eGaN® FET Wireless Energy Transfer Solutions

Efficient Power Conversion Corporation

Agenda

- Wireless Power Topologies Overview
- Wireless Power Results for each Topology
- Summary

Overview

Output Power < 30 W

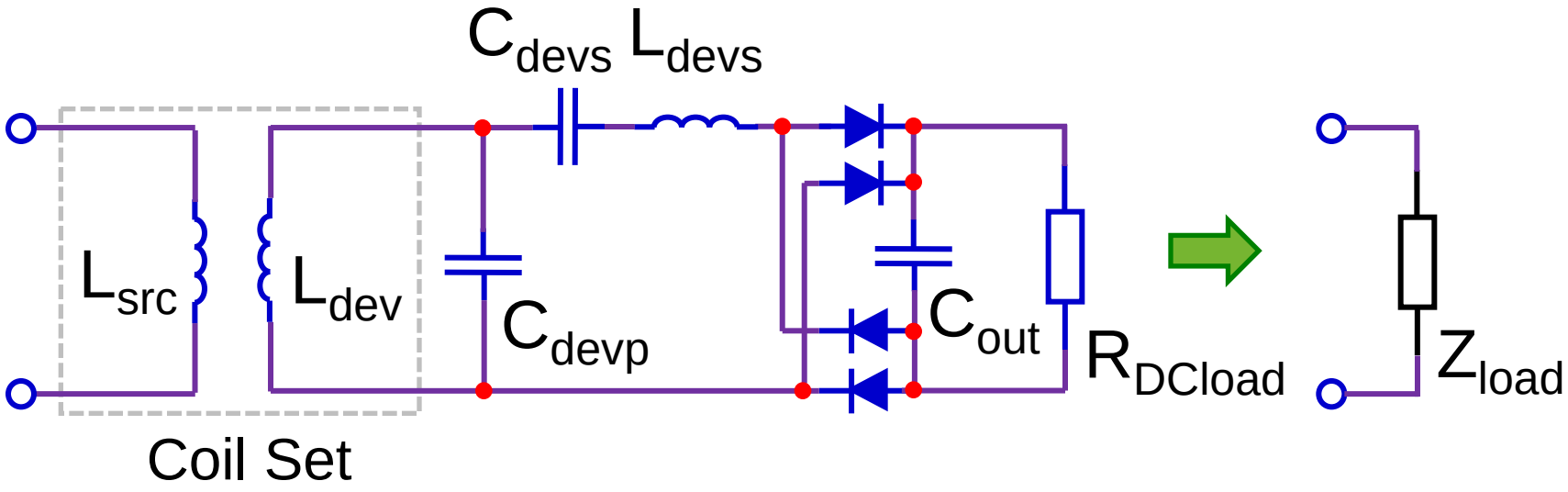
Loosely coupled, 6.78 MHz (ISM band) based on A4WP standard

Topologies Reviewed

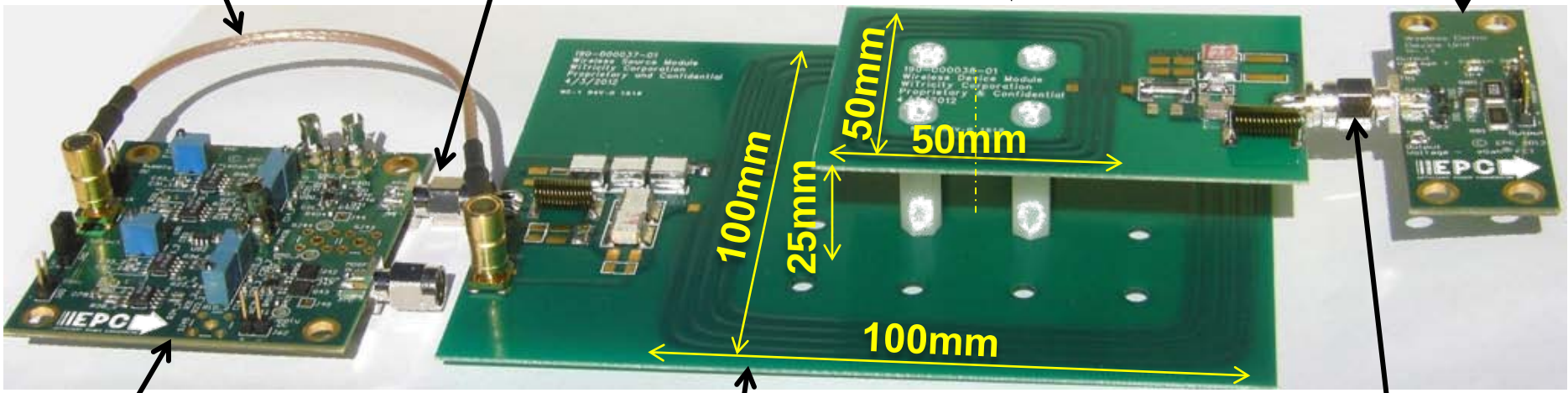
- Class D (Current and Voltage Mode)
- Class E
- ZVS Voltage Mode Class D

Wireless Coil-set Overview

Simplified representation of coil-set for easy comparison between topologies

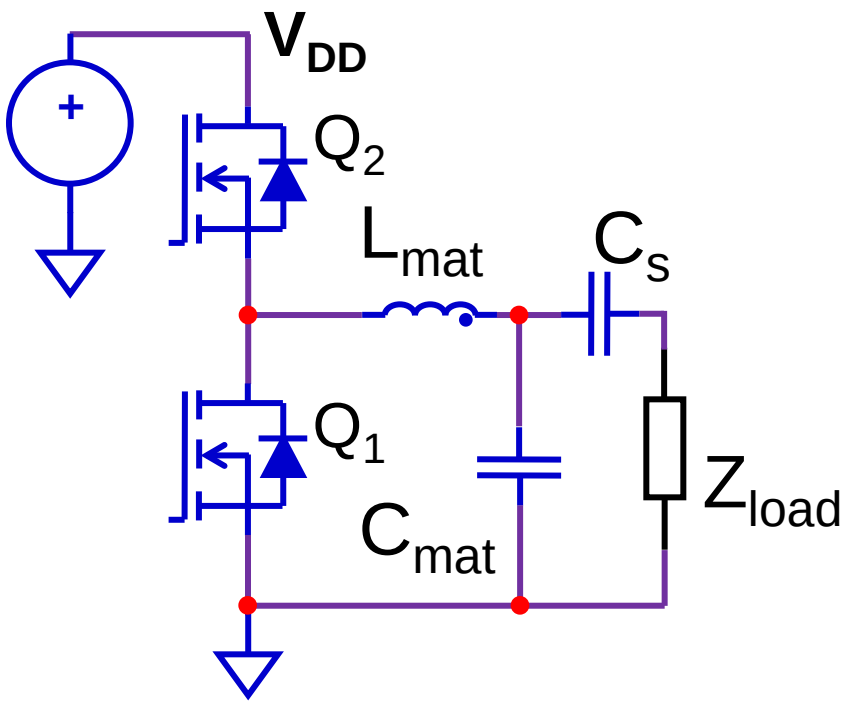


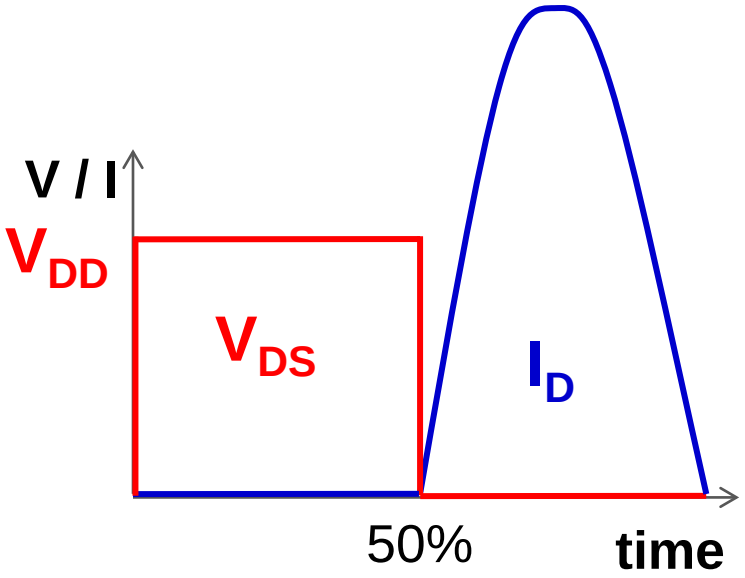
Experimental Setup



Traditional Voltage Mode Class D

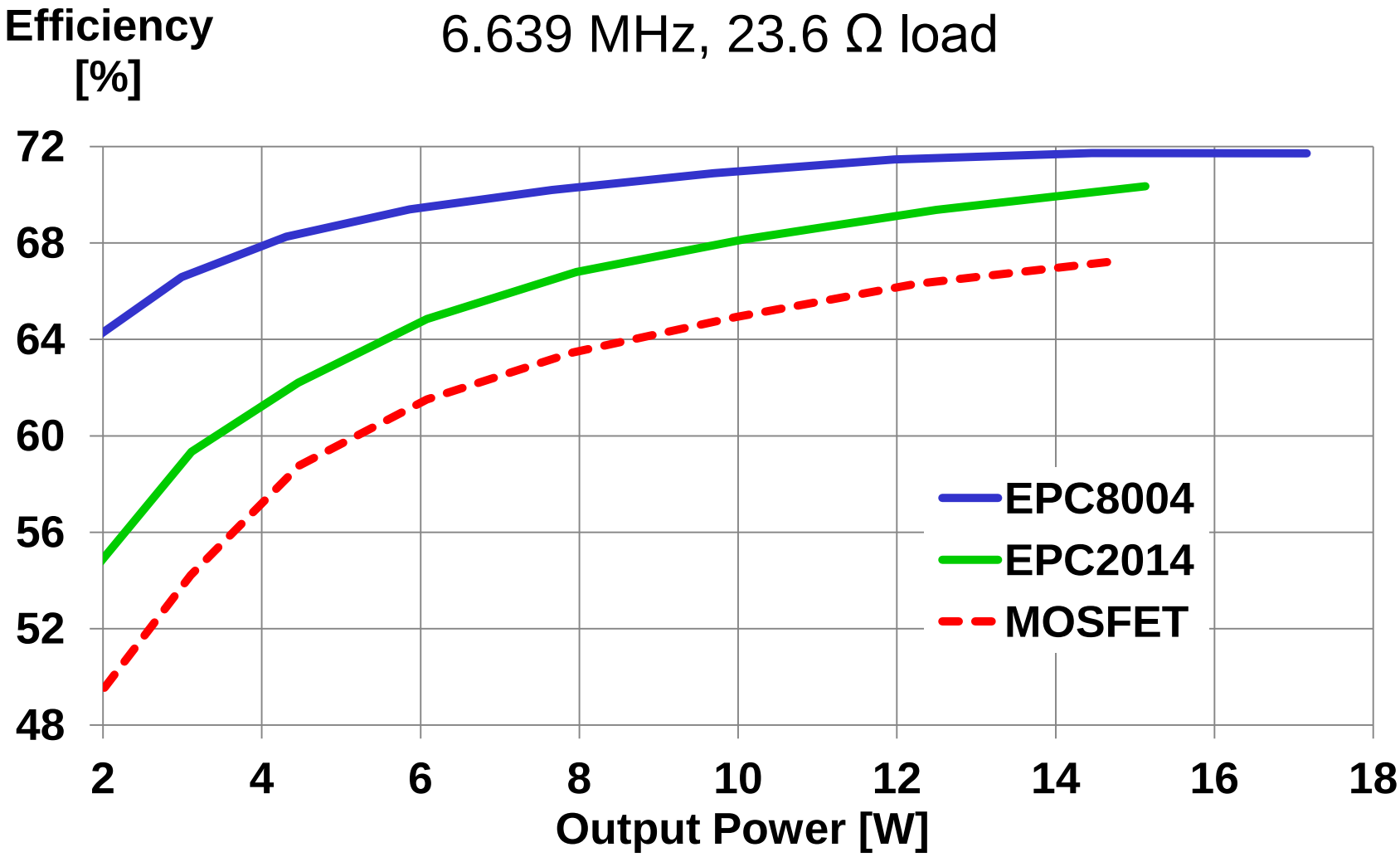
- Switch voltage rating = Supply (V_{DD}).
- Level shifting gate driver required.
- C_{OSS} plays an important role in losses.



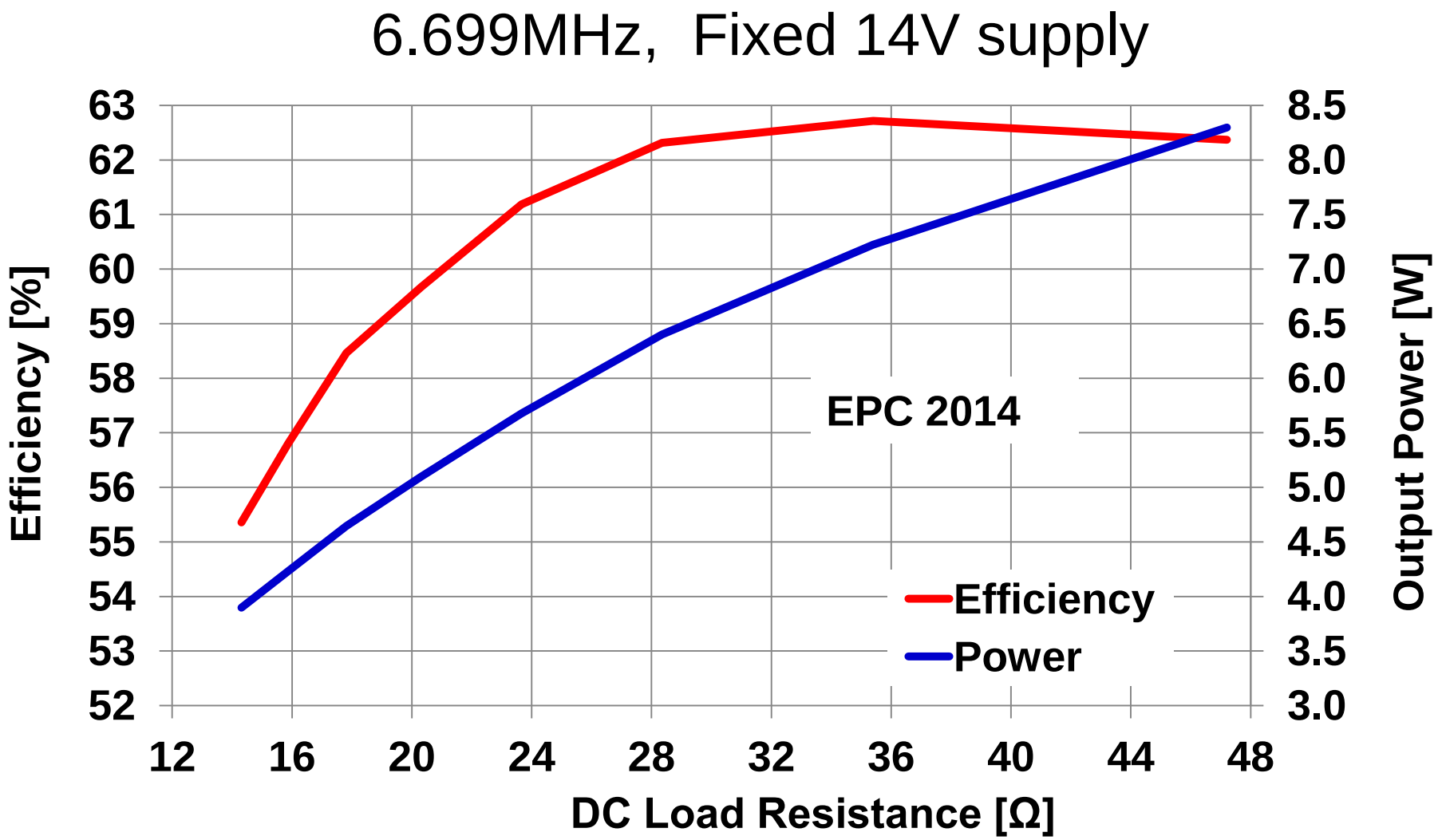


Ideal Waveforms

Voltage Mode Class D Efficiency

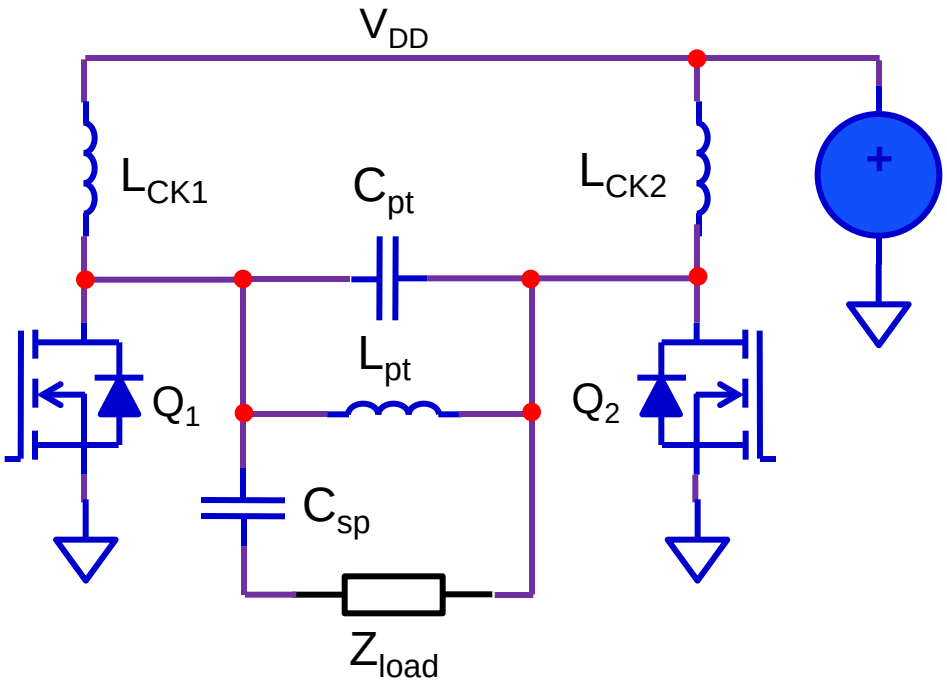


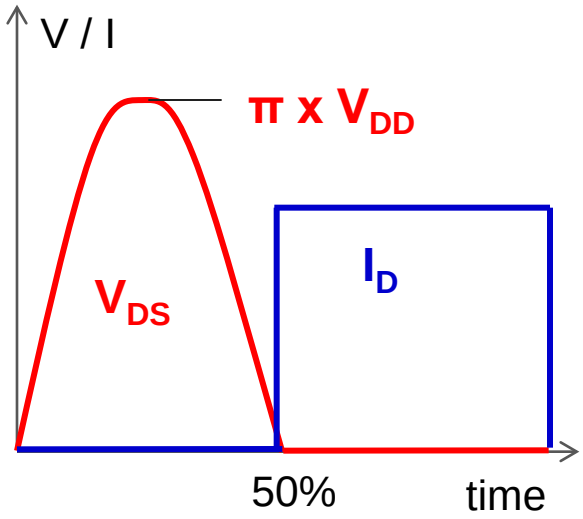
Voltage Mode Class D Load Effect



Current Mode Class D

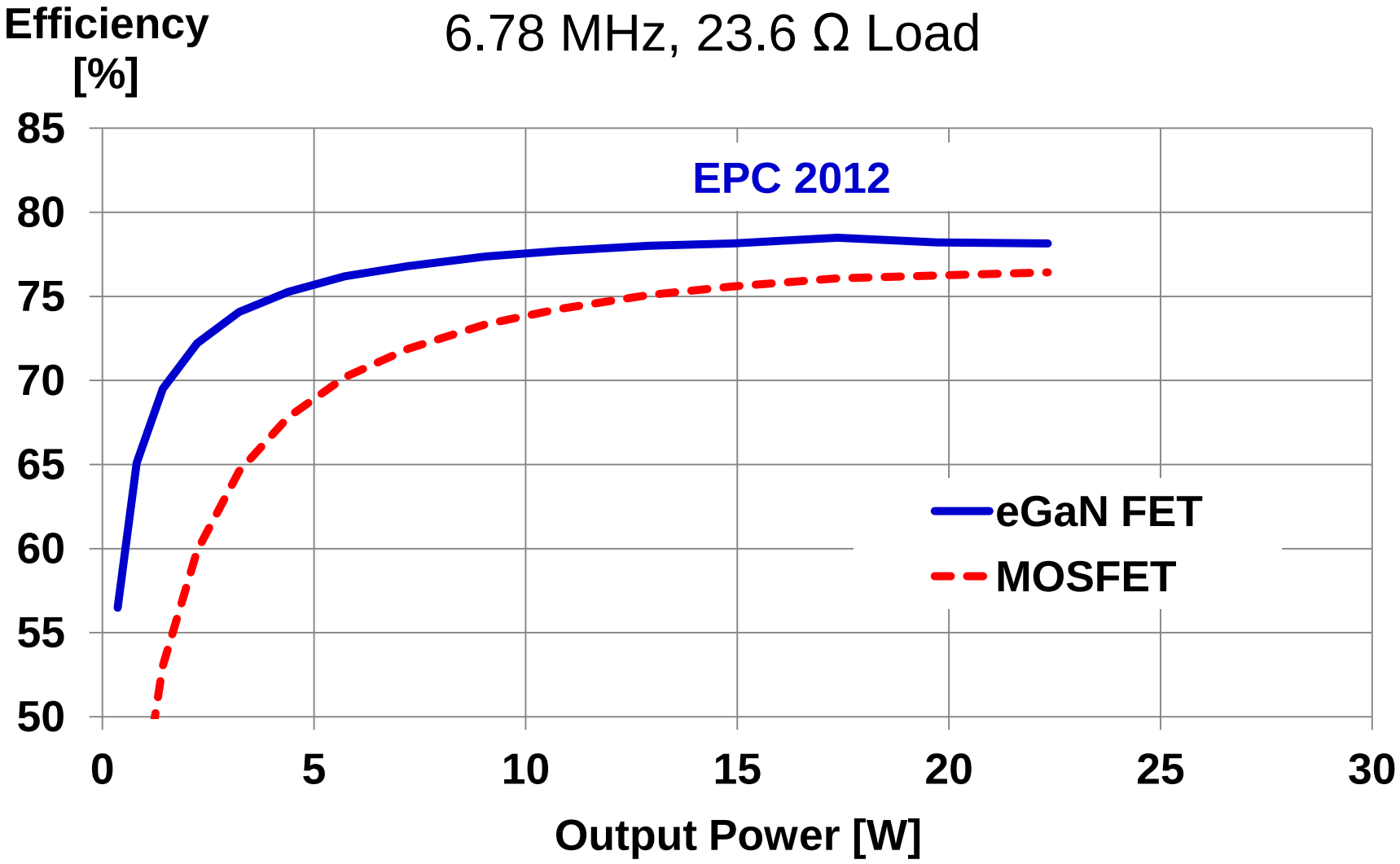
- EPC2012 has lower FoM than MOSFET
- C_{OSS} is absorbed into matching network.





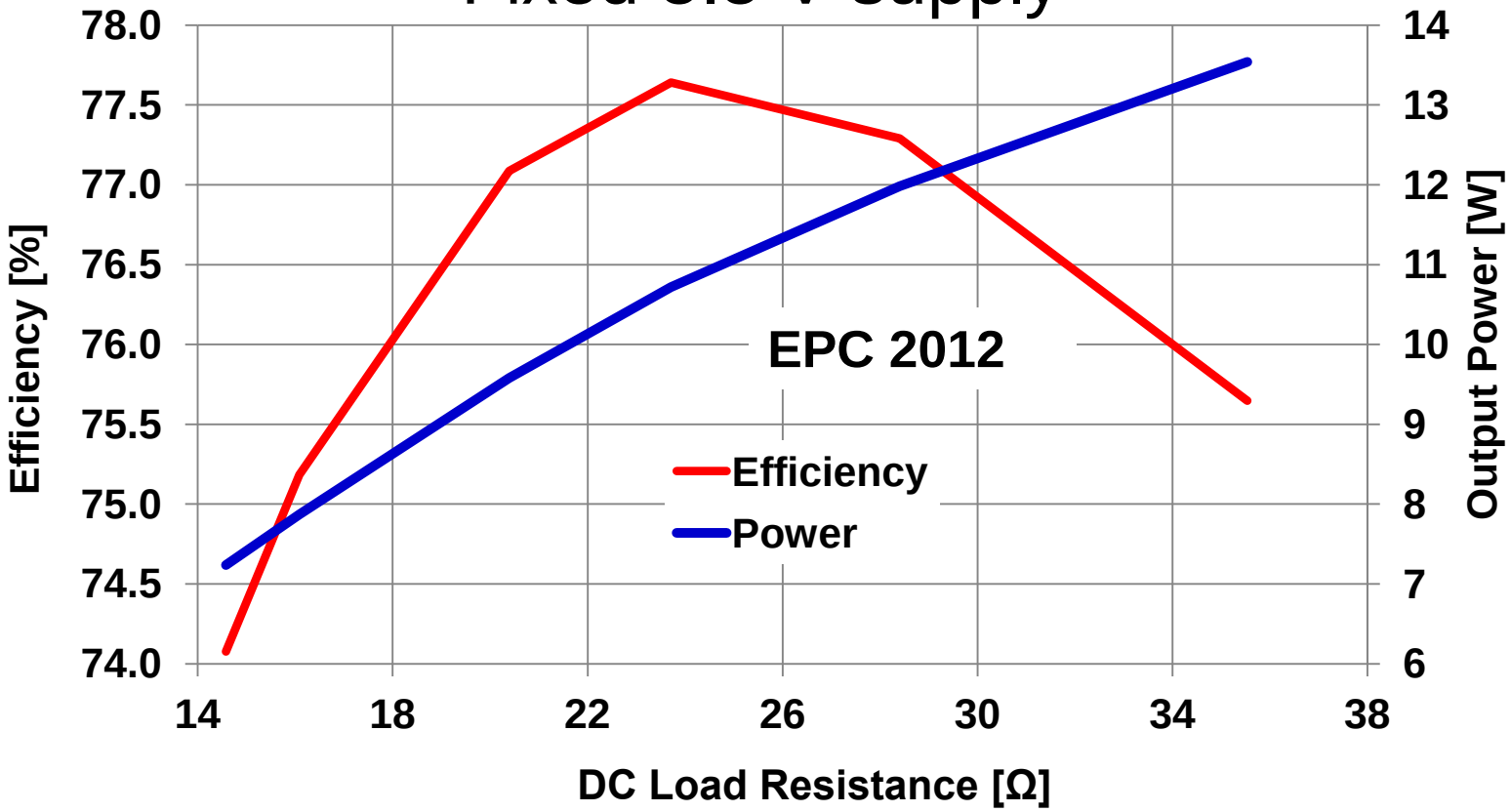
Ideal Waveforms

Current Mode Class D Efficiency



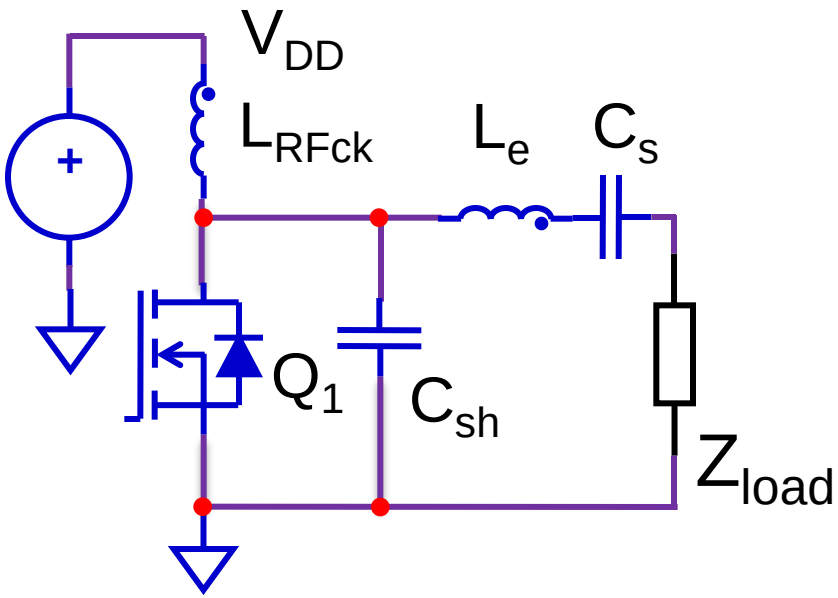
Current Mode Class D Load Effect

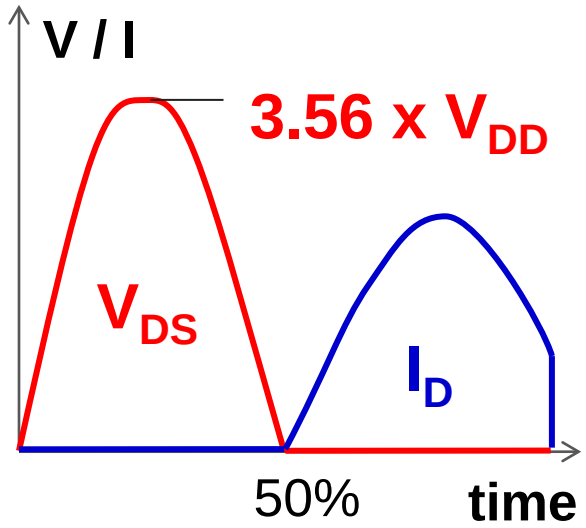
•Fixed 5.5 V supply



Class E Overview

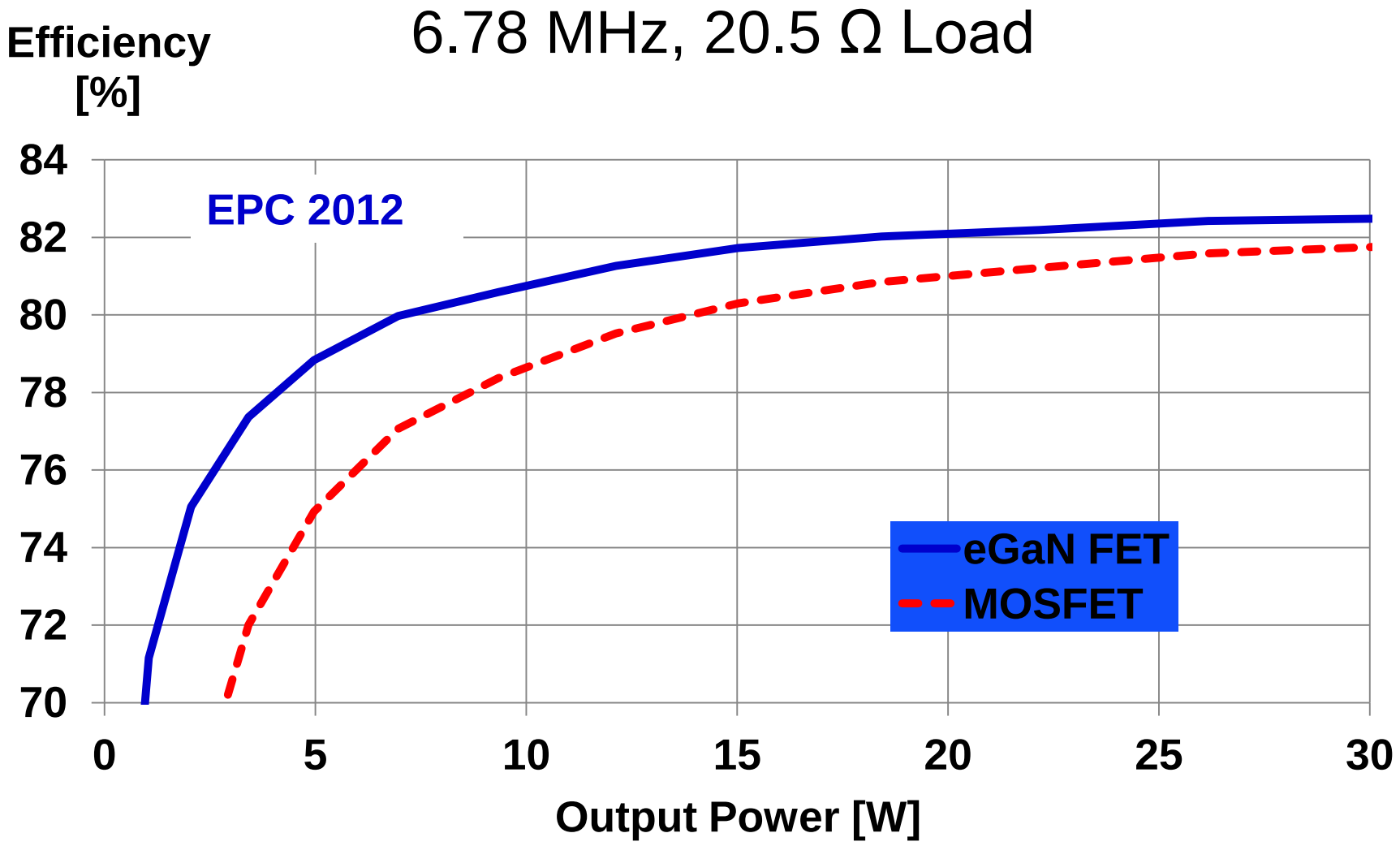
- Switch voltage rating = > 3.56·Supply (V_{DD}).
- C_{OSS} “absorbed” into matching network.



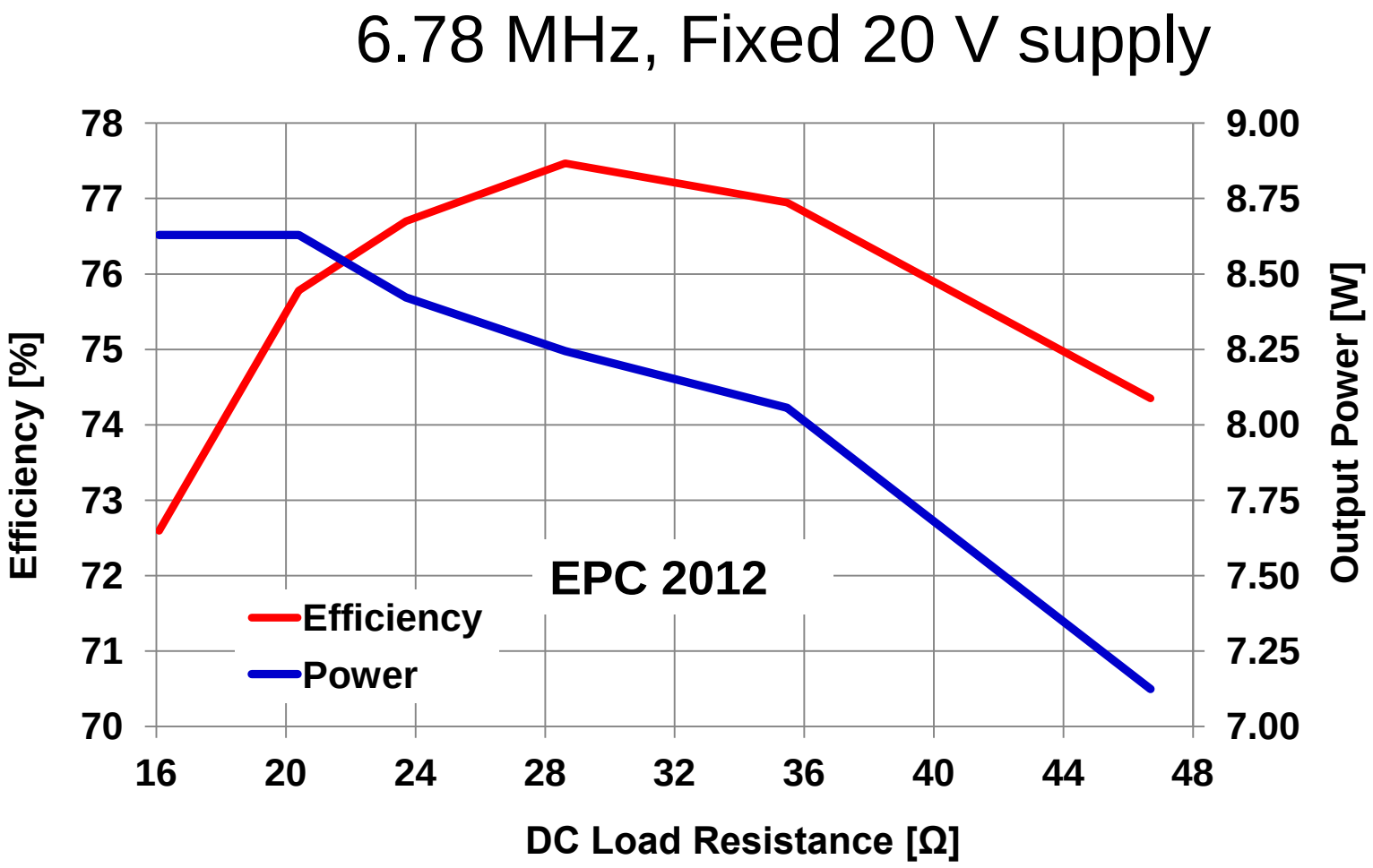


Ideal Waveforms

Class E Efficiency as Function of Load



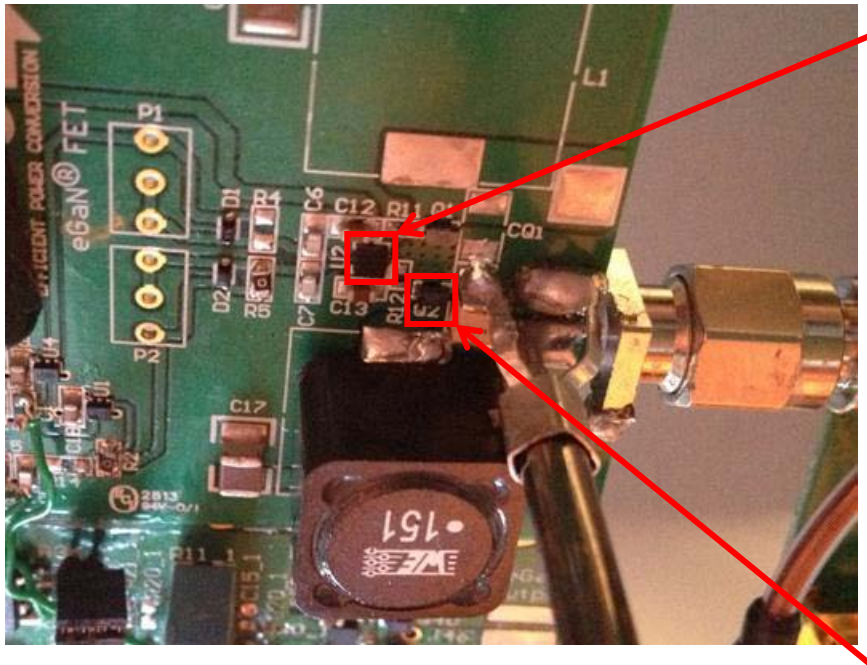
Class E Load Effect

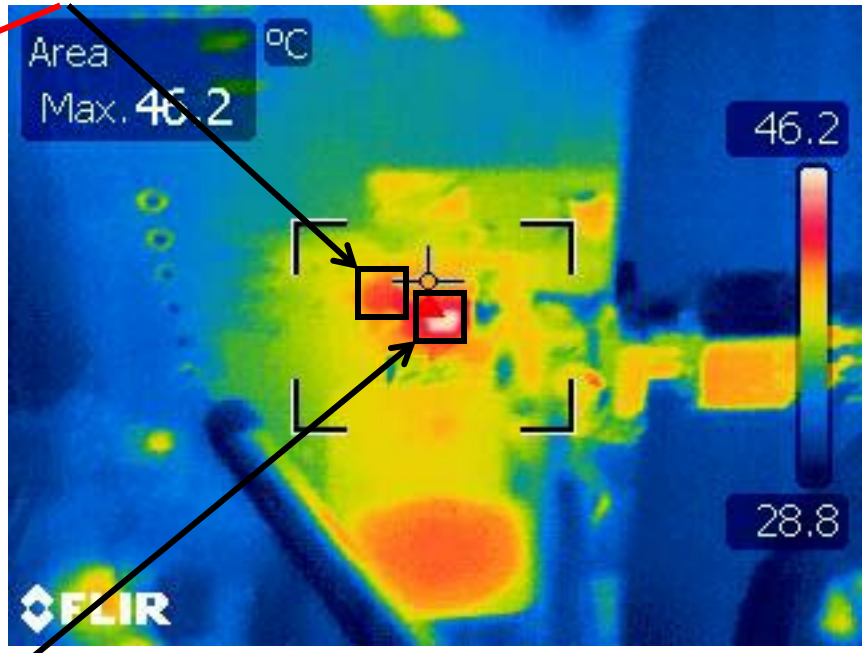


Class E Thermal Performance

- NO HEAT-SINK
- 30 W , 20.2 Ω Load

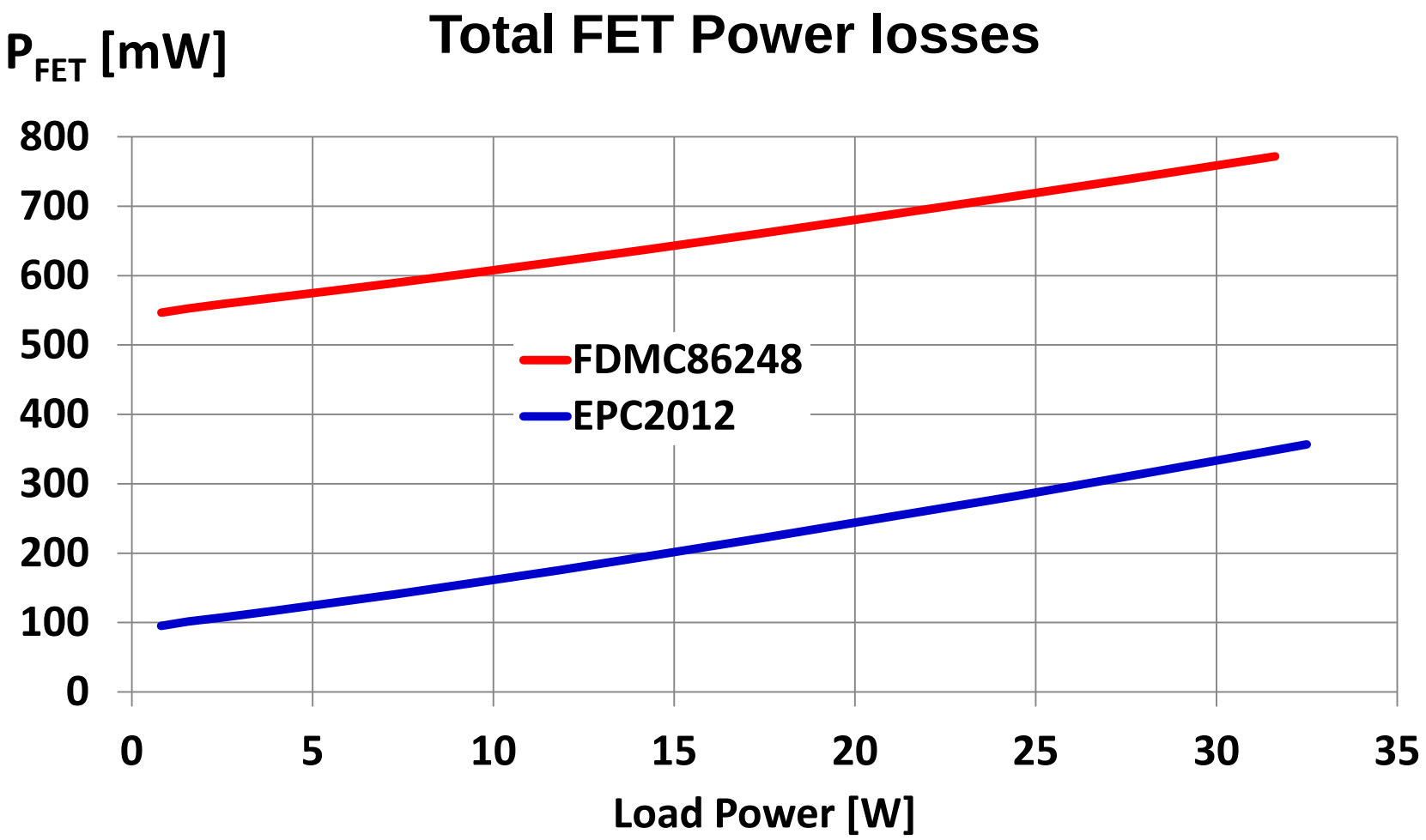
LM5113TM





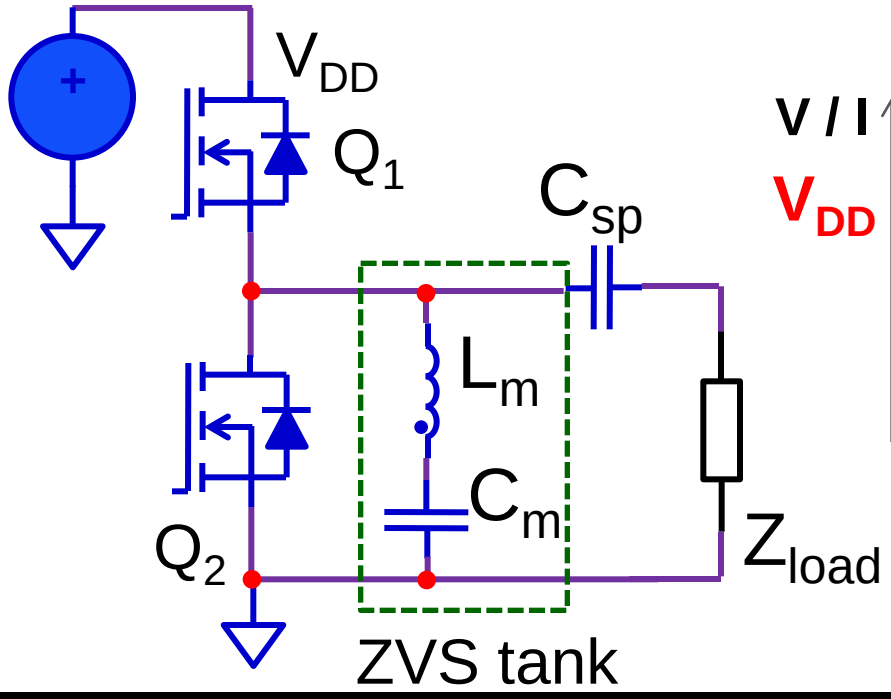
EPC2012

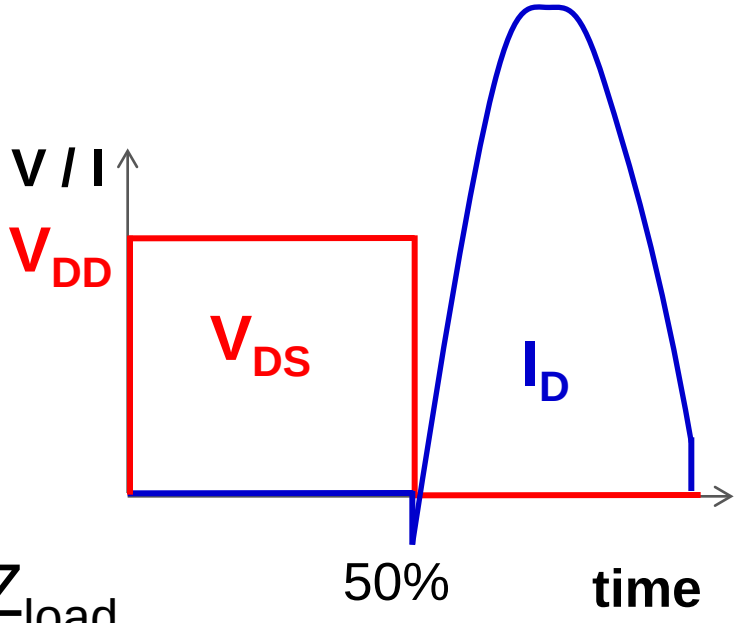
Class E – eGaN FET vs. MOSFET



ZVS Voltage Mode Class D

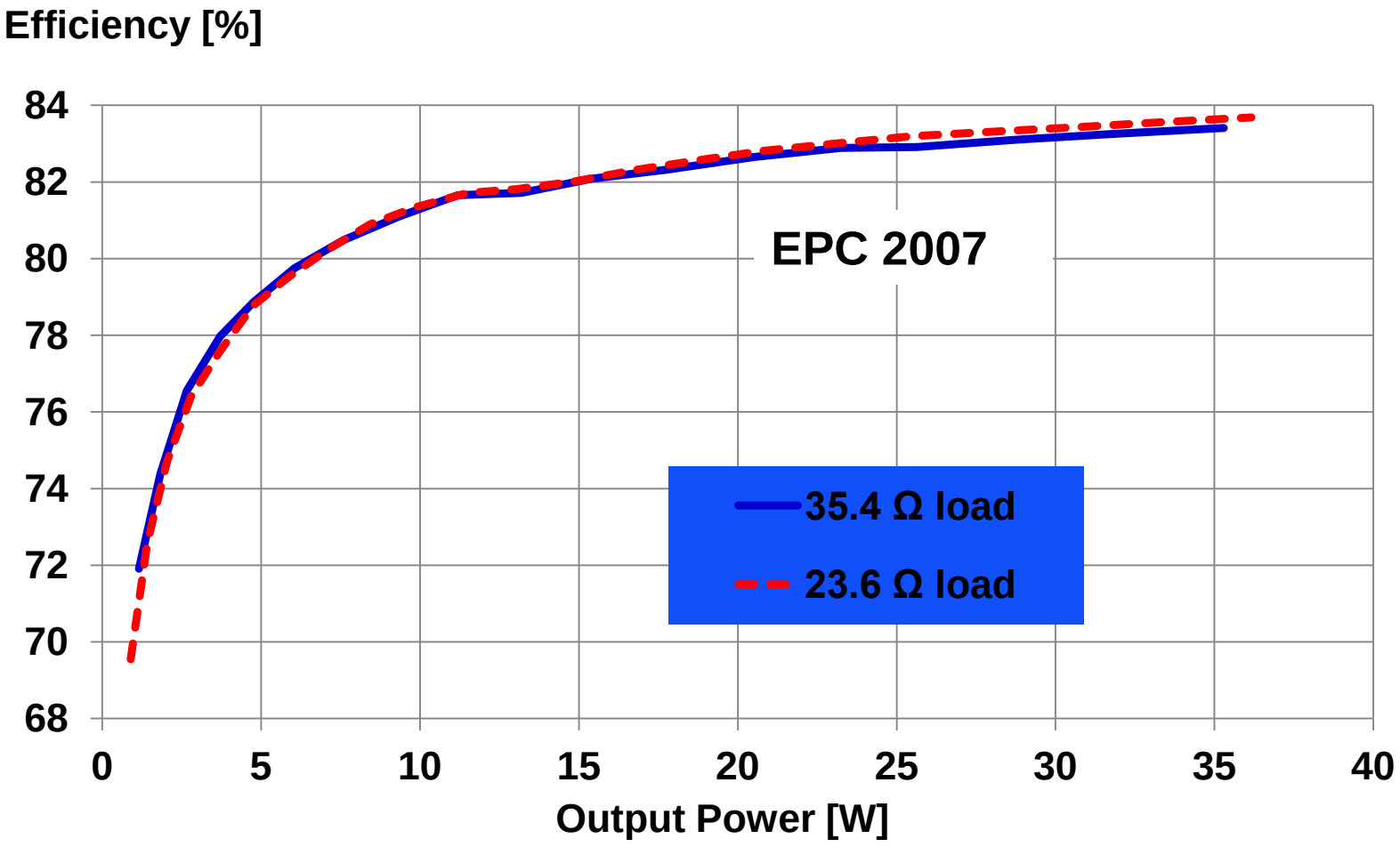
- C_{OSS} Voltage is transitioned by the ZVS tank
- Lower eGaN FET C_{OSS} leads to higher available duty cycle
- Highest system efficiency



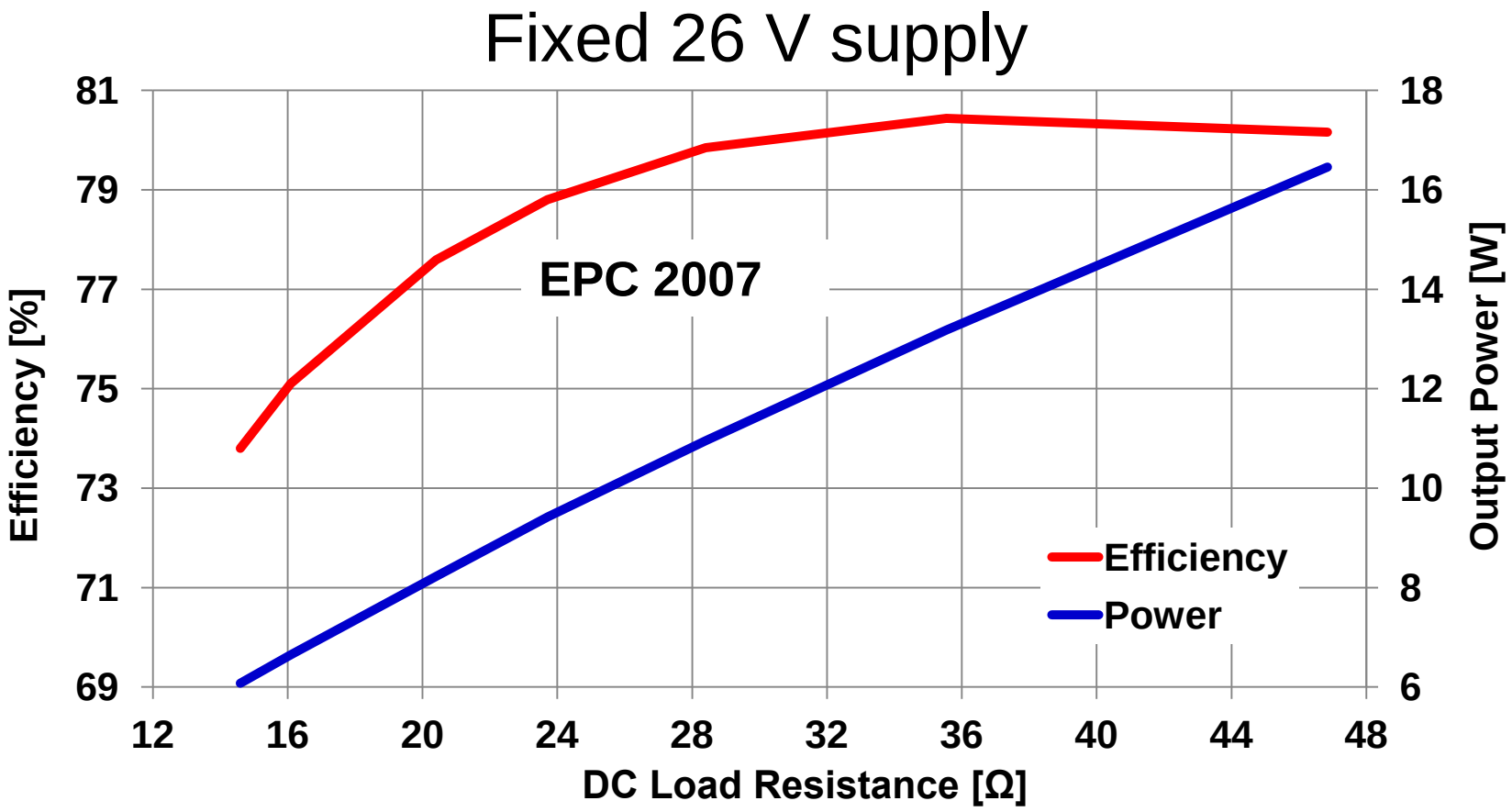


Ideal Waveforms

ZVS Voltage Mode Class D Efficiency

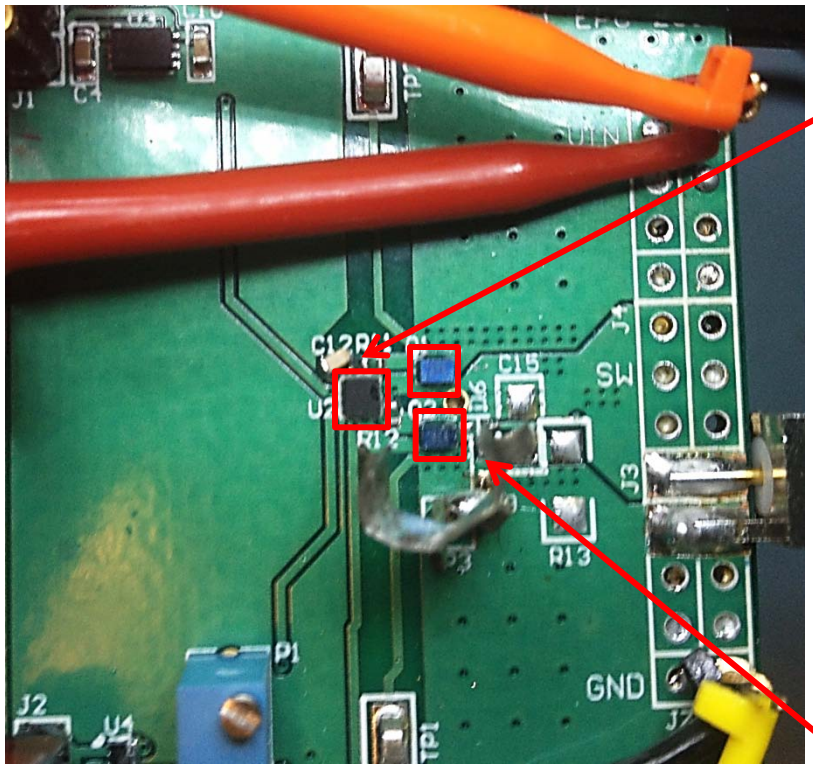


ZVS Voltage Mode Class D Load Effect

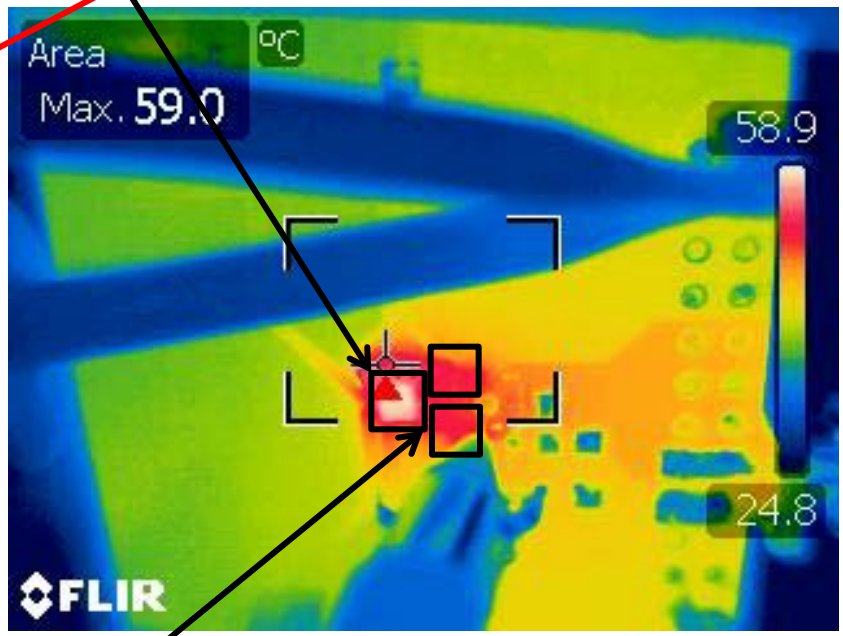


ZVS Class D Thermal Performance

- NO **HEAT-SINK**
- R_{DCLoad} = 35 Ω, V_{in} = 42 V, P_{out} = 35 W, f = 6.78 MHz

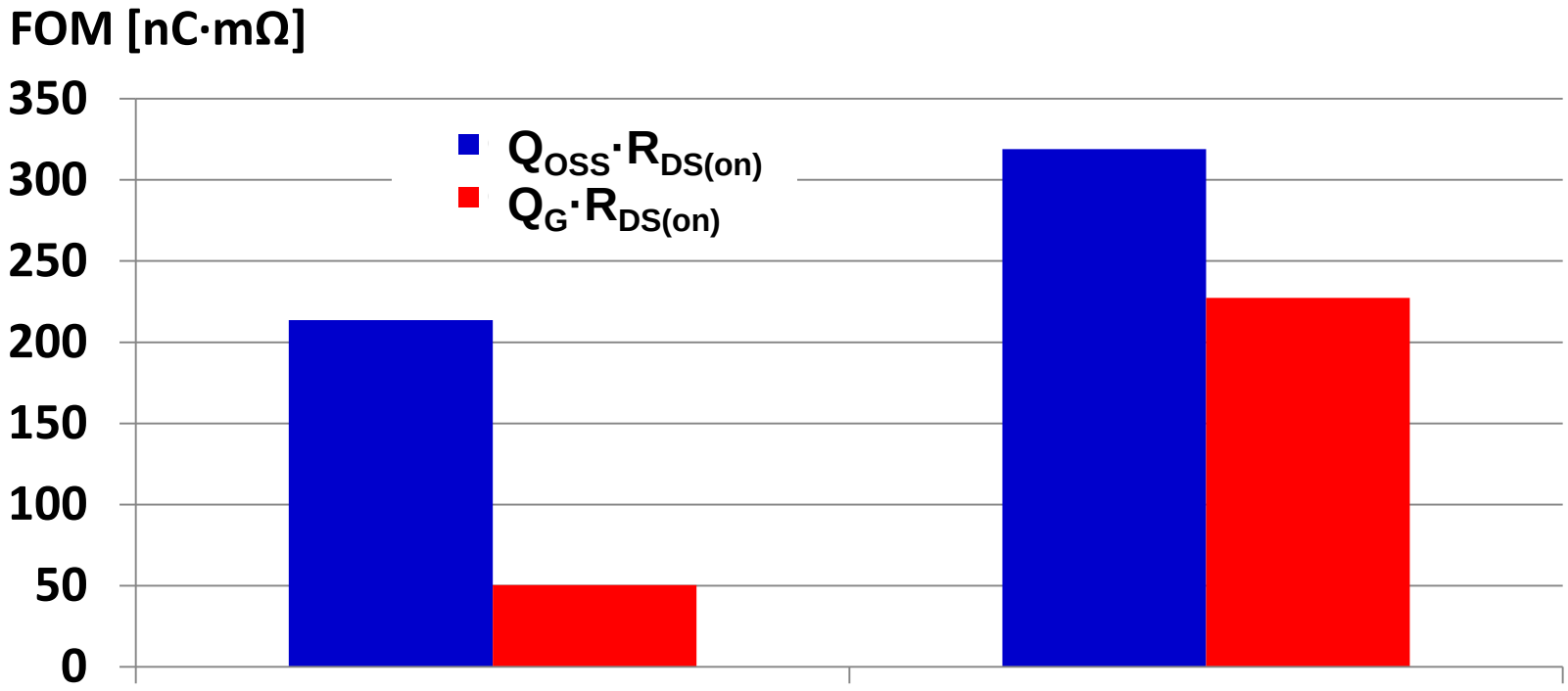


LM5113TM



EPC2007

ZVS Class D FoM Comparison



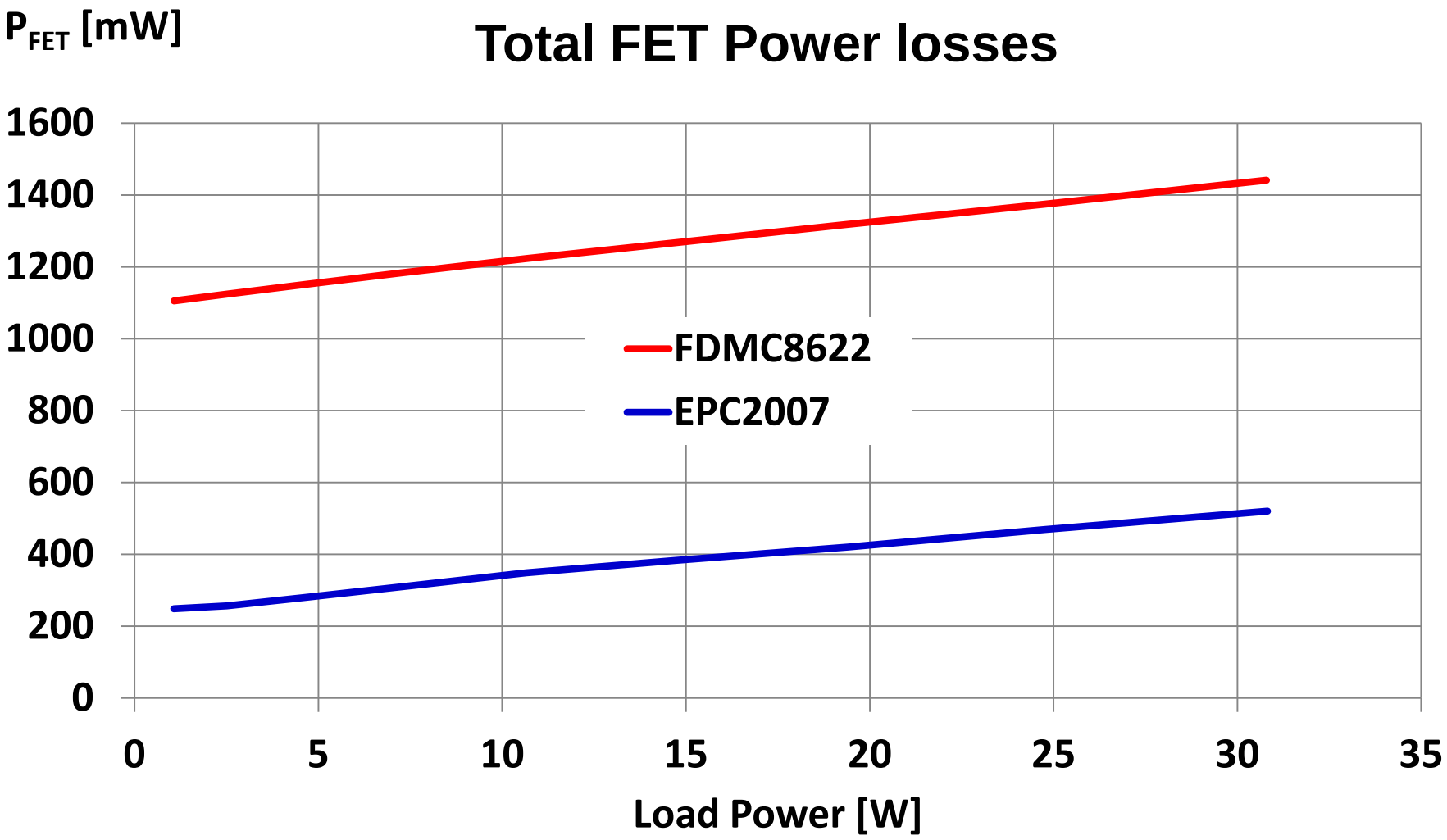
EPC2007

BV_{DSS} = 100 V
Q_{OSS} = 8.9 nC at 40 V
Q_G = 2.1 nC at 5 V
$R_{DS(on)}$ = 24 mΩ

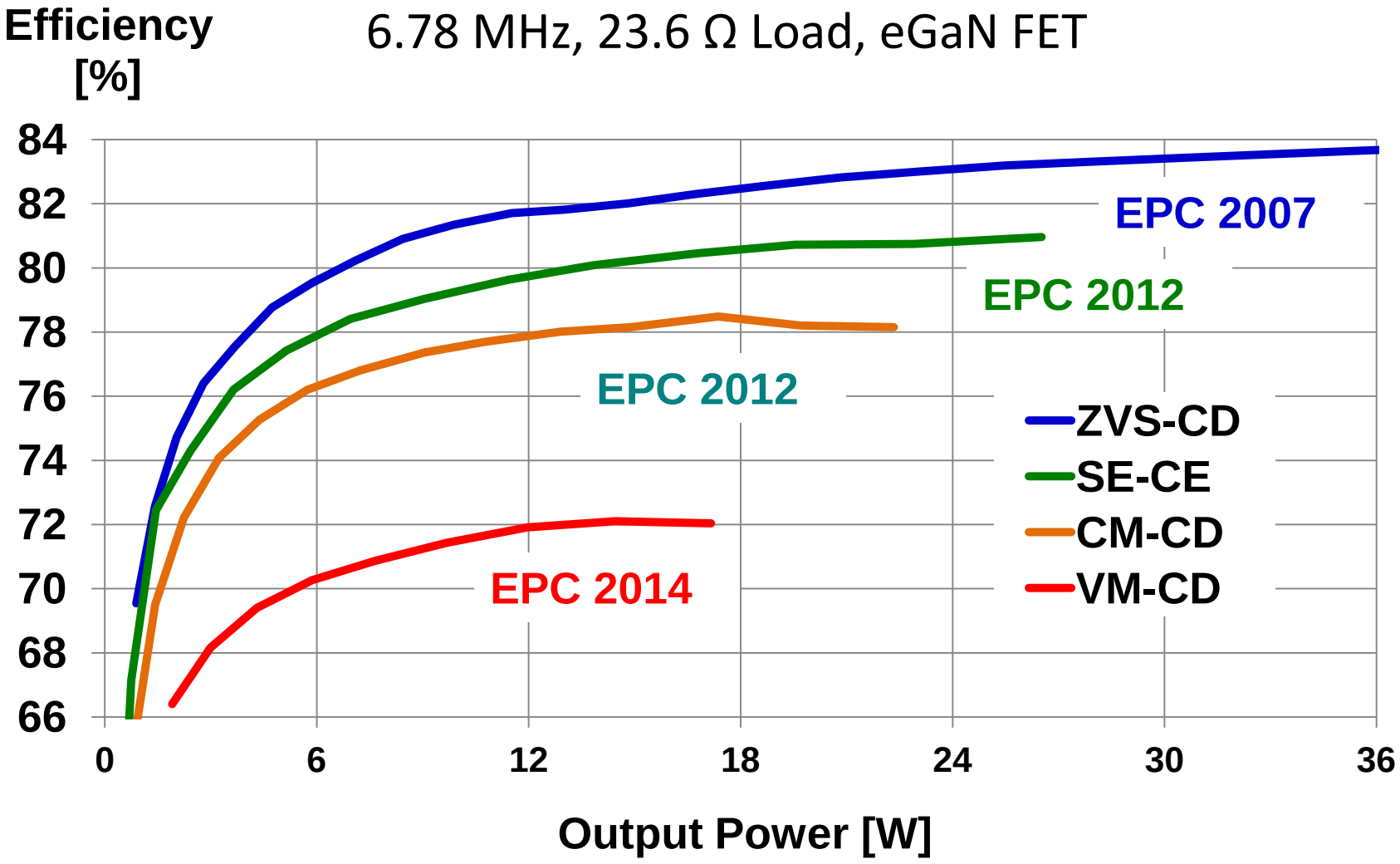
FDMC8622

BV_{DSS} = 100 V
Q_{OSS} = 7.3 nC at 40 V
Q_G = 5.2 nC at 10 V
$R_{DS(on)}$ = 43.7 mΩ

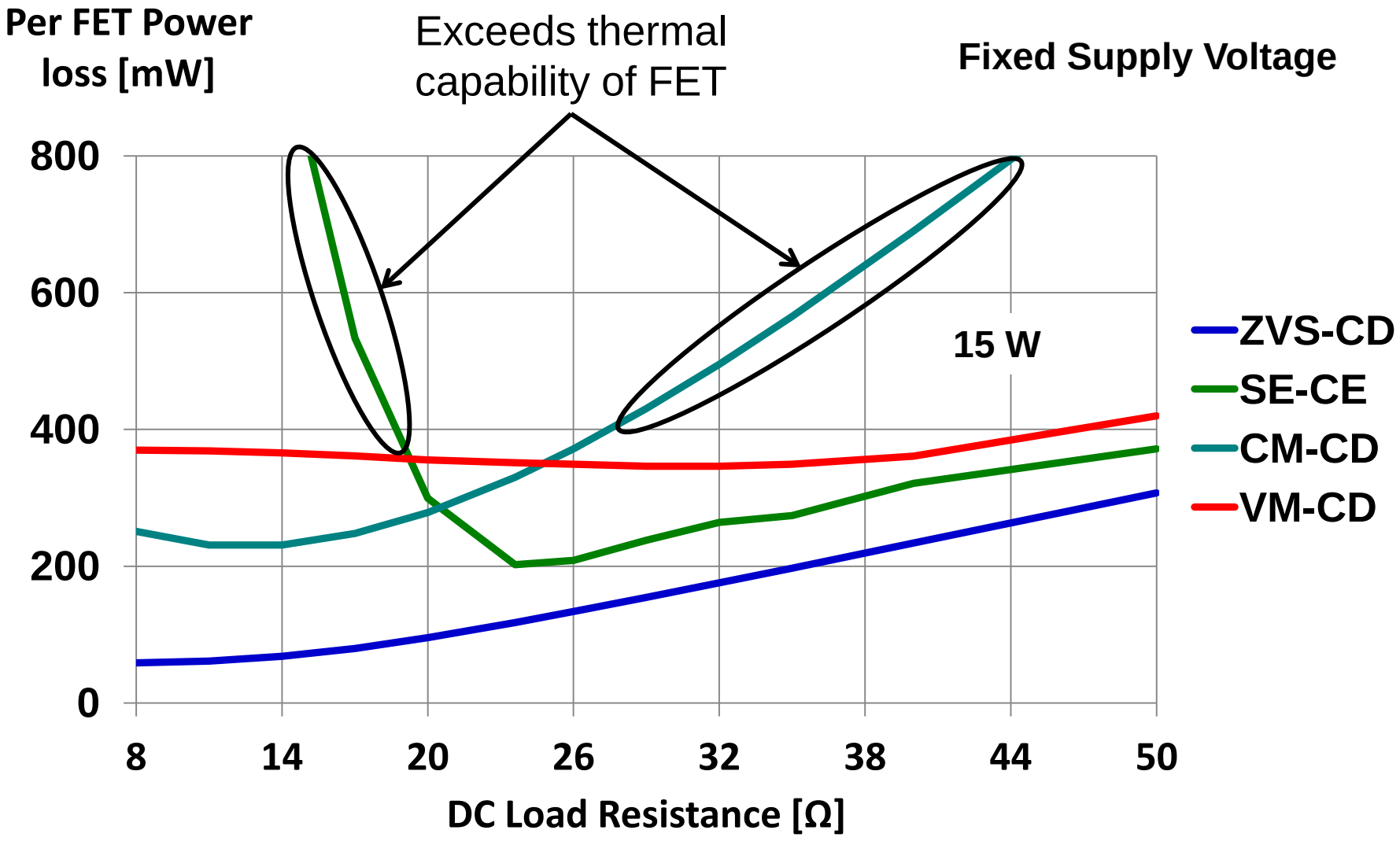
ZVS Class D – eGaN FET vs. MOSFET



Summary of Efficiency Results



Simulated FET Losses – All Topologies



Summary

- Wireless Power Transmission is one of the largest potential markets for power transistors.
- ZVS Class D shows great promise for a simple, low cost, and high efficiency topology for wireless power. eGaN FETs enable greater duty cycle and higher efficiency.
- eGaN FETs enable the highest efficiency in all topologies using 6.78 MHz and 13.56 MHz frequencies.
- eGaN® technology is disruptive.

EFFICIENT POWER CONVERSION

The end of the road for silicon…..

is the beginning of the eGaN FET journey!