

A green rectangular road sign with a white border is mounted on a weathered wooden post. The sign is positioned on the left side of a long, straight road that stretches into the distance. The road is flanked by rolling hills under a dramatic sky with large, white, fluffy clouds. The sun is low on the horizon, creating a bright, golden glow that illuminates the clouds and the road. In the distance, a modern building with a grid-like facade is visible on the horizon. The overall scene conveys a sense of a long, forward journey.

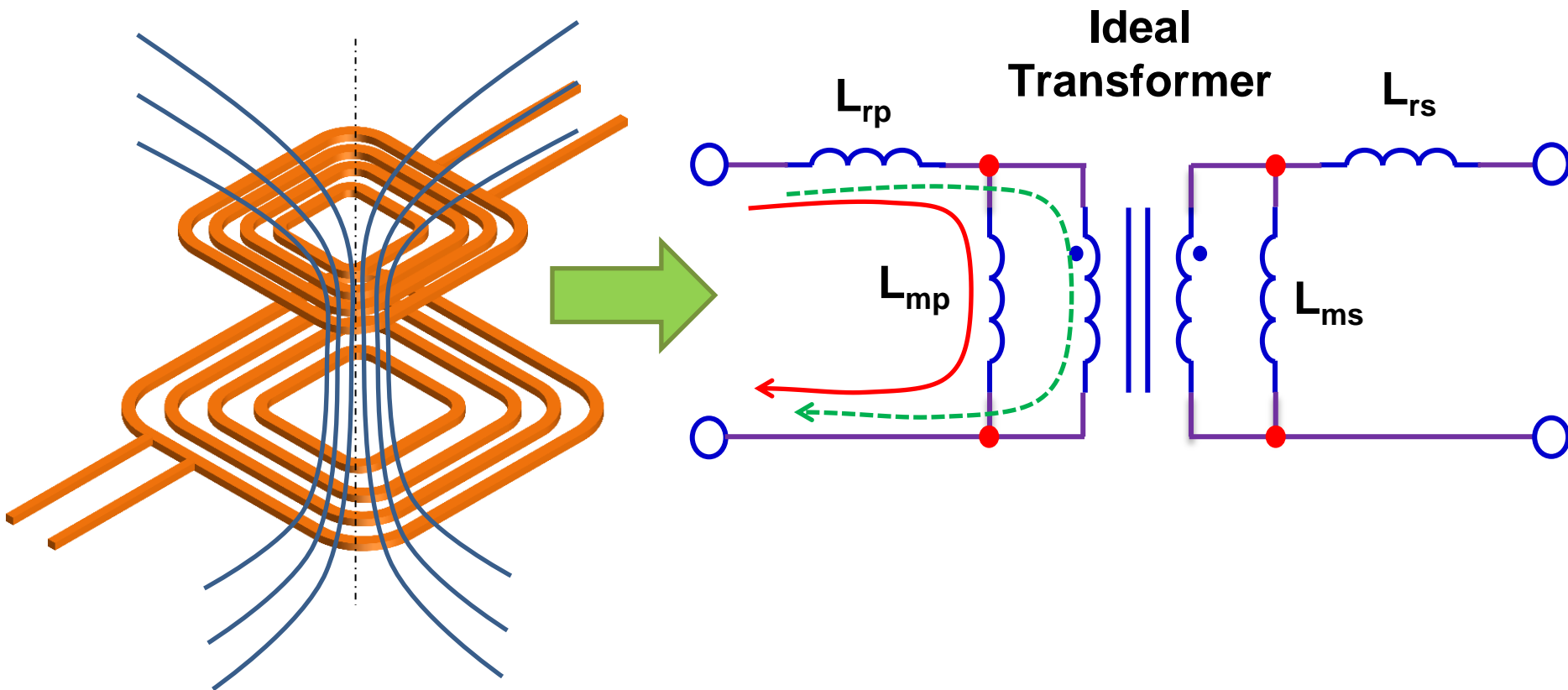
The eGaN[®] FET
Journey Continues

Wireless Energy Transfer – Technology Drivers

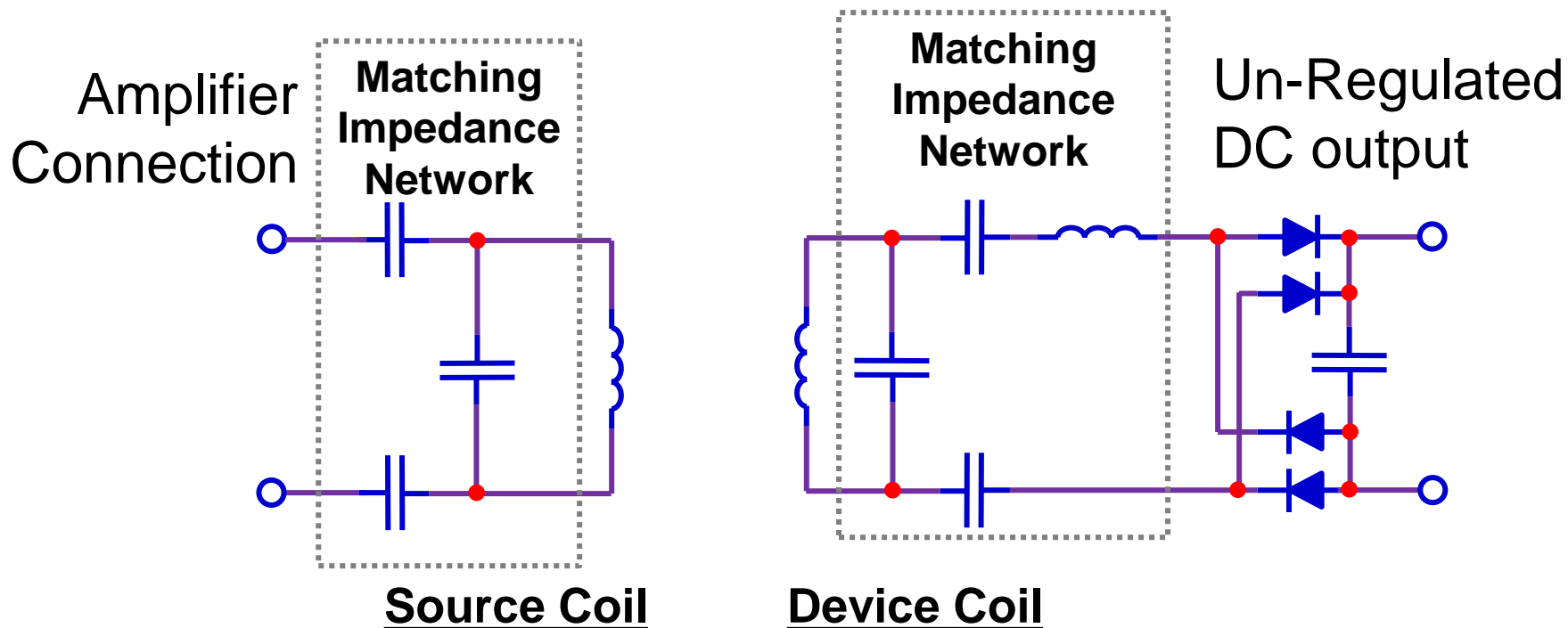
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Efficient Power Conversion Corporation

- Overview of Wireless Energy Transfer
- Wireless Energy Transfer Enabling Technologies
- Wireless Energy Topology Overview
- Wireless Energy Experimental Results



- Coils tuned to resonate at 6.78 MHz
- Series and Shunt tuned can be used
- Coupling and load variation can shift resonance



- Mobile device charging
 - Convenience
 - Extended battery life
- Medical Implants
 - Quality of life improvement
 - Life extender
- Hazardous environment systems
 - Explosive atmosphere
 - Corrosive locations
 - High Voltage



- High Efficiency – limited dissipation budget
- Low Profile – mobile market
- Robustness to dynamic operating conditions
(convenience factor)
- Foreign object response
- Regulatory compliance

- Industrial Scientific Medical (ISM) Band
 - 6.78 MHz \pm 15kHz (subject to local restrictions)
 - 13.56 MHz \pm 7kHz
 - No Power limit specified, but!
- FCC / EN Standards
 - Intentional radiator
 - Must comply with FCC part 15 / EN55011

- Alliance for Wireless Power (A4WP / Rezence)

- Highly resonant (ISM band)
- loosely coupled coils



- Wireless Power Consortium (WPC - Qi)

- Low frequency (~ 100 - 200 kHz)
- Tightly coupled (Inductive)



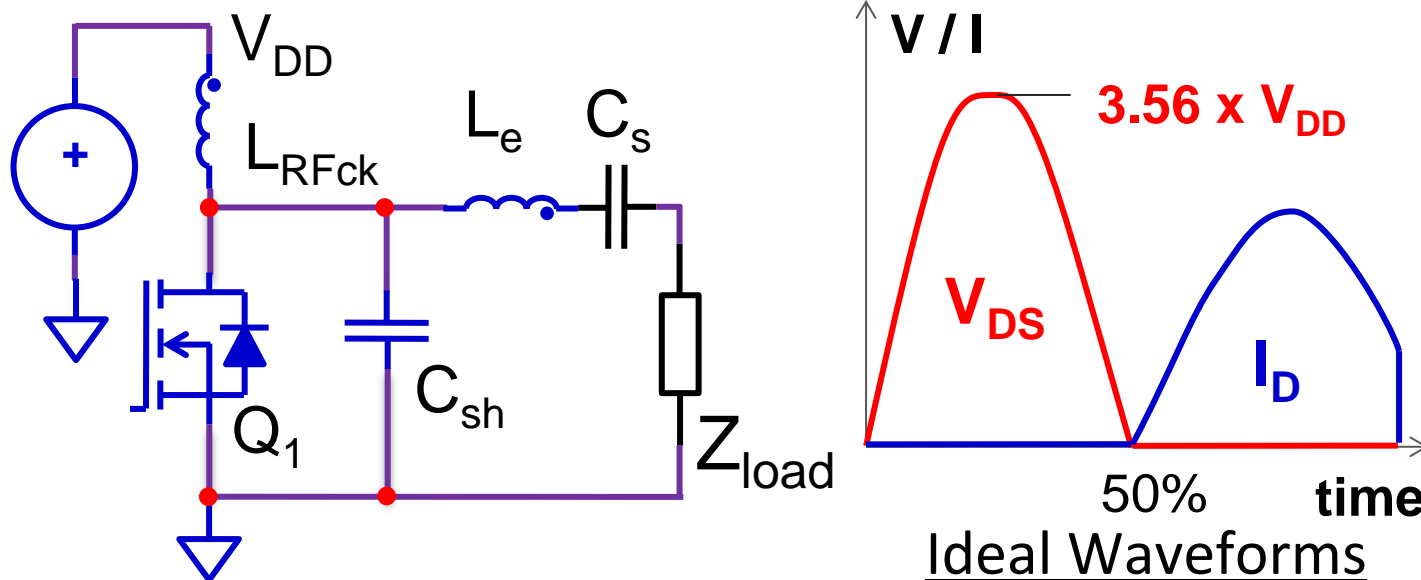
- Power Matters Alliance (PMA)

- Joined with A4WP standard

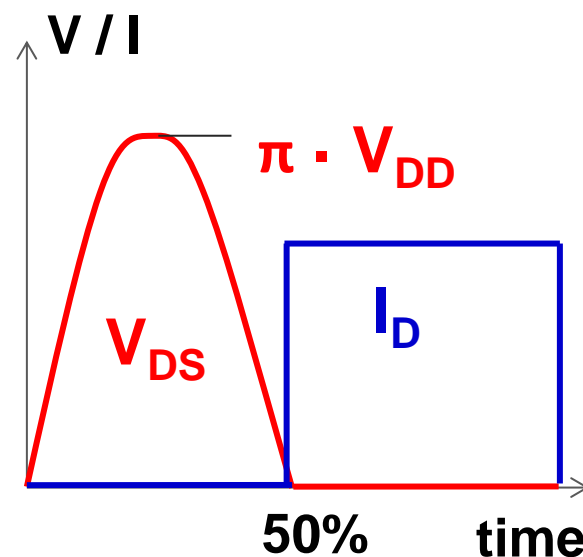
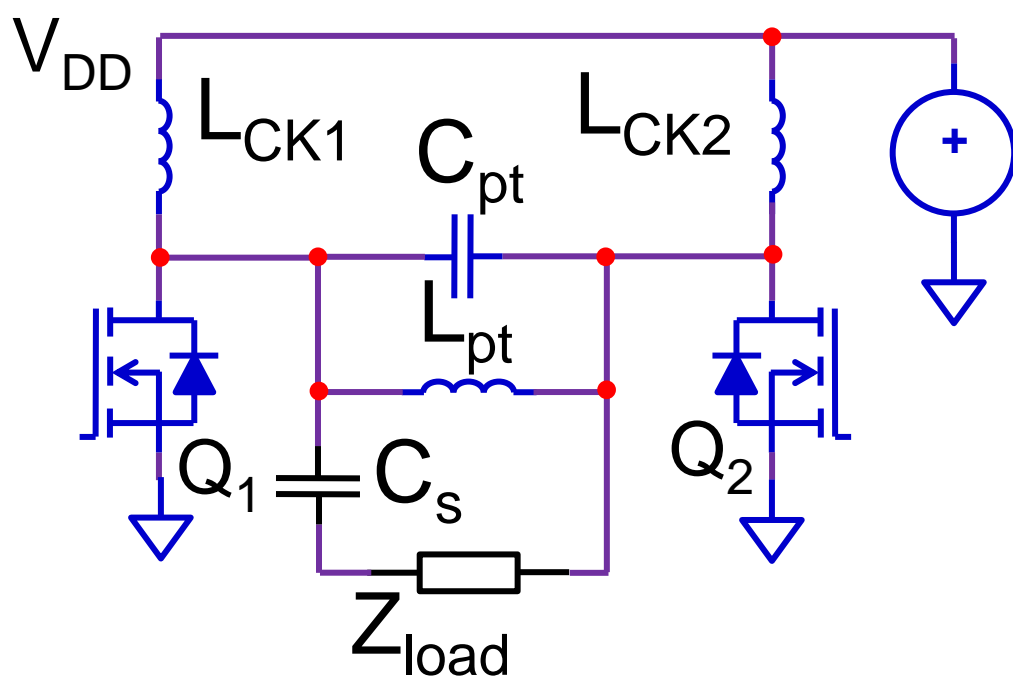


- Antenna
 - Design for high Efficiency
- eGaN FETs
 - Enable high frequency Amplifiers
 - Easy to use
 - Support structure – gate drivers
- Topologies
 - New topologies enabled by new FETs

- Switch voltage rating $\geq 3.56 \cdot \text{Supply}$ (V_{DD}).
- C_{OSS} “absorbed” into matching network.
- Susceptible to load variation - high FET losses
- Coil Voltage $\approx 0.707 \cdot V_{DD}$ [V_{RMS}]

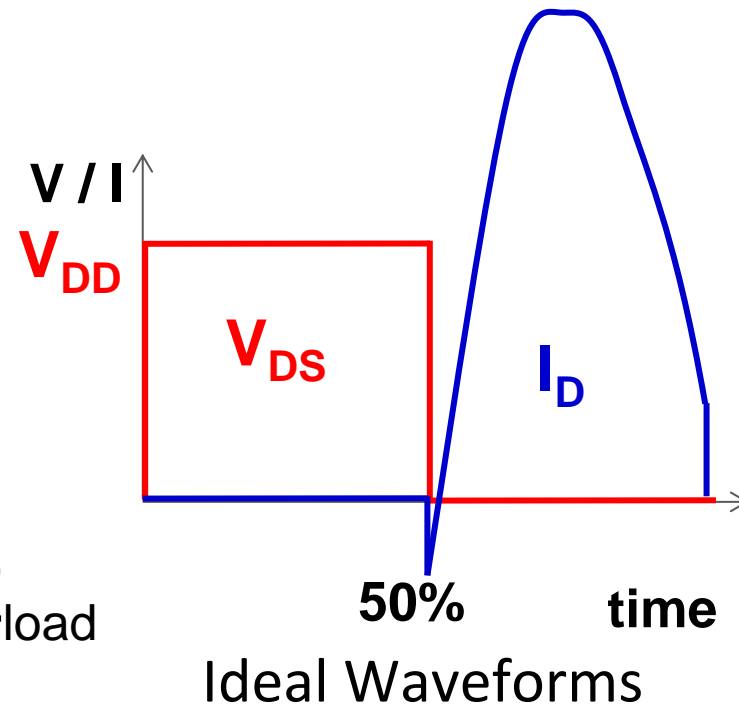
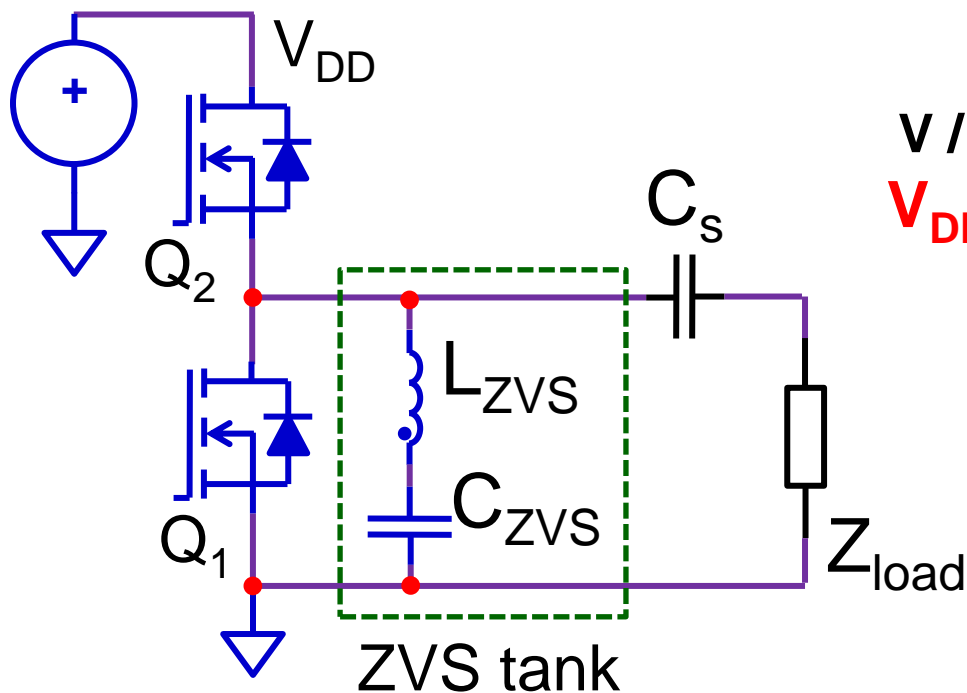


- Switch voltage rating = $3.14 \cdot \text{Supply } (V_{DD})$.
- C_{OSS} “absorbed” into matching network.
- High current in resonant inductor
- Coil Voltage = $2.22 \cdot V_{DD} [V_{RMS}]$

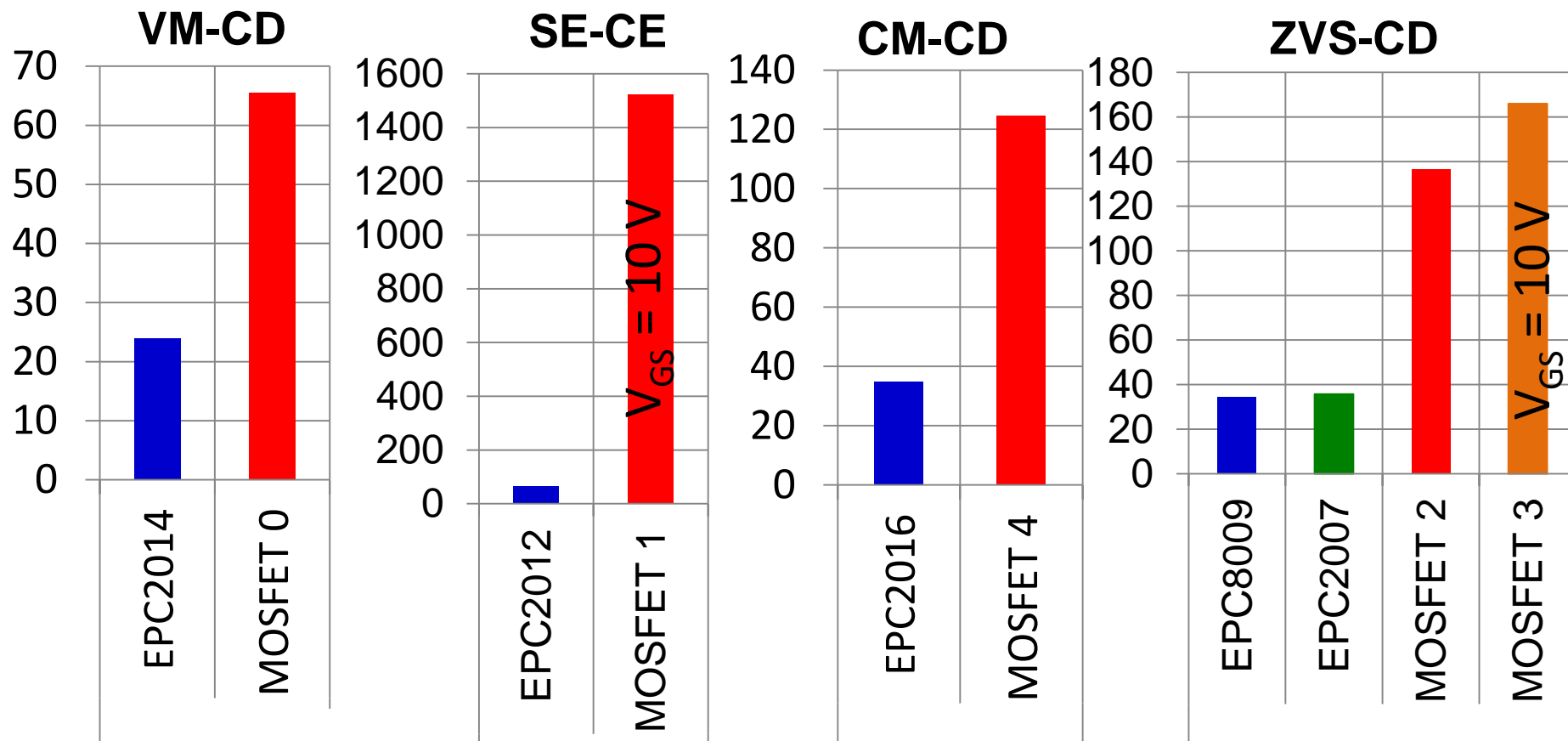


Ideal Waveforms

- Switch voltage rating = Supply (V_{DD}).
- C_{OSS} Voltage is transitioned by the ZVS tank
- ZVS tank circuit does not carry load current
- Coil Voltage = $\frac{1}{2} \cdot V_{DD}$ [V_{RMS}]

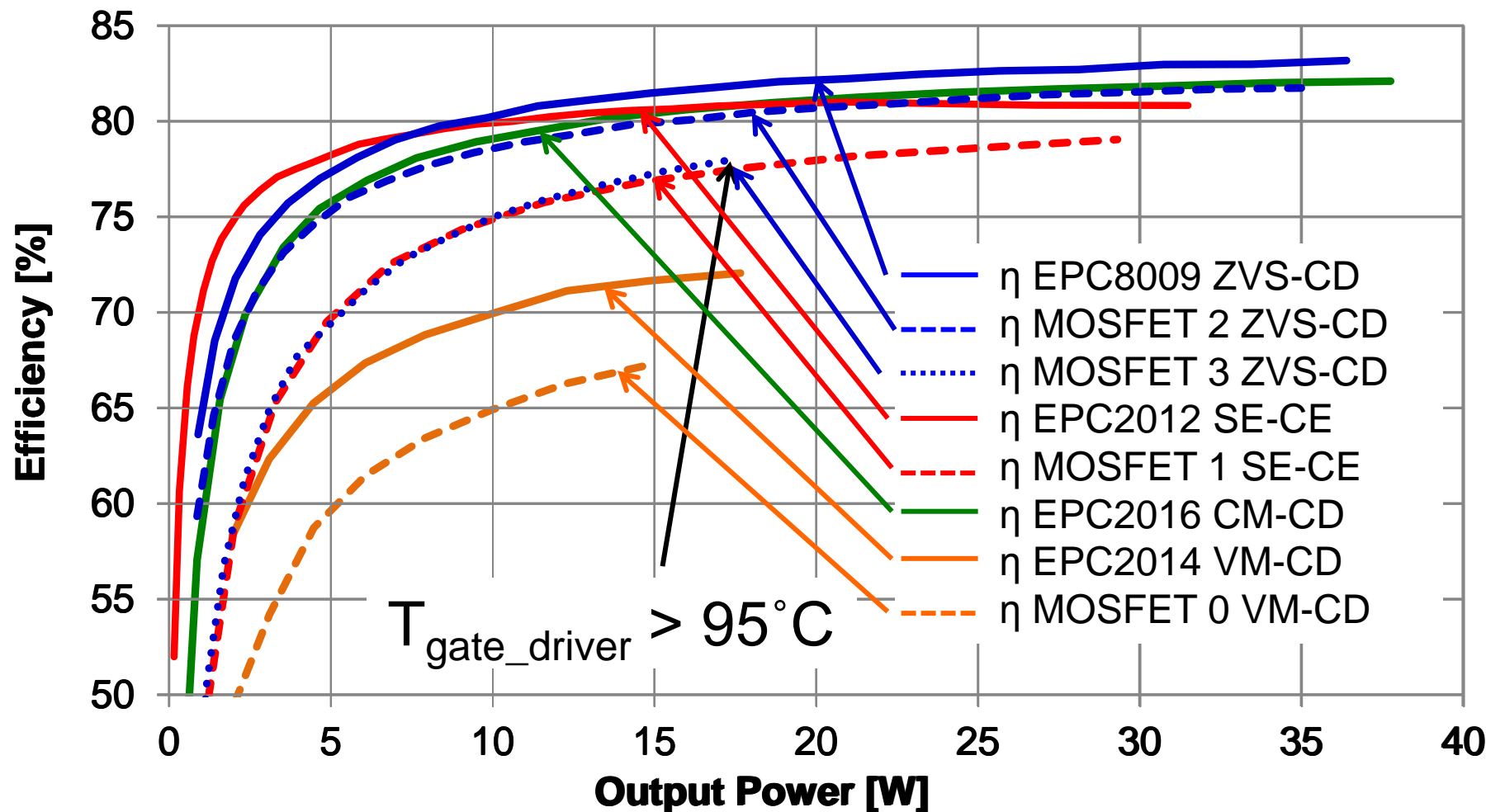


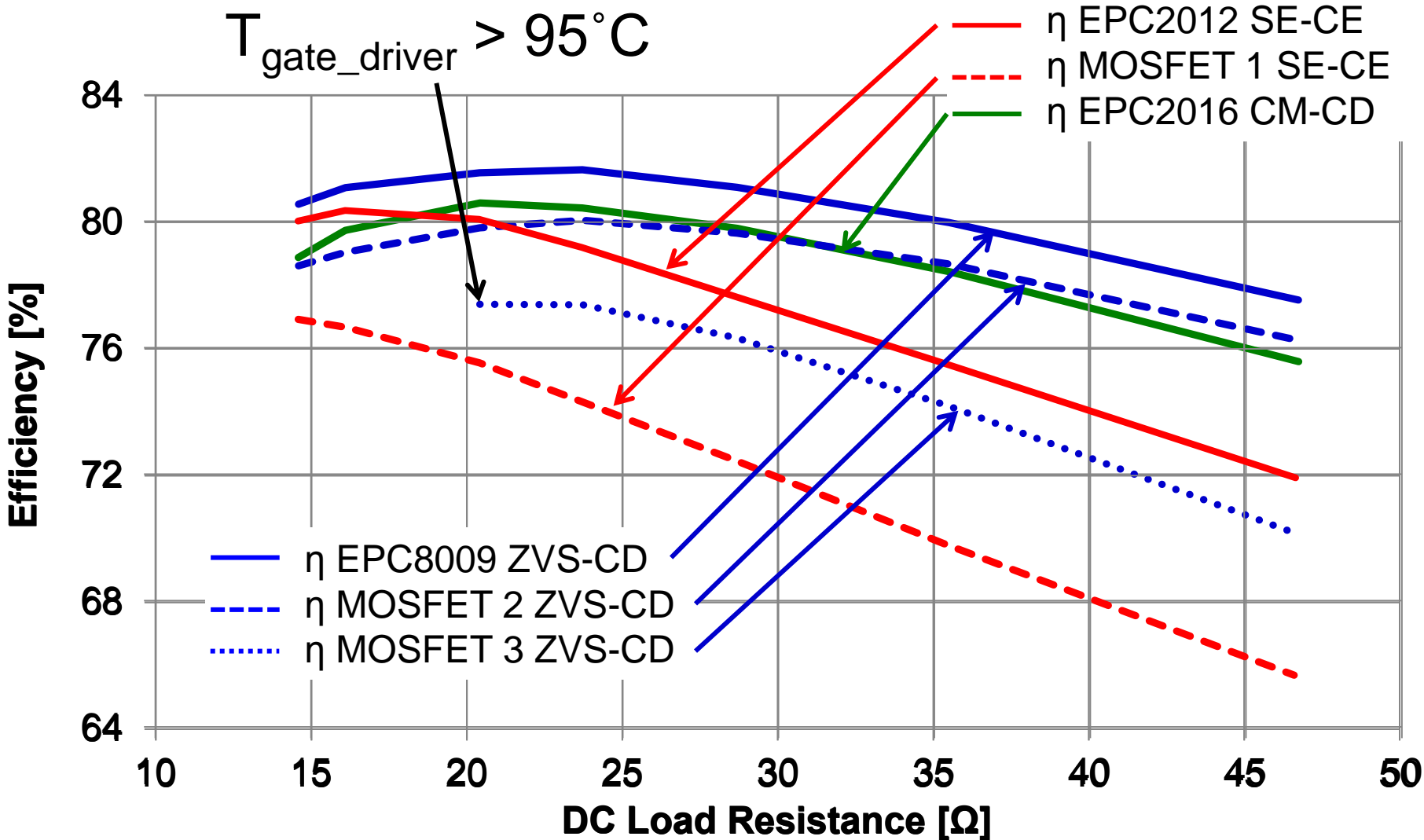
FoM_{WPT} [nC·mΩ]



$$FOM_{WPT} = R_{DS(on)} \cdot (Q_G - Q_{GD})$$

23.6 Ω DC Load





Wireless Energy Transfer Solutions Require:

- New enabling devices e.g. eGaN[®] FETs
- Operation at 6.78 MHz and 13.56 MHz
- Low profile and high efficiency solutions
- Easy to implement
- Drive new topologies e.g. ZVS Class D
- Growing support e.g. Gate drivers and products use them
- Robustness to operating conditions



*The end of the road
for silicon.....*

*is the beginning of
the eGaN FET
journey!*

Simplified representation of coil-set for easy comparison between topologies

