

Improvements in Hard- and Soft-Switching Applications with GaN Transistors

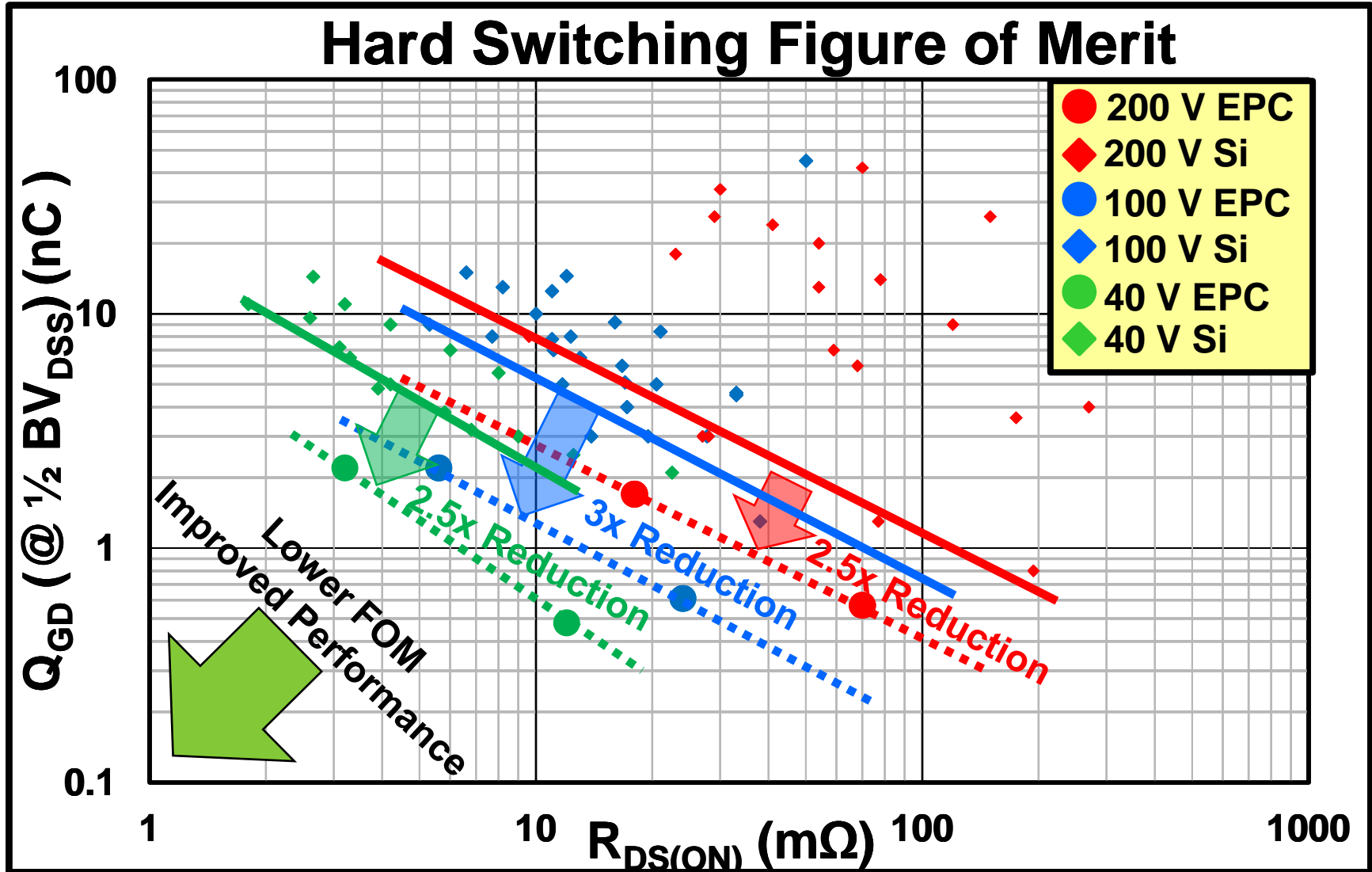
Michael de Rooij, Johan Strydom,
David Reusch and, Alex Lidow
Efficient Power Conversion

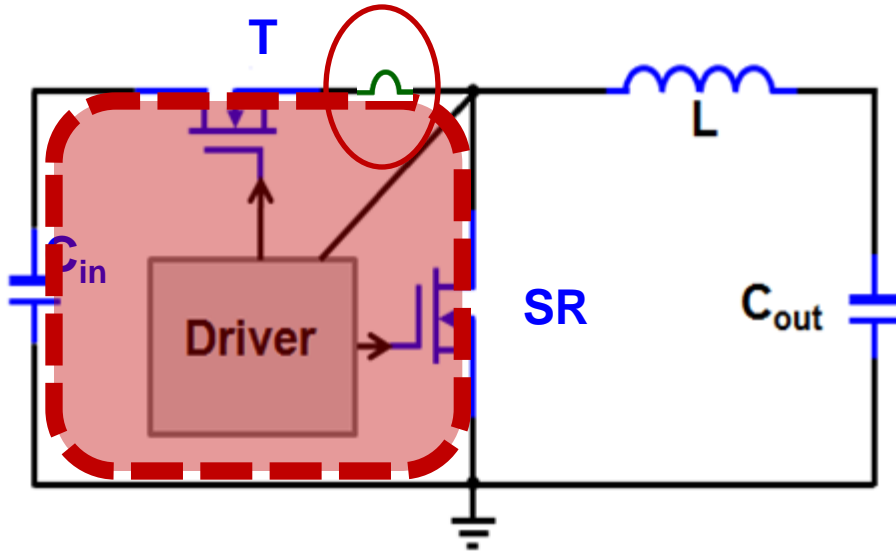


Key Applications



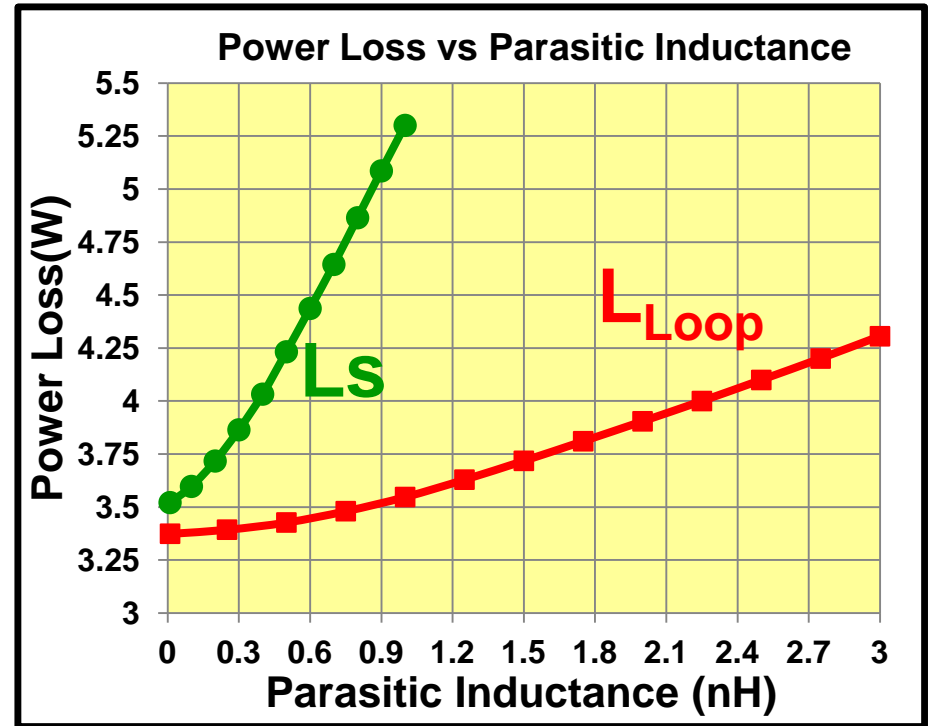
- **Point of Load Modules** HARD Switching
- **RF DC-DC “Envelope Tracking”**
- **Wireless Power Transmission** SOFT Switching
- **Network and Server Power Supplies**
- **Radiation Hard Applications**
- **RF Transmission**
- **Solar Micro-inverters**
- **Energy Efficient Lighting**
- **Class D Audio**





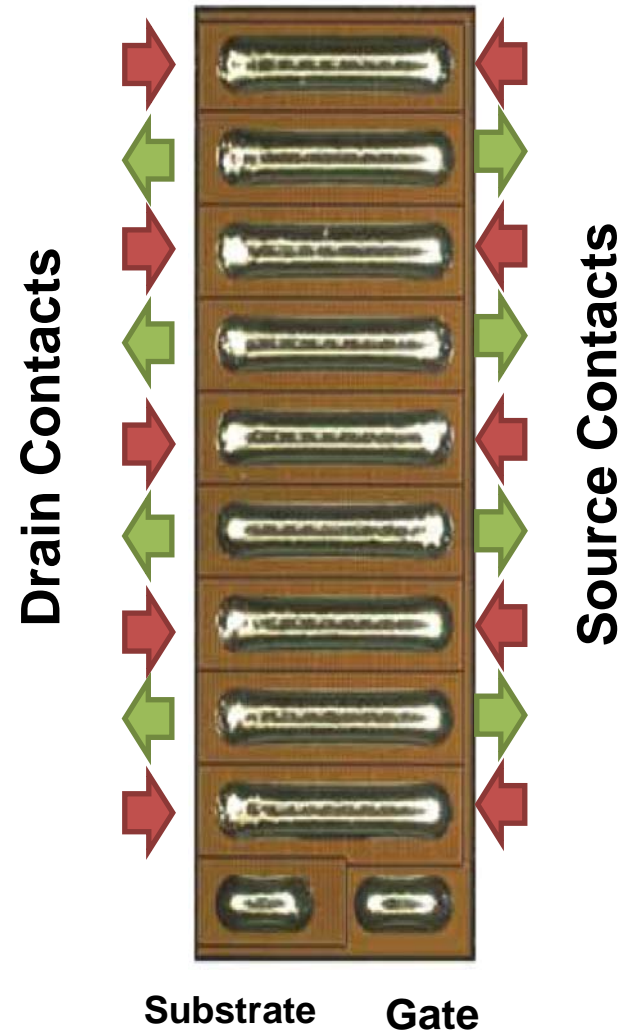
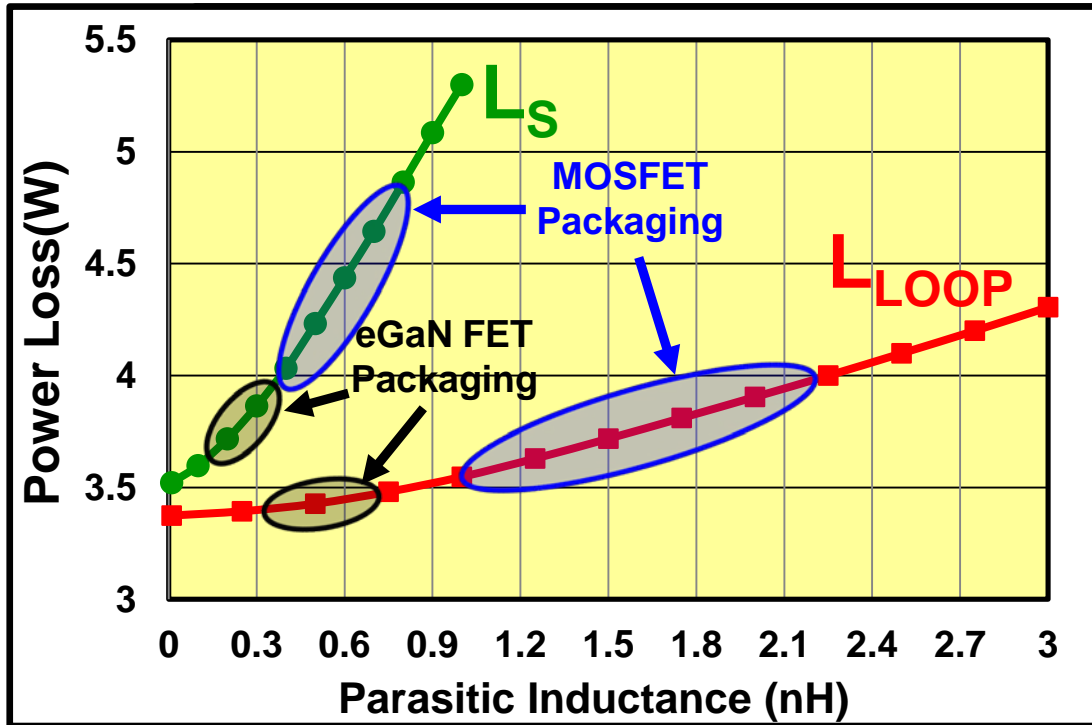
L_S : Common Source Inductance

L_{Loop} : High Frequency Power Loop Inductance



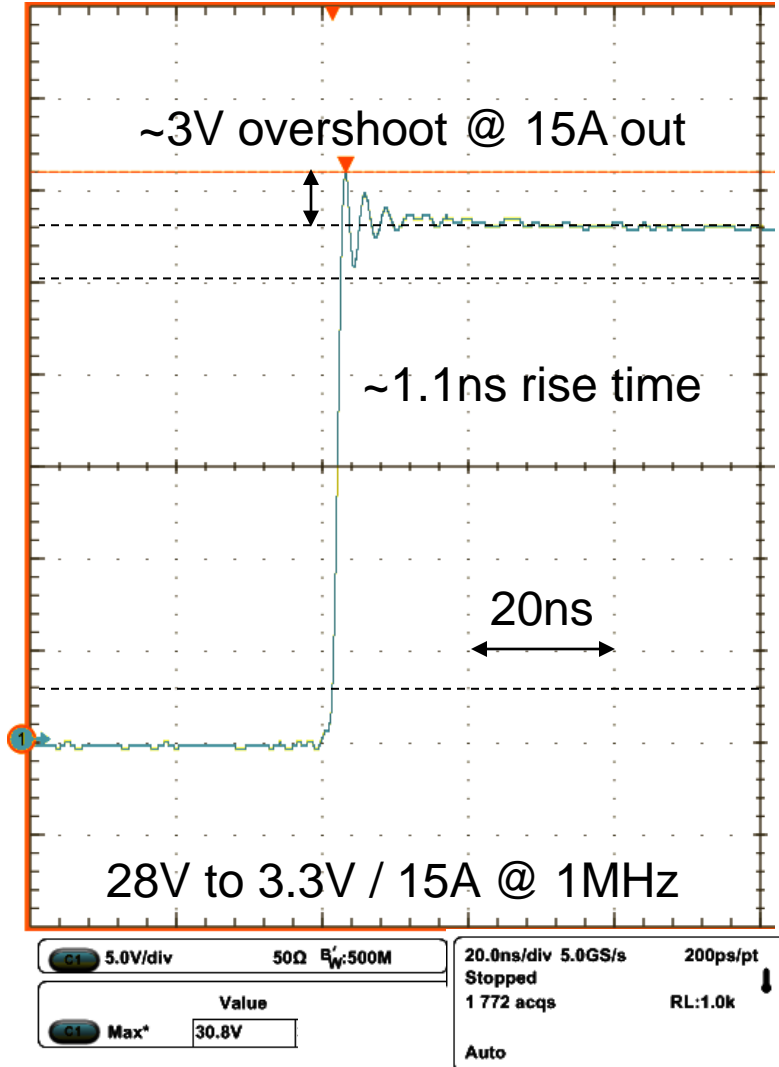
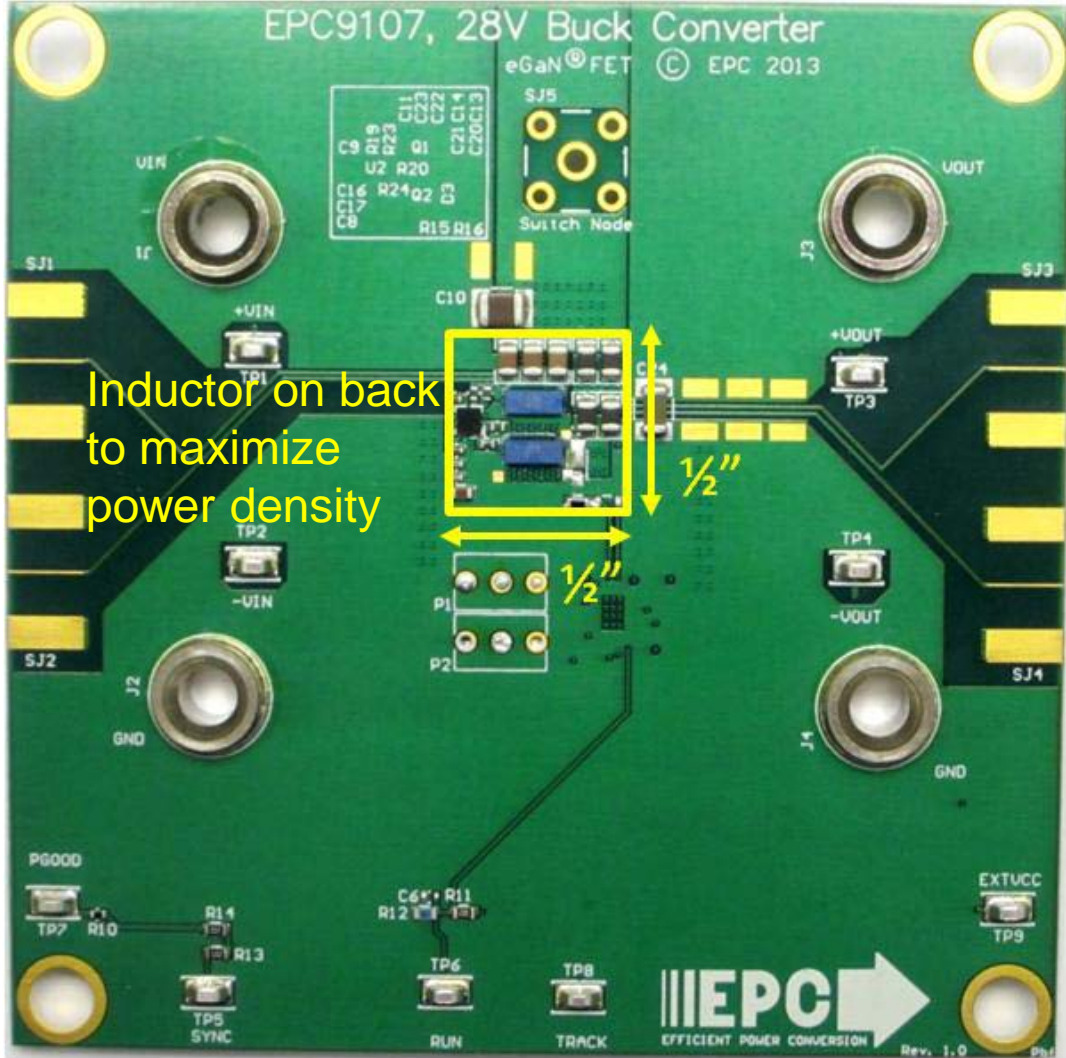
$V_{IN}=12\text{ V}$, $V_{OUT}=1.2\text{ V}$,
 $F_S=1\text{ MHz}$, $I_{OUT}=20\text{ A}$

Interleaving reduces inductance further



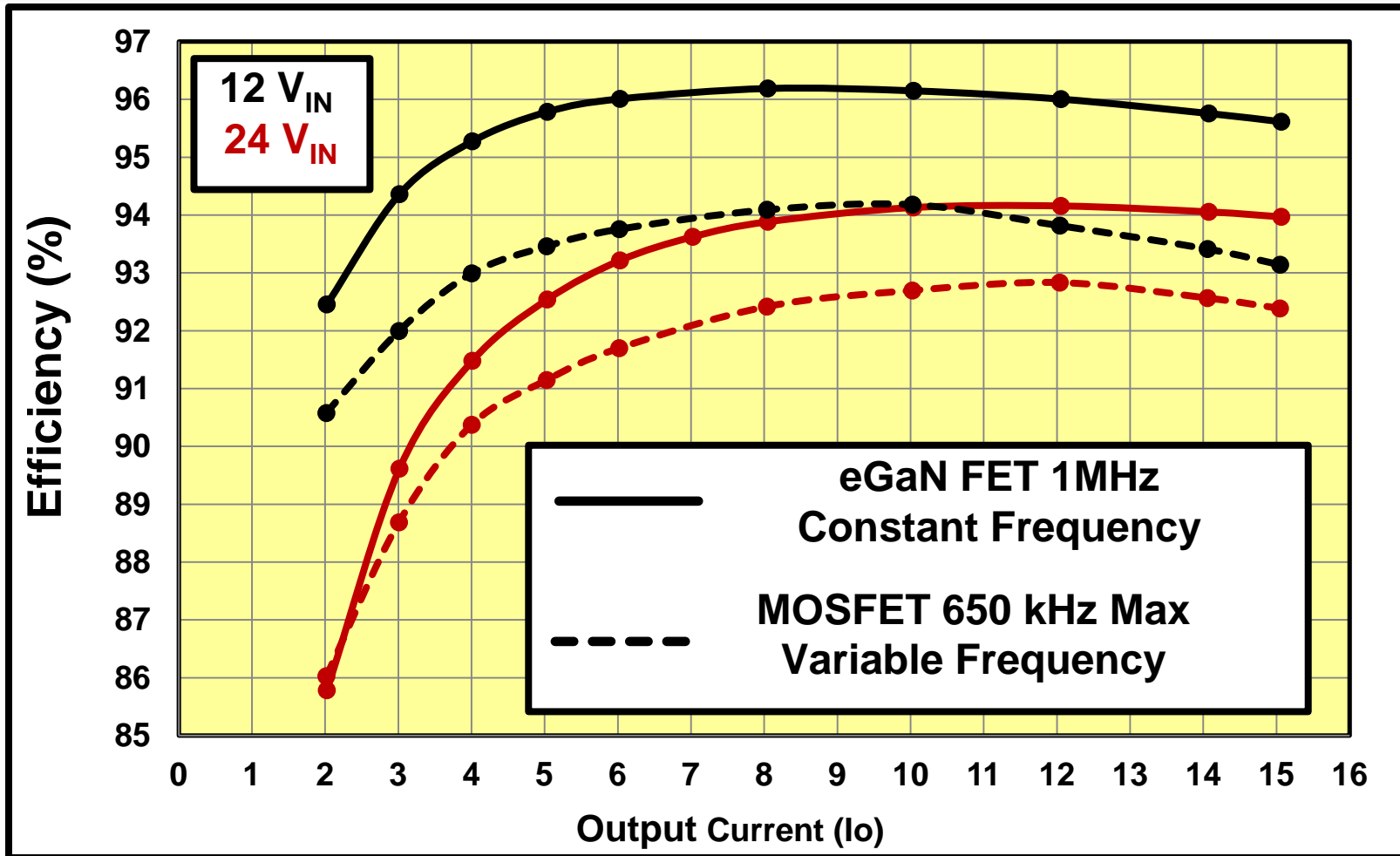
$V_{IN}=12\text{ V}$ $V_{OUT}=1.2\text{ V}$ $I_{OUT}=20\text{ A}$ $F_S=1\text{ MHz}$

EPC9107 Demonstrator





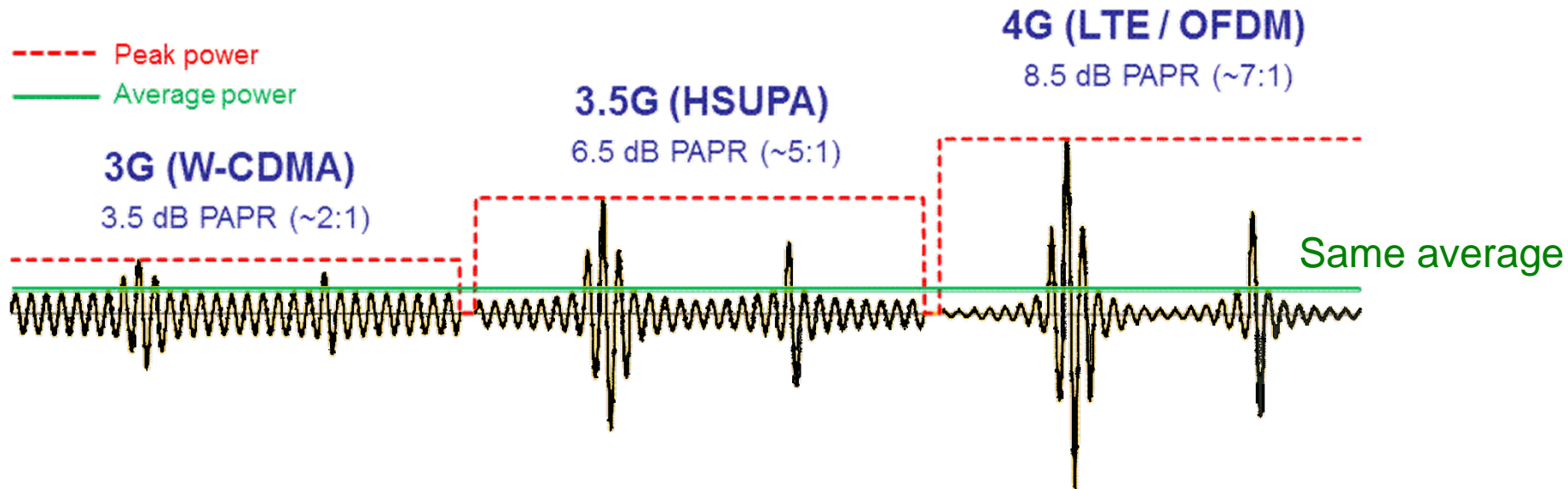
EPC9107 Efficiency Results



$V_{OUT}=3.3\text{ V}$ $F_S=1\text{ MHz}$
GaN T/SR: EPC2015 Driver LM5113

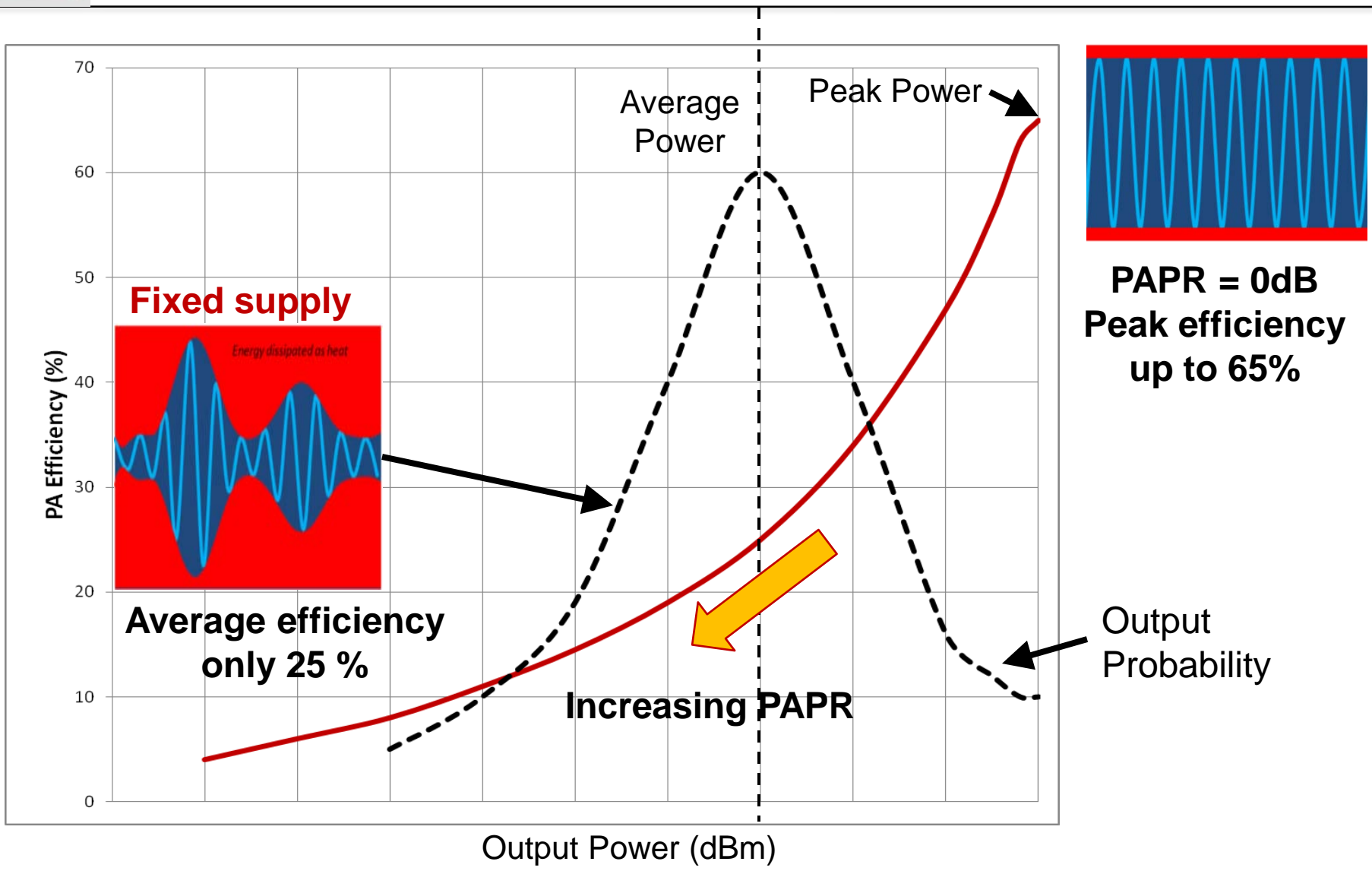


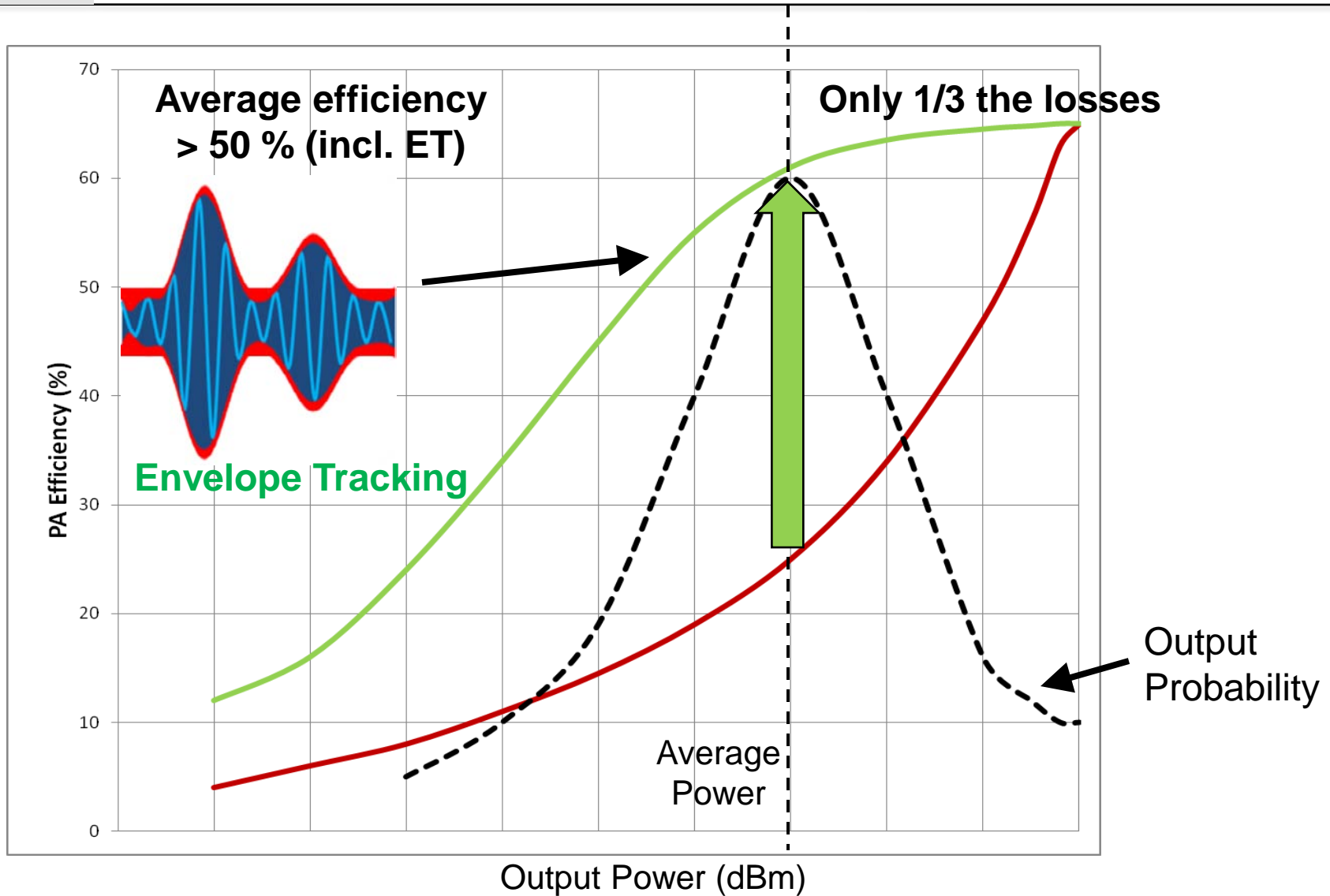
Peak to Average Power Ratio (PAPR)



Reference: Nujira.com website

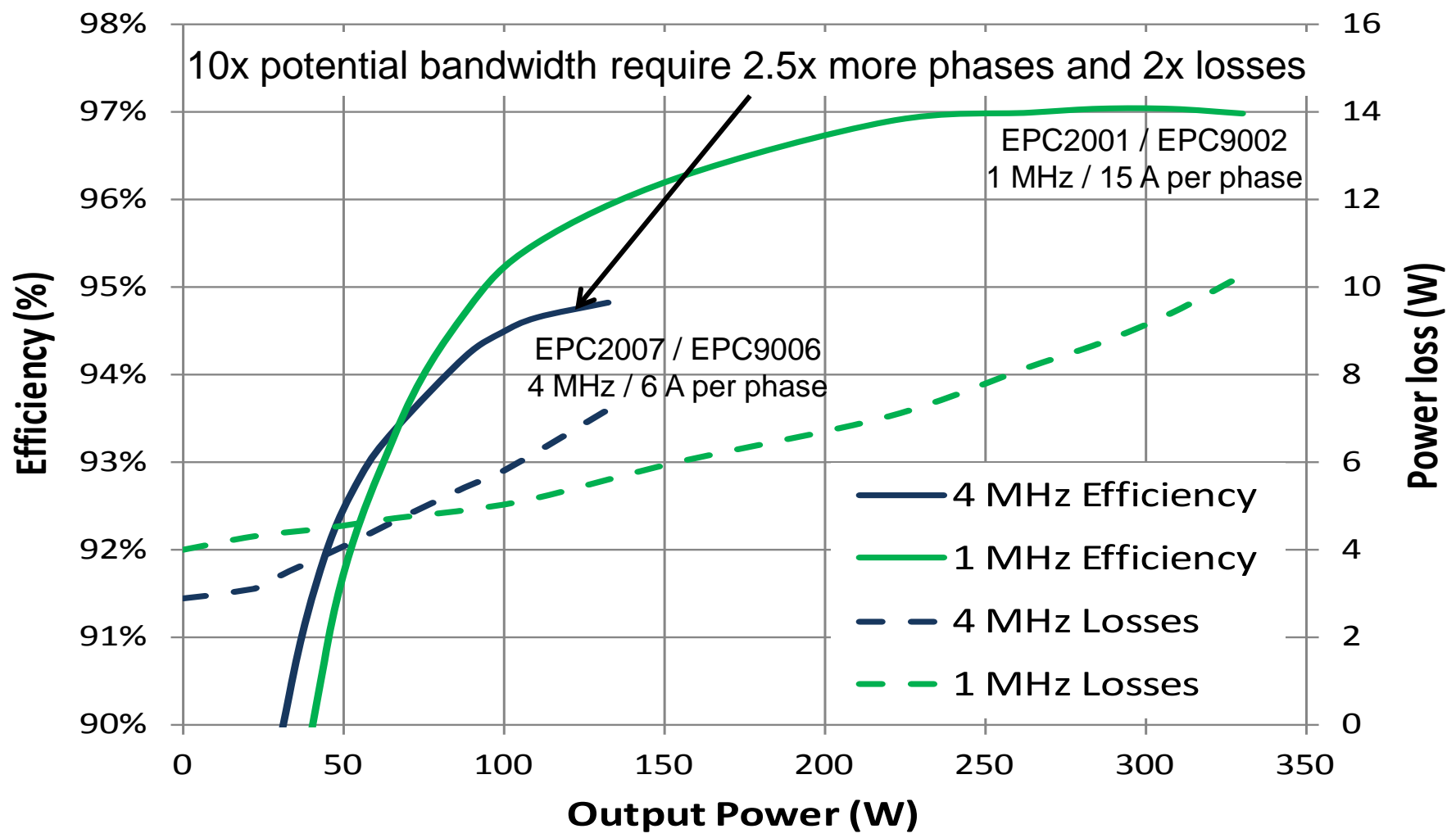
Effect of PAPR

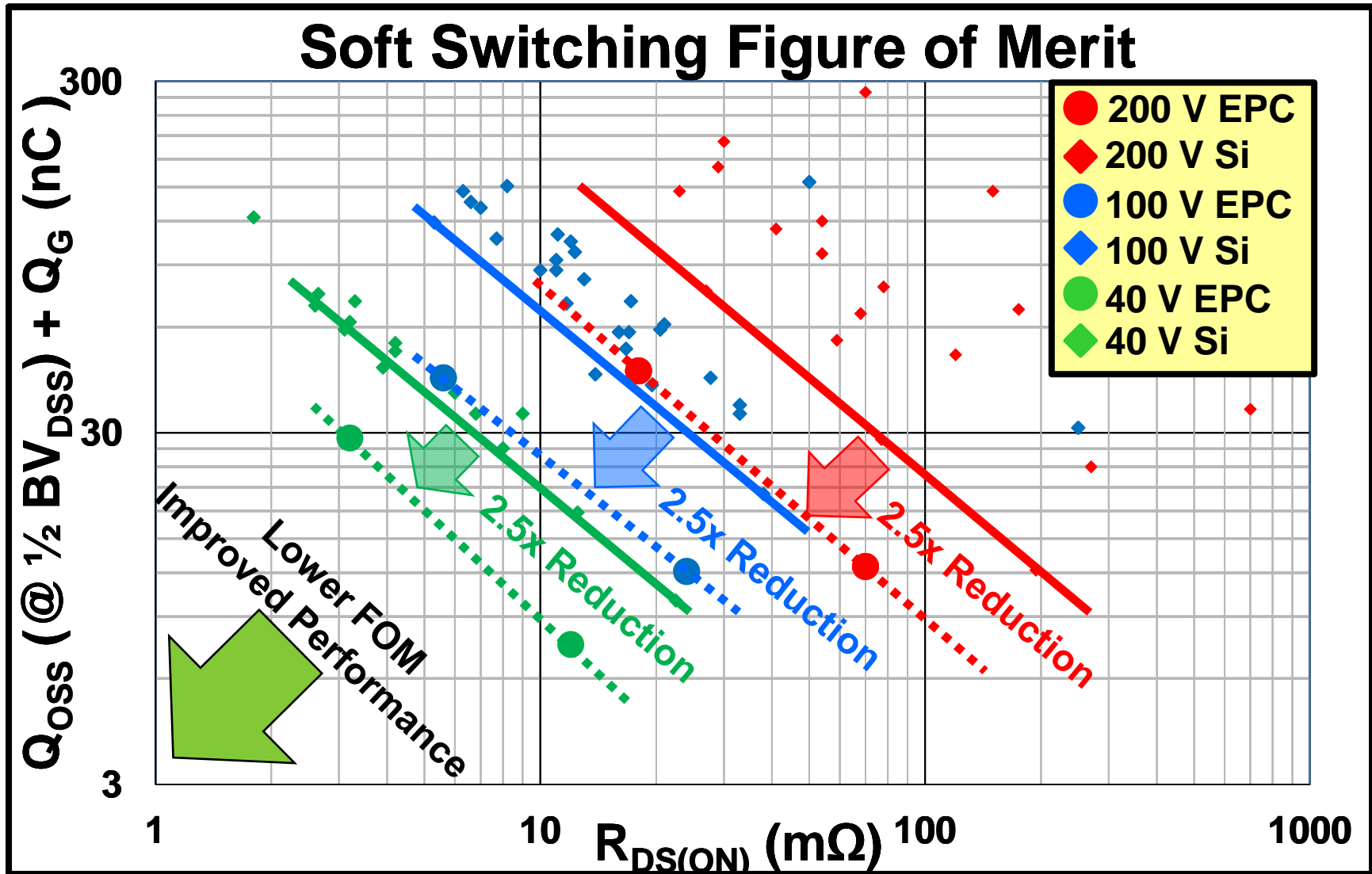




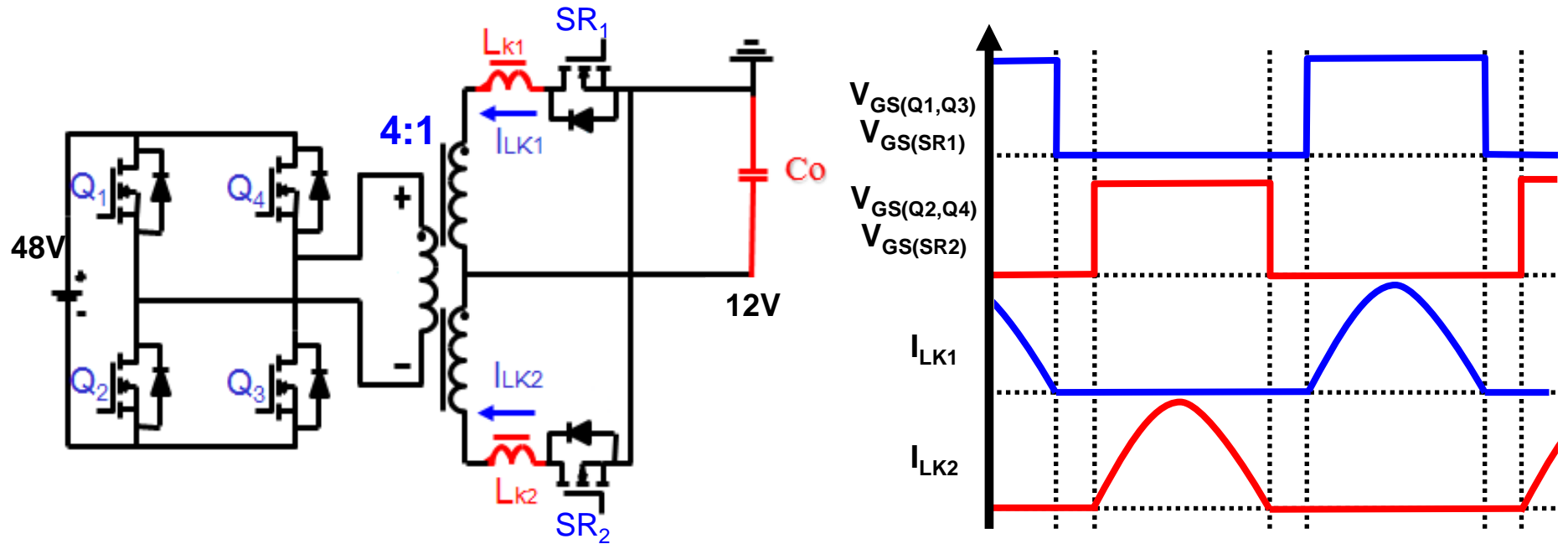


Efficiency Results



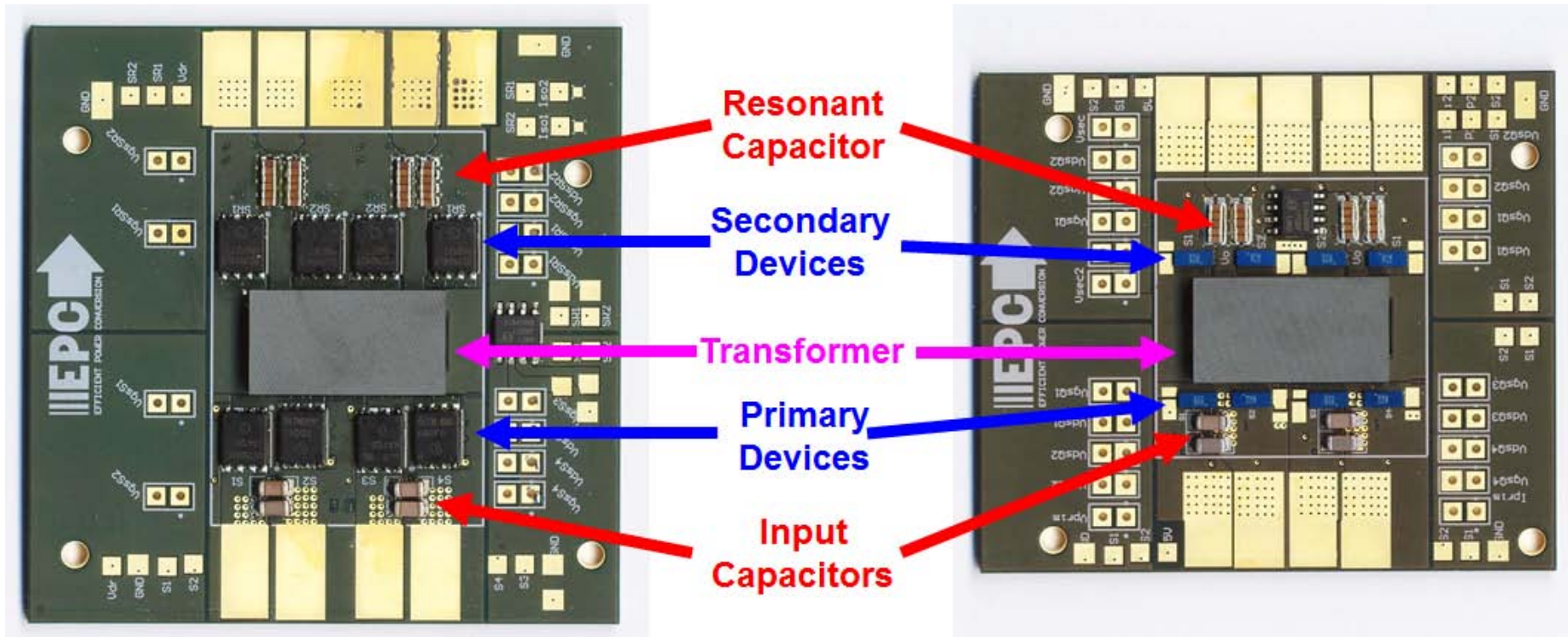


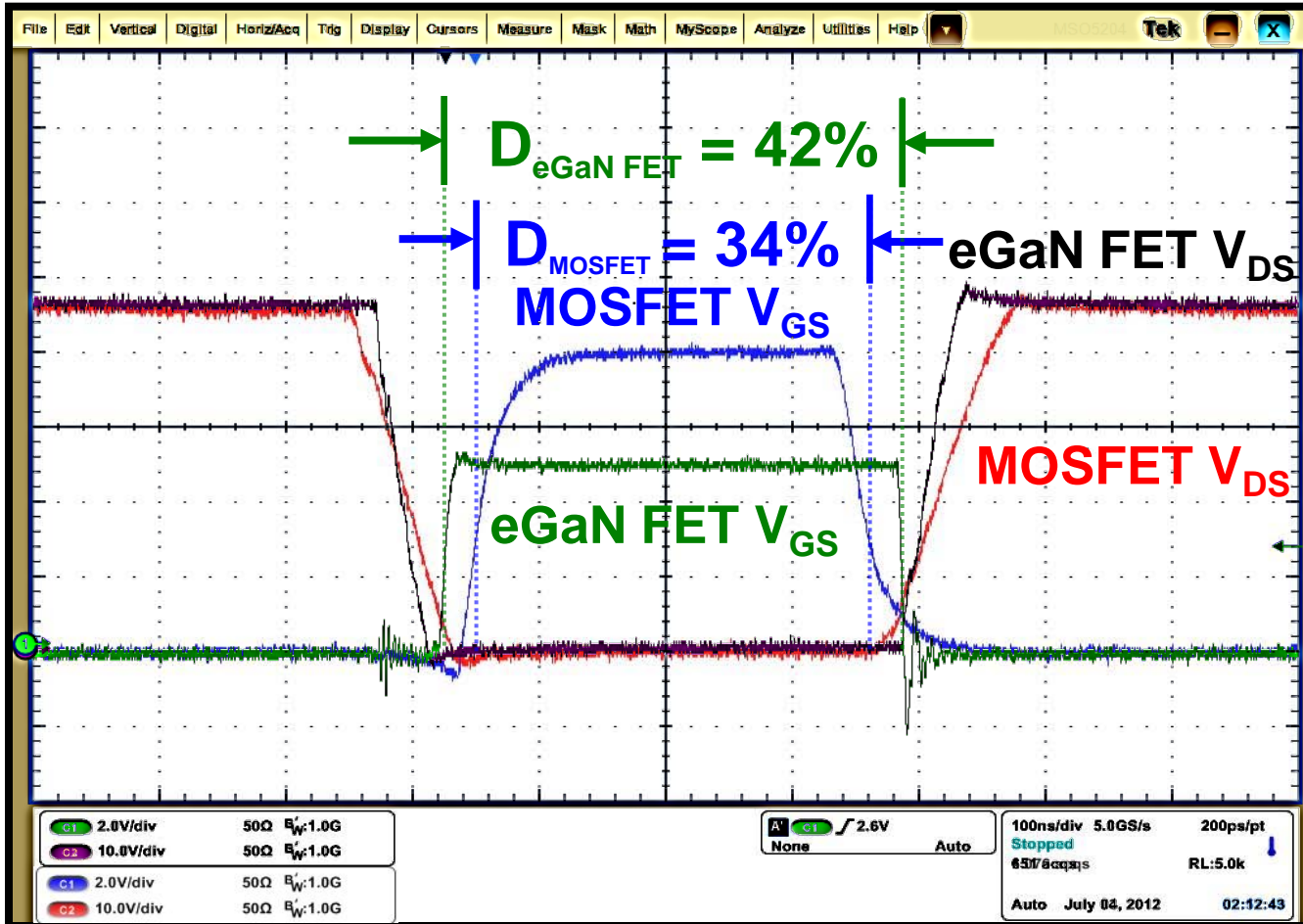
High Frequency DC/DC Transformer



Ref: Y. Ren, M. Xu, J. Sun, and F. C. Lee, "A family of high power density unregulated bus converters," IEEE Trans. Power Electron., vol. 20, no. 5, pp. 1045–1054, Sep. 2005.

eGaN FET vs. MOSFET

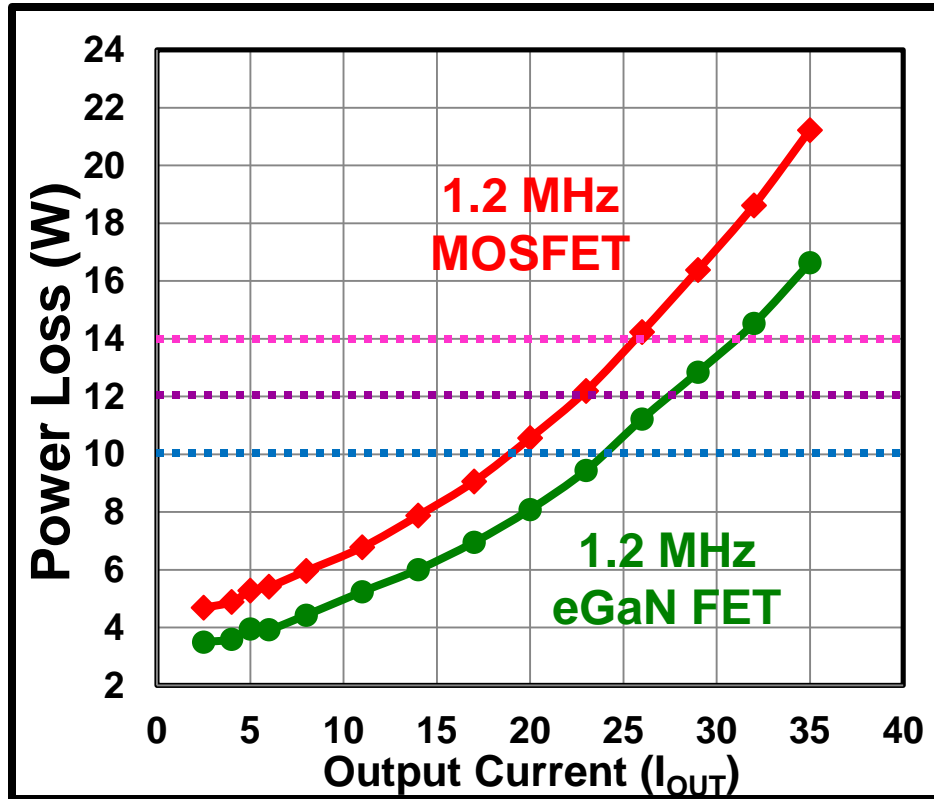
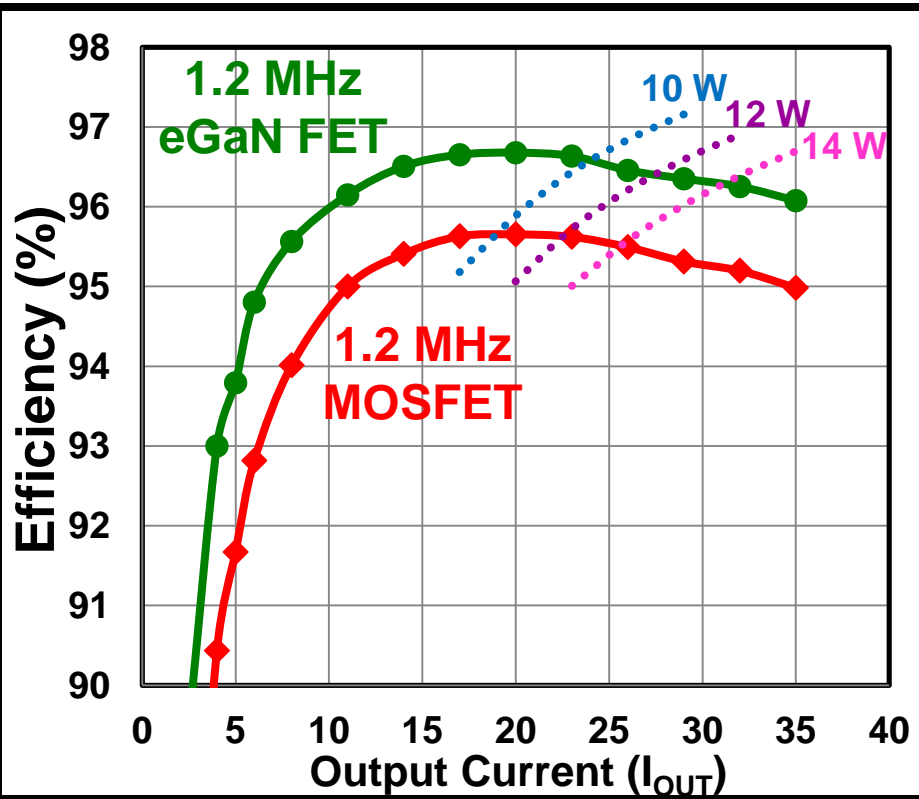




$F_S = 1.2\text{ MHz}$, $V_{IN} = 48\text{ V}$, and $V_{OUT} \approx 12\text{ V}$

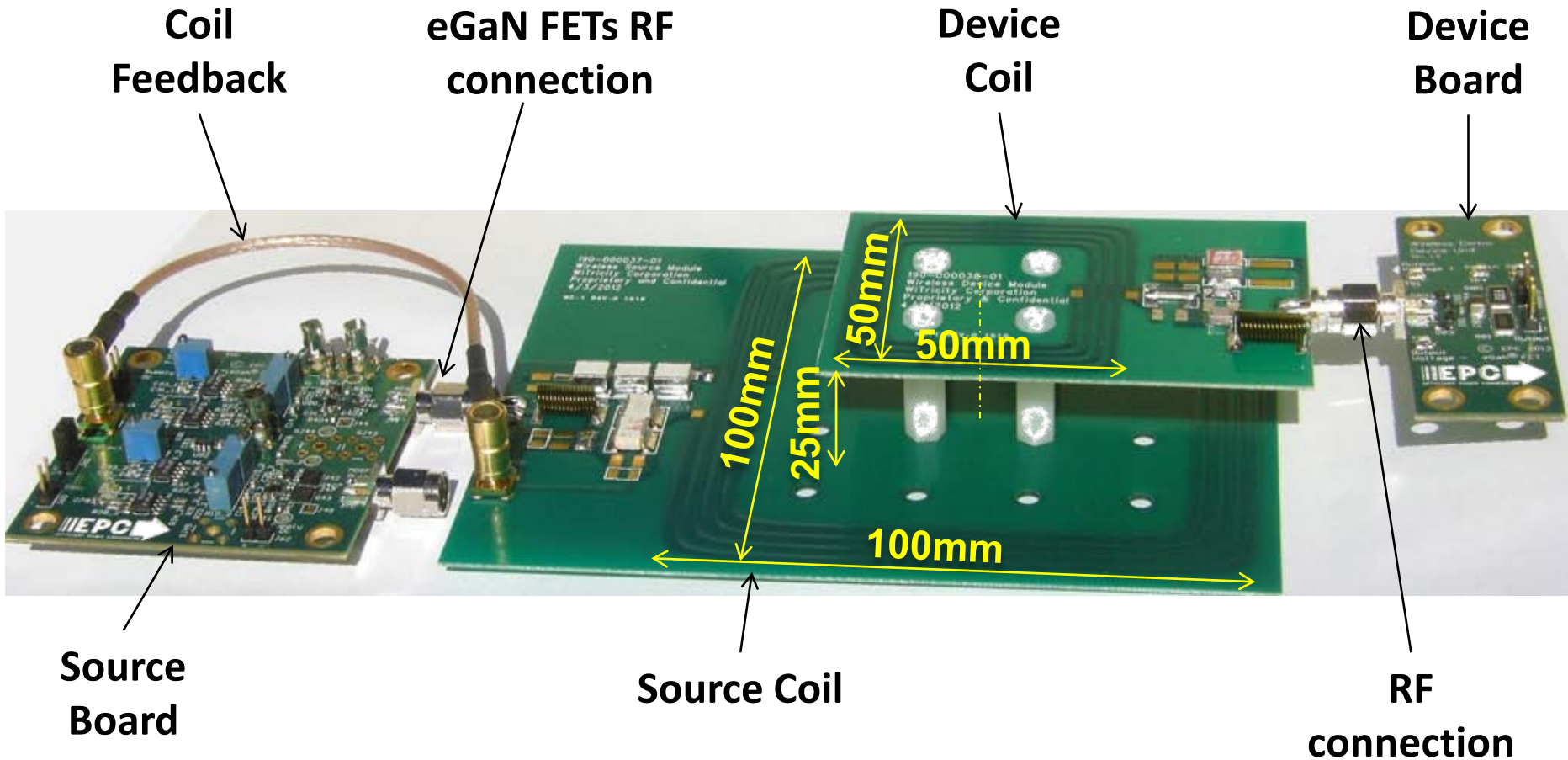


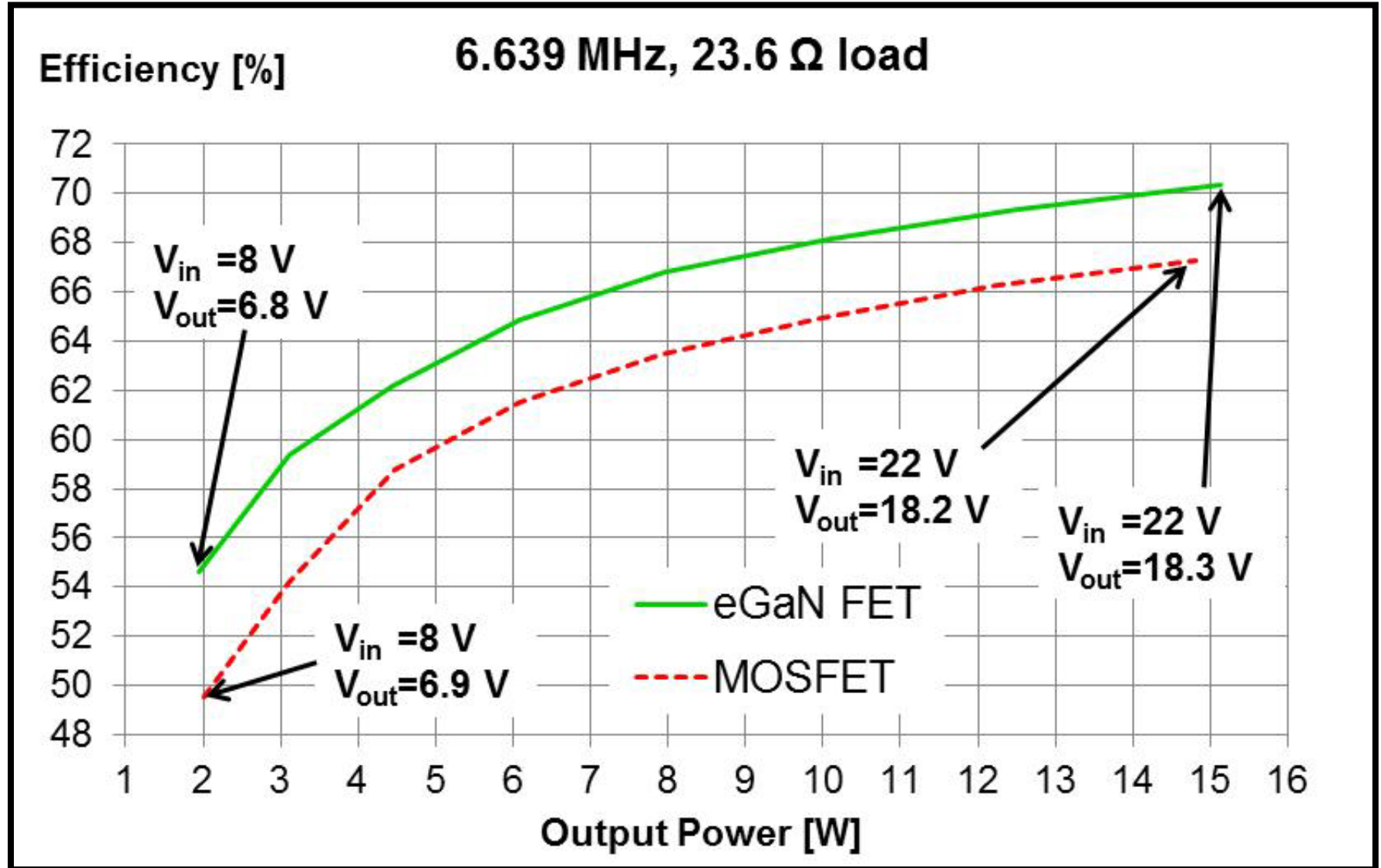
Efficiency Comparison



$F_S = 1.2 \text{ MHz}$, $V_{IN} = 48 \text{ V}$, and $V_{OUT} \approx 12 \text{ V}$

6.78 MHz Wireless Power





eGaN FETs pushes the frequency envelope in both hard- and soft-switching applications

- Lower switching charge
- Improved device packaging / layout
- Zero diode reverse recovery (Q_{RR})
- Lower output charge
- Lower gate charge

Thank you for your time!