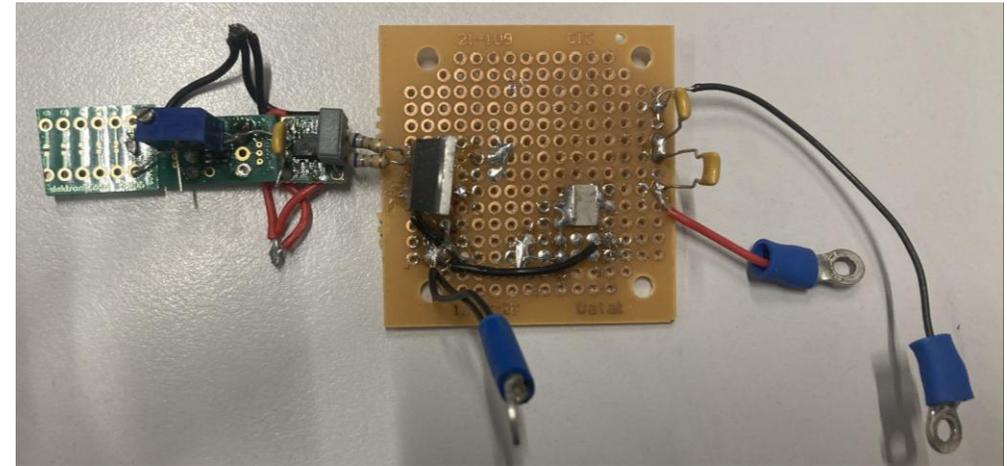
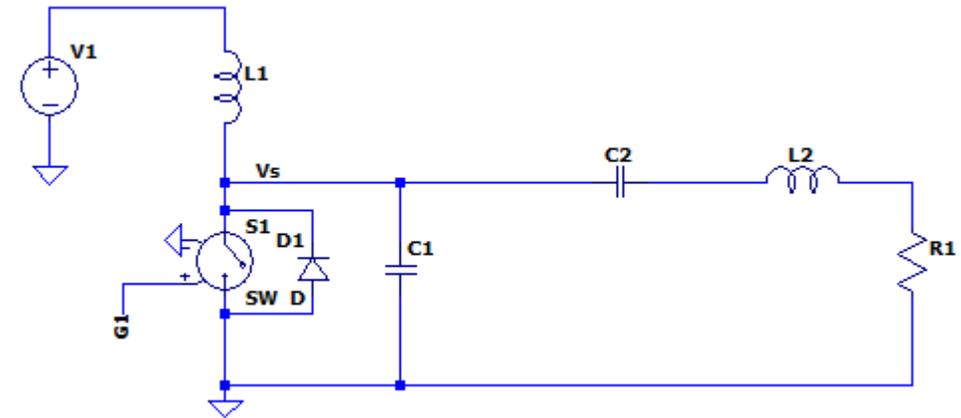
Class-E inverter

- Design process
 - ZVS



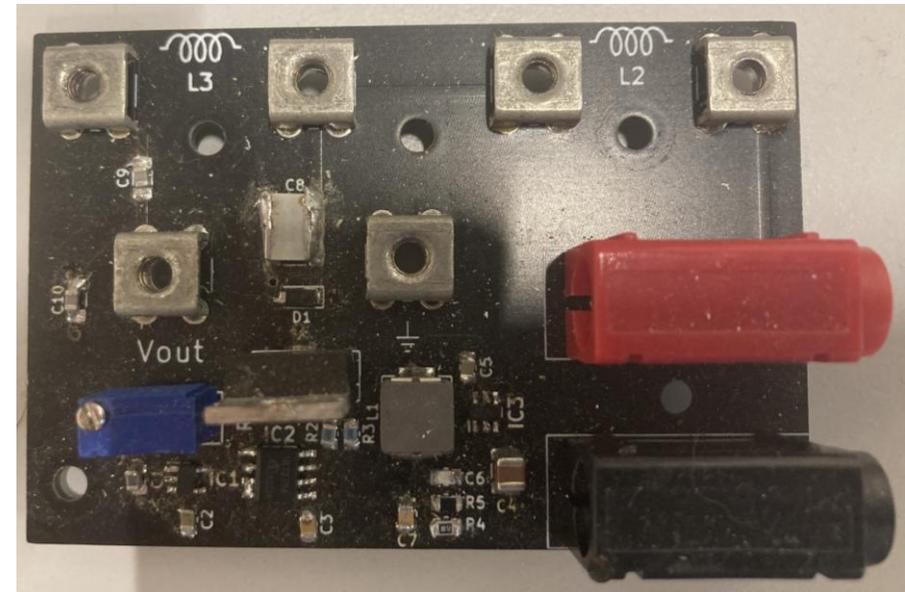
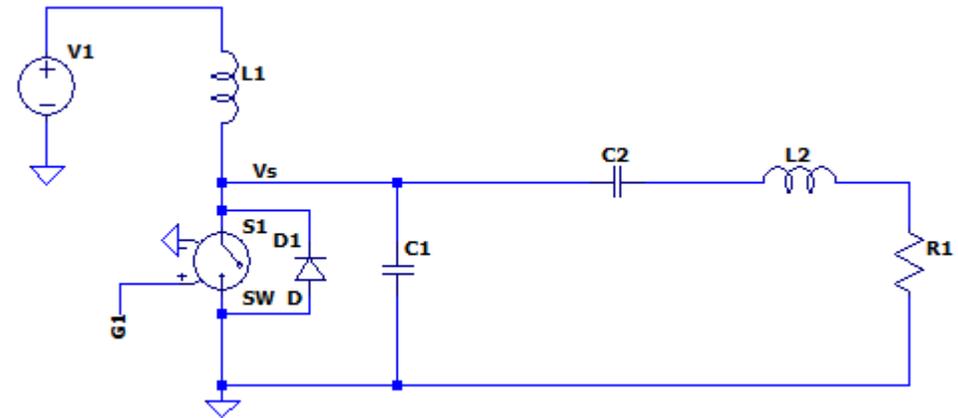
Class-E inverter

- Design process
 - ZVS
- Early prototype



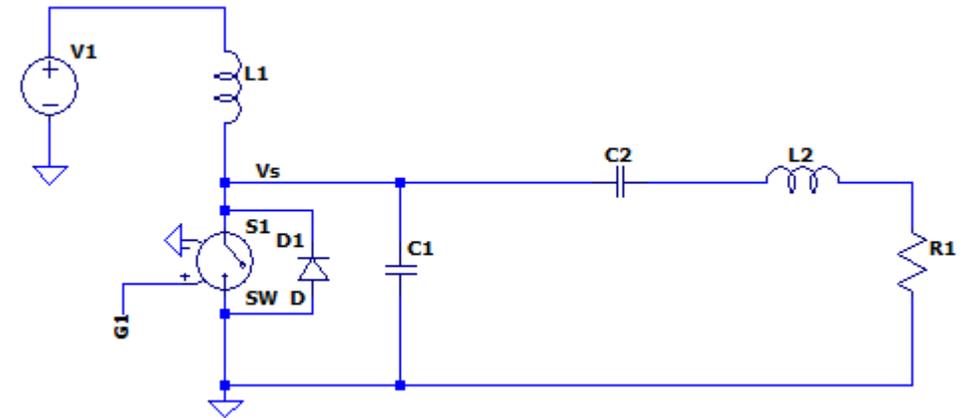
Class-E inverter

- Design process
 - ZVS
- Early prototype
- PCB implementation



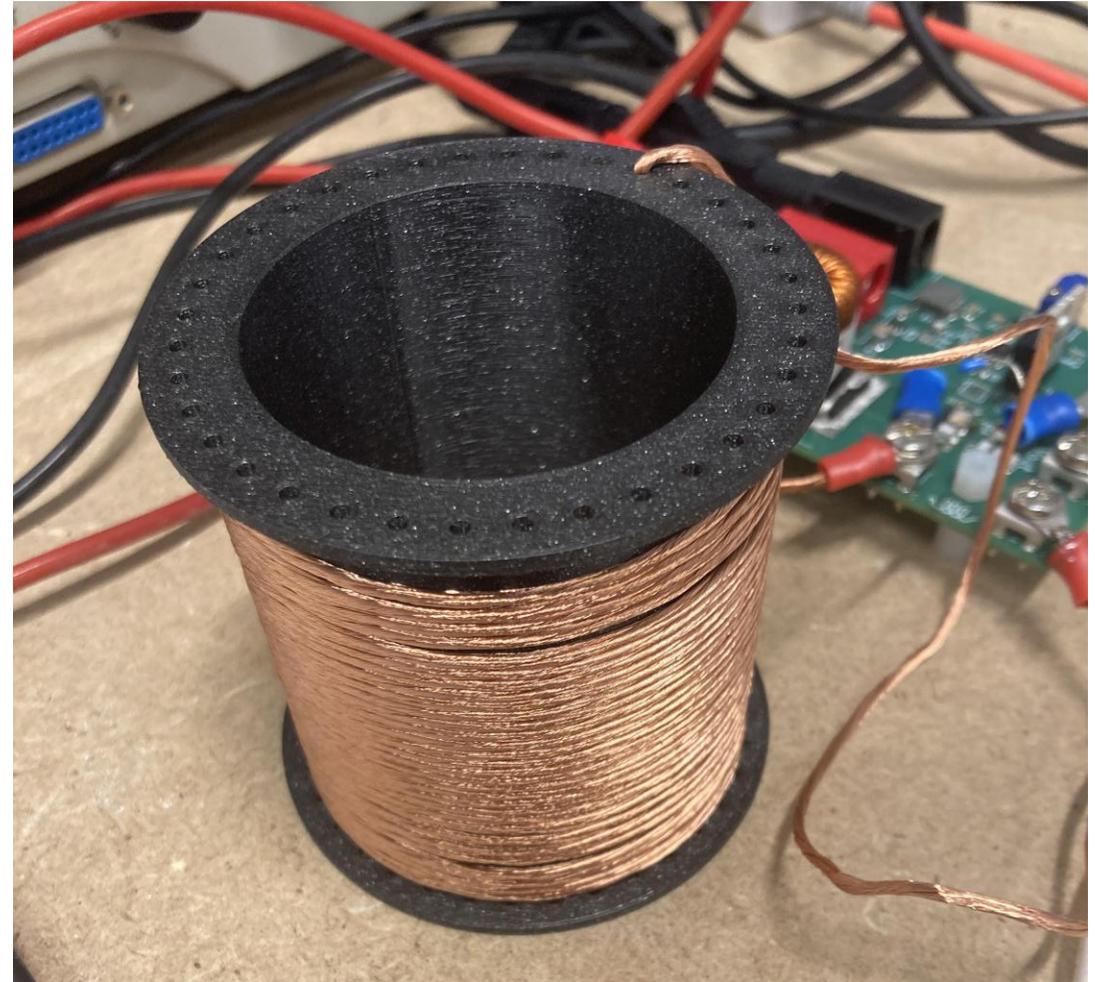
Class-E inverter

- Design process
 - ZVS
- Early prototype
- PCB implementation
- GaN switch



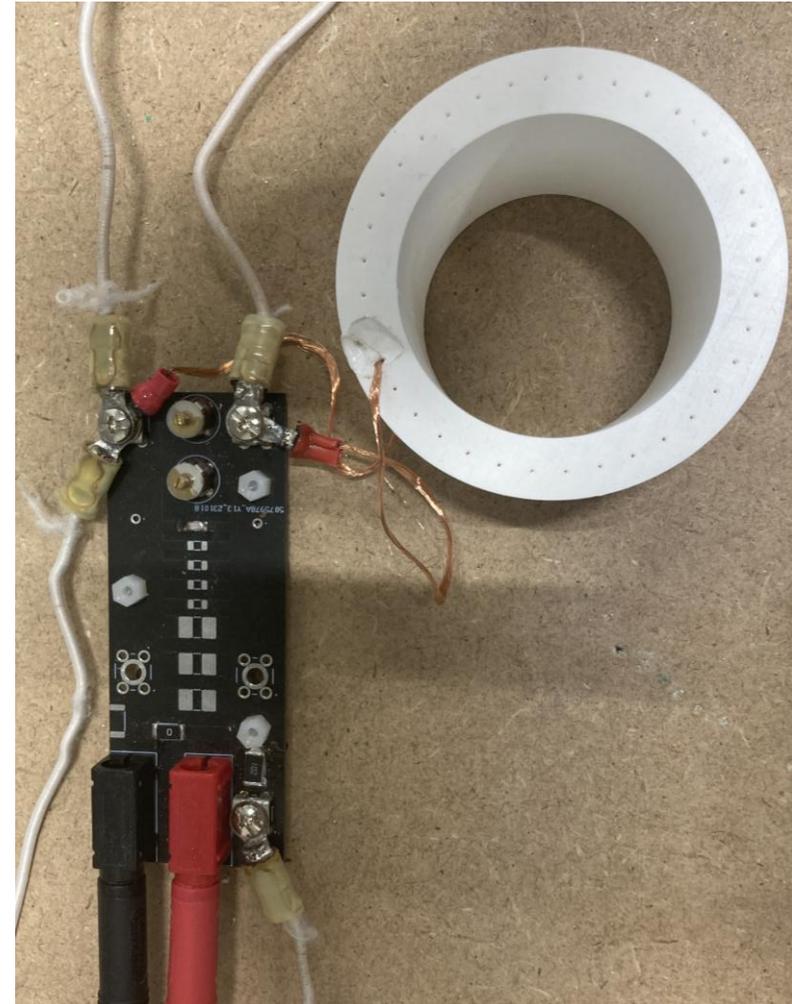
Coupler & Compensation

- **Coil design**
 - Air core
 - Litz wire



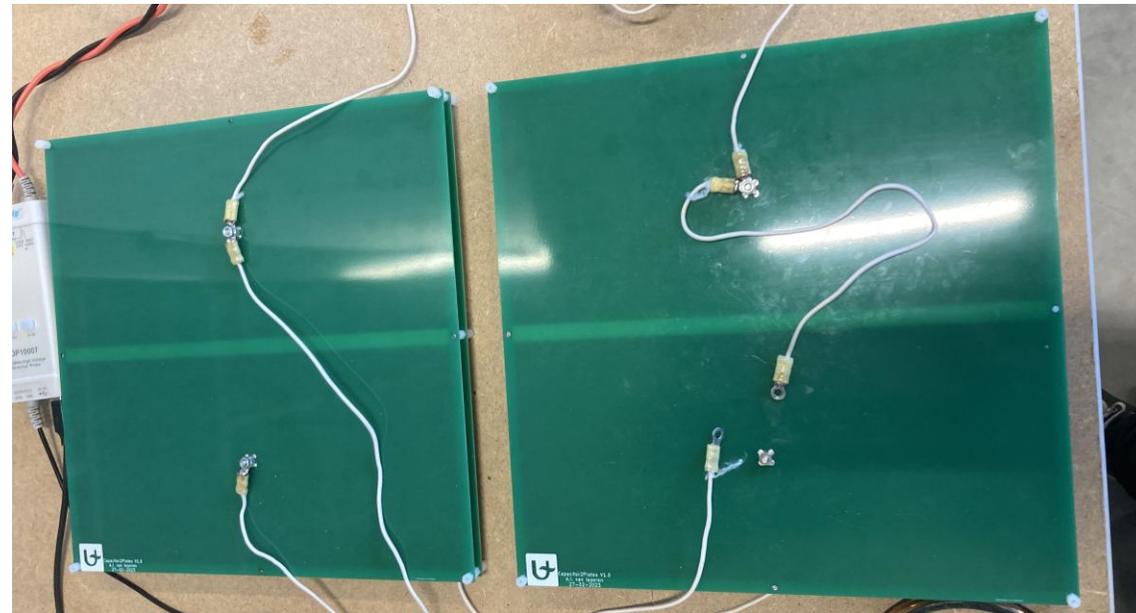
Coupler & Compensation

- **Coil design**
 - Air core
 - Litz wire
- **Compensation circuit**



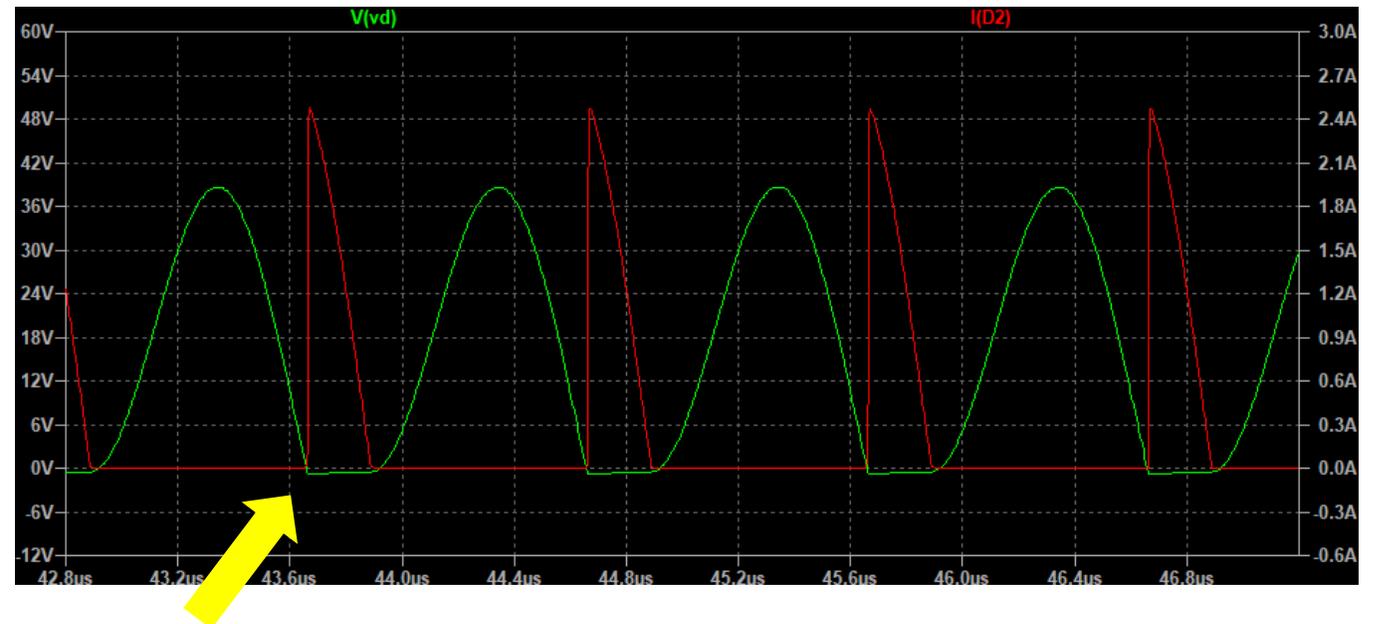
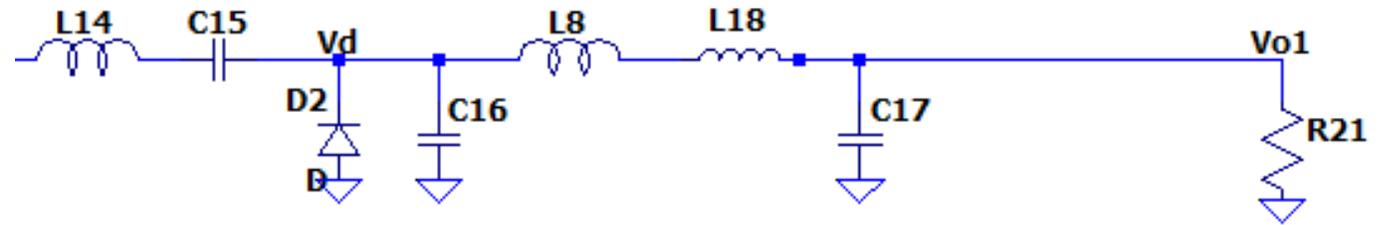
Coupler & Compensation

- **Coil design**
 - Air core
 - Litz wire
- **Compensation circuit**
- **Coupler plates**
 - PCB



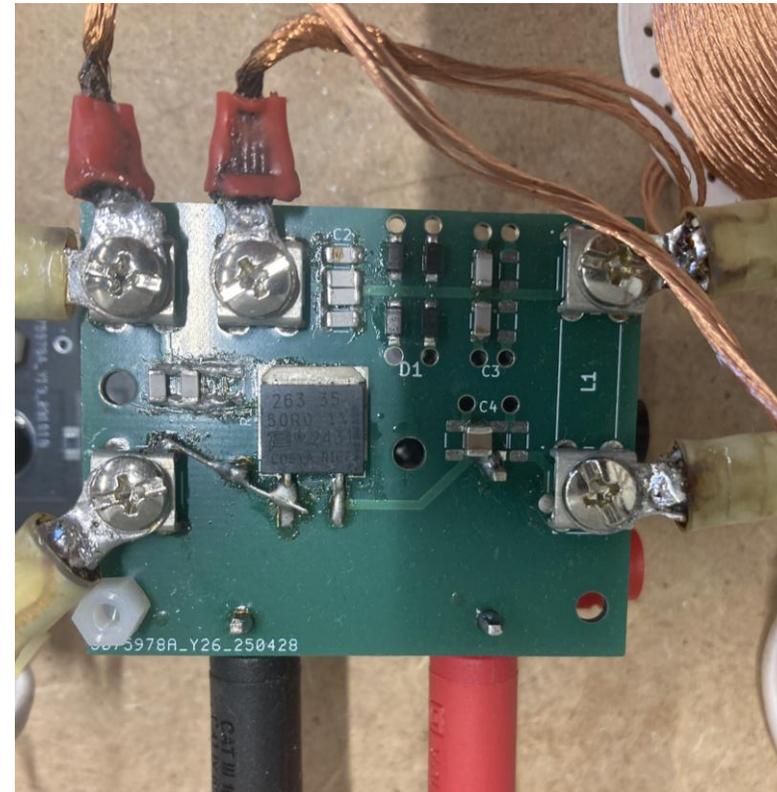
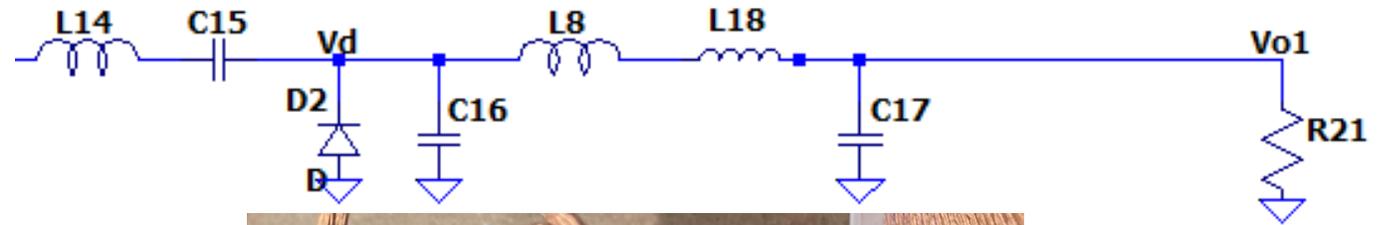
Class-E rectifier

- ZVS



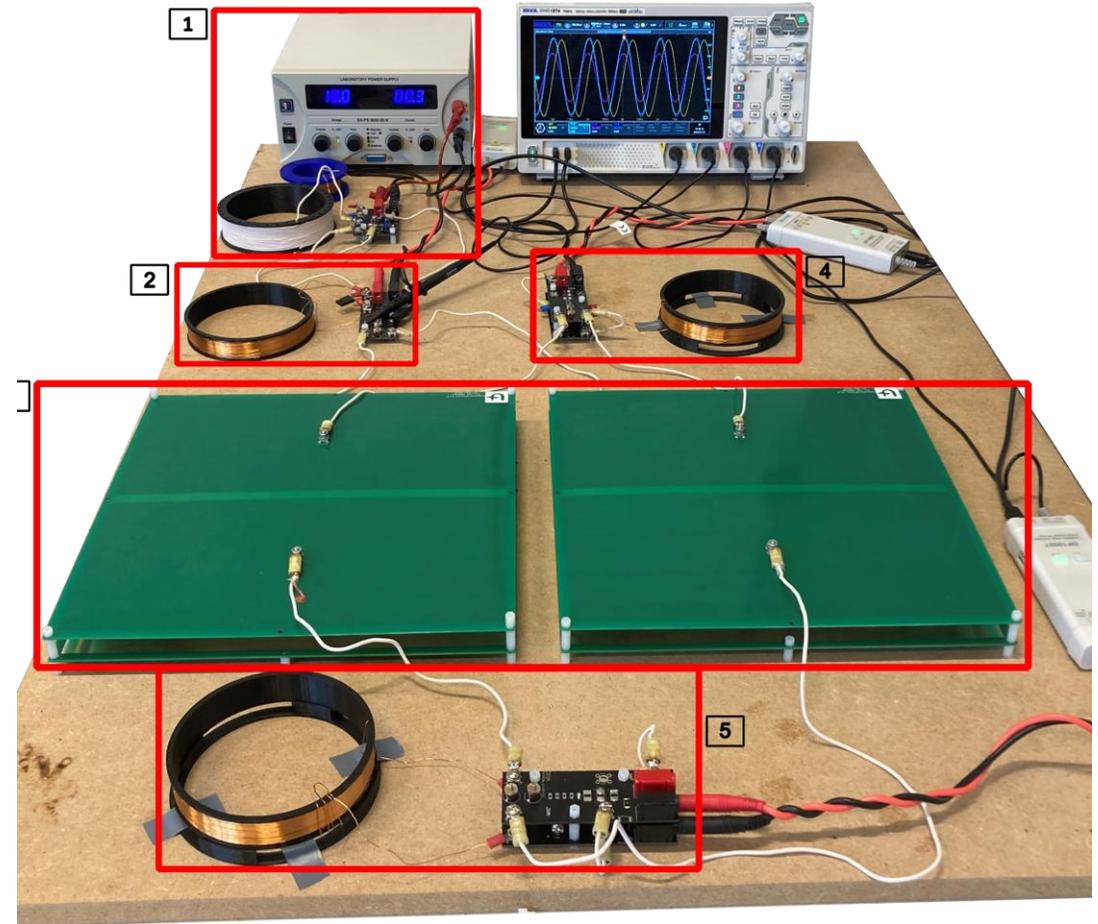
Class-E rectifier

- ZVS
- Load matching



Experimental setup

- **Measurement equipment**
 - DC power supply
 - Oscilloscope
 - Differential probes

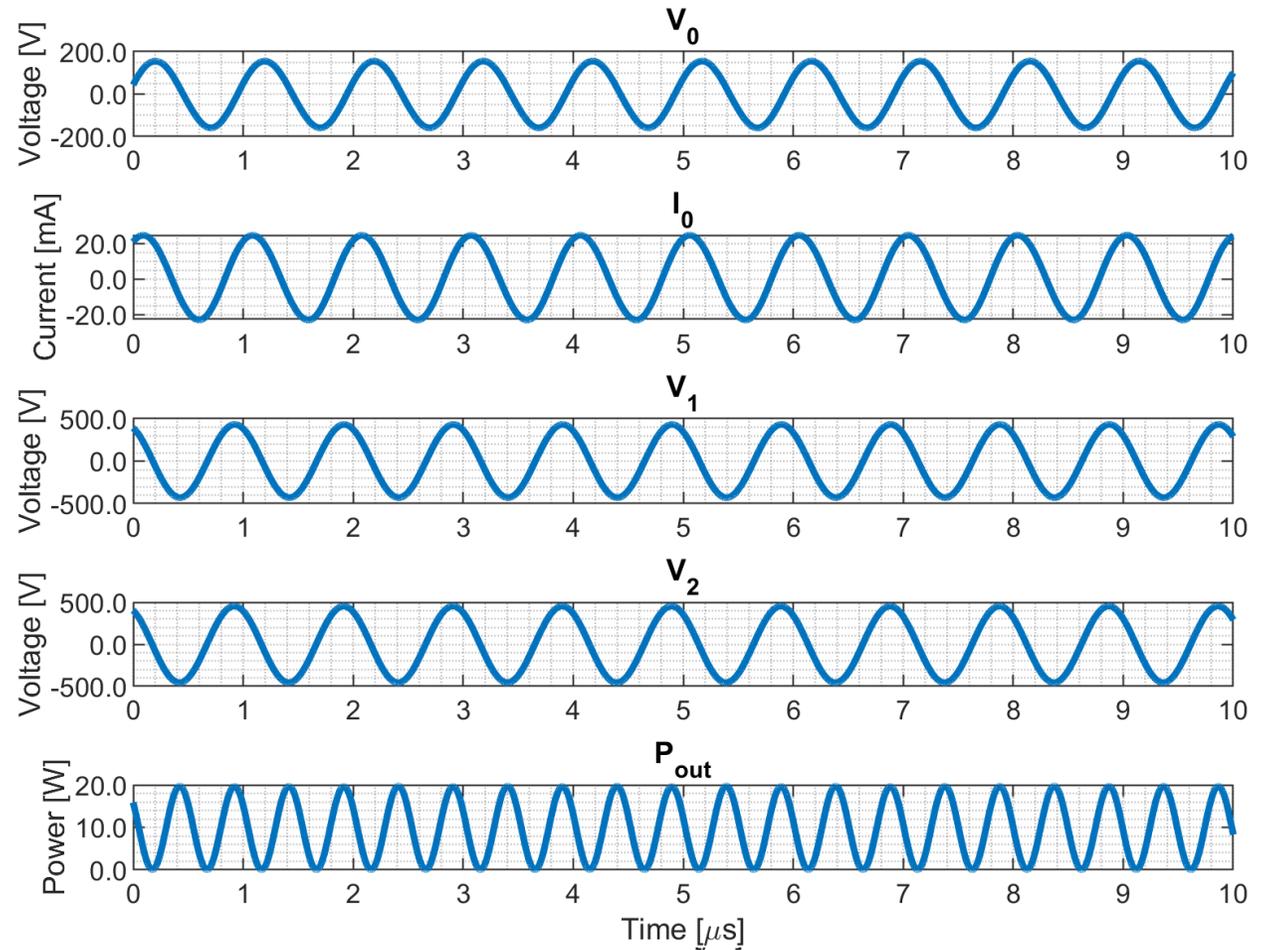


Experimental procedure

- **System calibration, resonant tuning**
 - Trim capacitors
- **Frequency sweep using trimmer pot**
- **Ranges**
 - 100 kHz – 3 MHz
 - 5 V – 32 V Input voltage
 - ~30 W max power

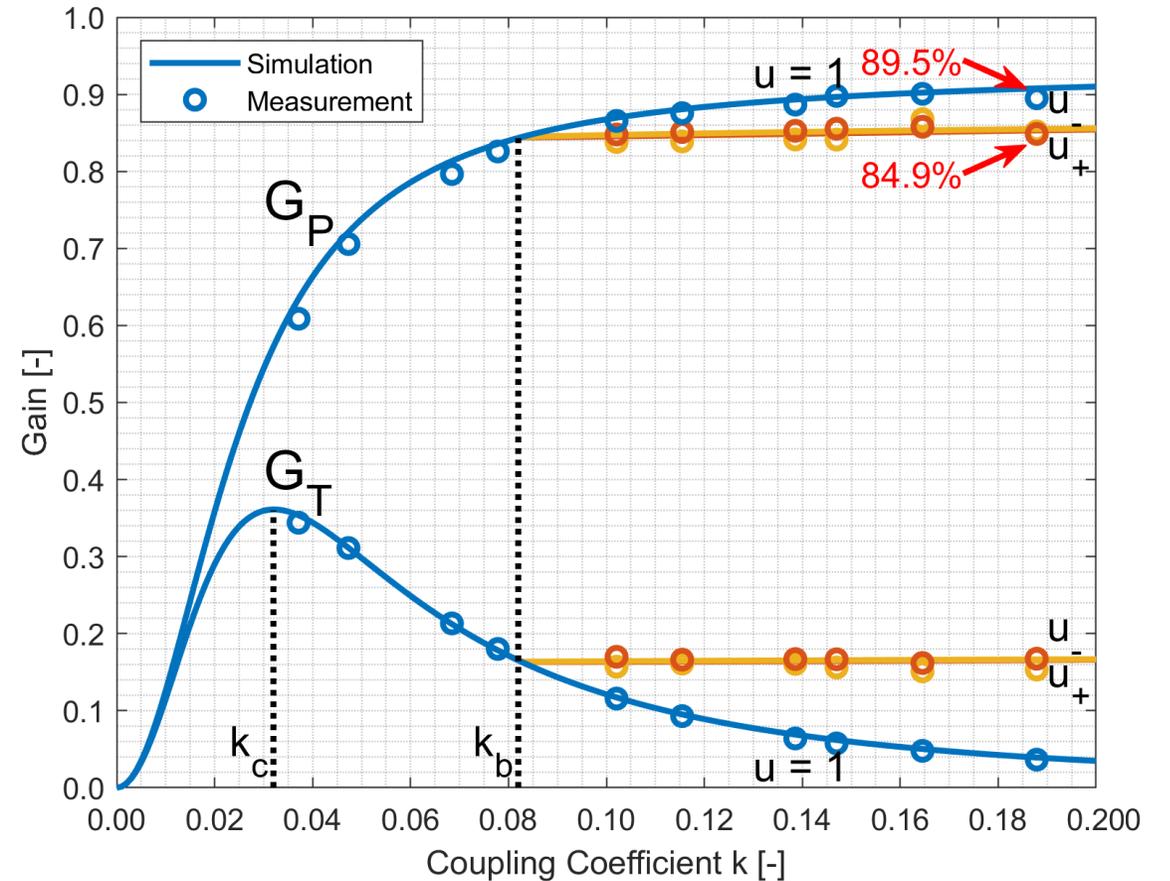
Results

- AC input voltage
- AC input current
- AC output voltages



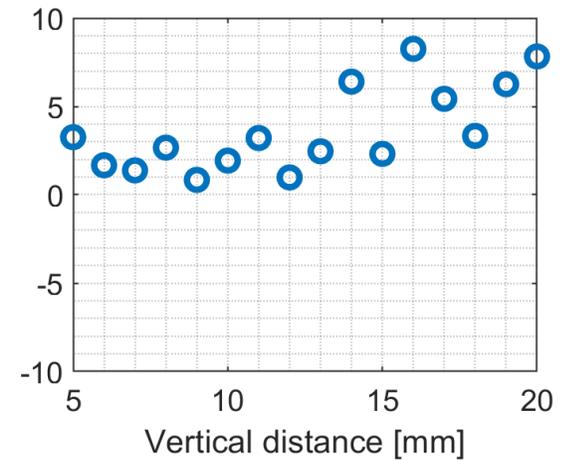
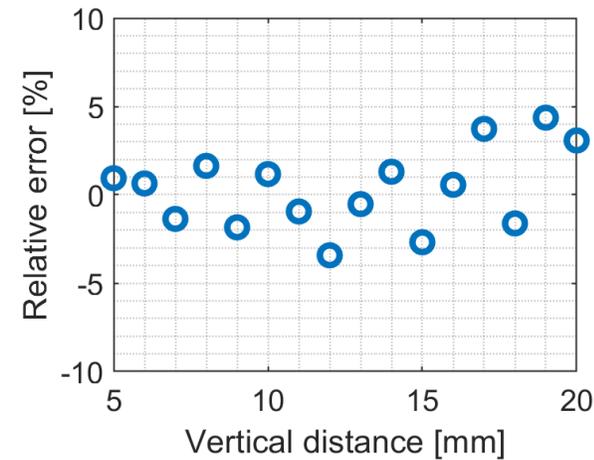
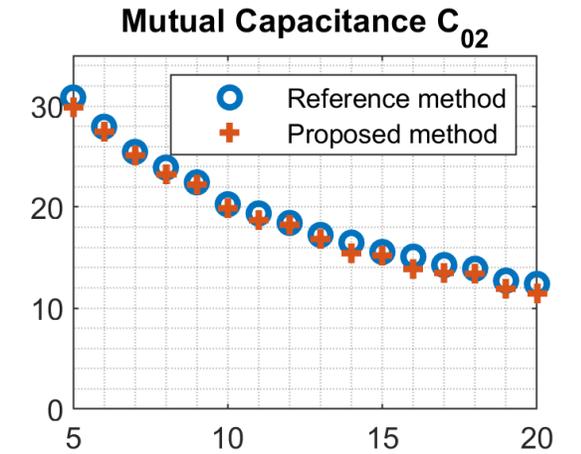
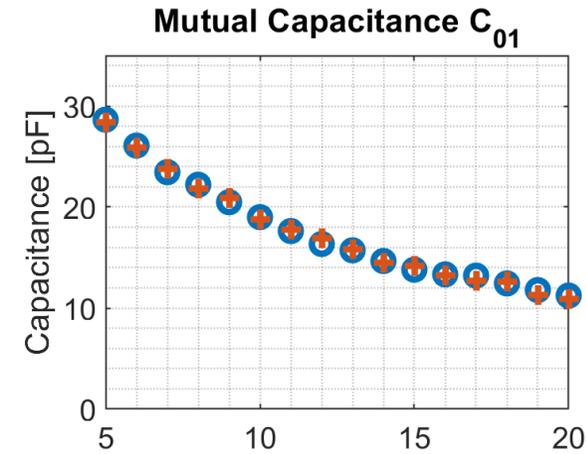
Results – Case 1

- Frequency bifurcation
- Constant power
- 5 W, 89.5% efficiency



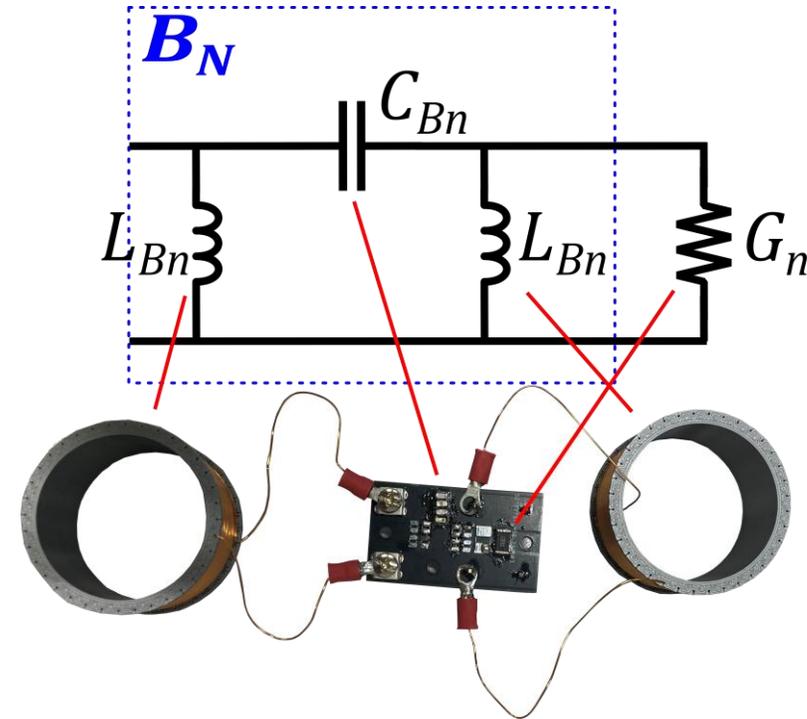
Results – Case 2

- Measuring coupling capacitance
- SISO and SIMO



Results – Case 3

- Selective power delivery
- Admittance inverter
- 10 W, 88.7% efficiency



		L_{B2}			
		39 μH	53.6 μH	61 μH	105 μH
L_{B1}	39 μH	-	34.58%	30.51%	15.86%
	53.6 μH	60.77%	-	41.59%	23.80%
	61 μH	67.79%	55.91%	-	30.63%
	105 μH	82.38%	71.81%	68.35%	-

Industrial implications

- **Adaptive WPT systems: self-tuning based on live capacitance estimation**
- **Scalable architecture: supports multiple transmitters and receivers**
- **Integration opportunities:**
 - Embedded sensors
 - Automated calibration
 - Compact, modular form factors for industrial environments

Future work

- **Integration of closed-loop control for power regulation and phase alignment**
- **Multiple transmitters**
- **Multi-frequency operation**
- **Higher frequency operation (6.78 MHz)**