

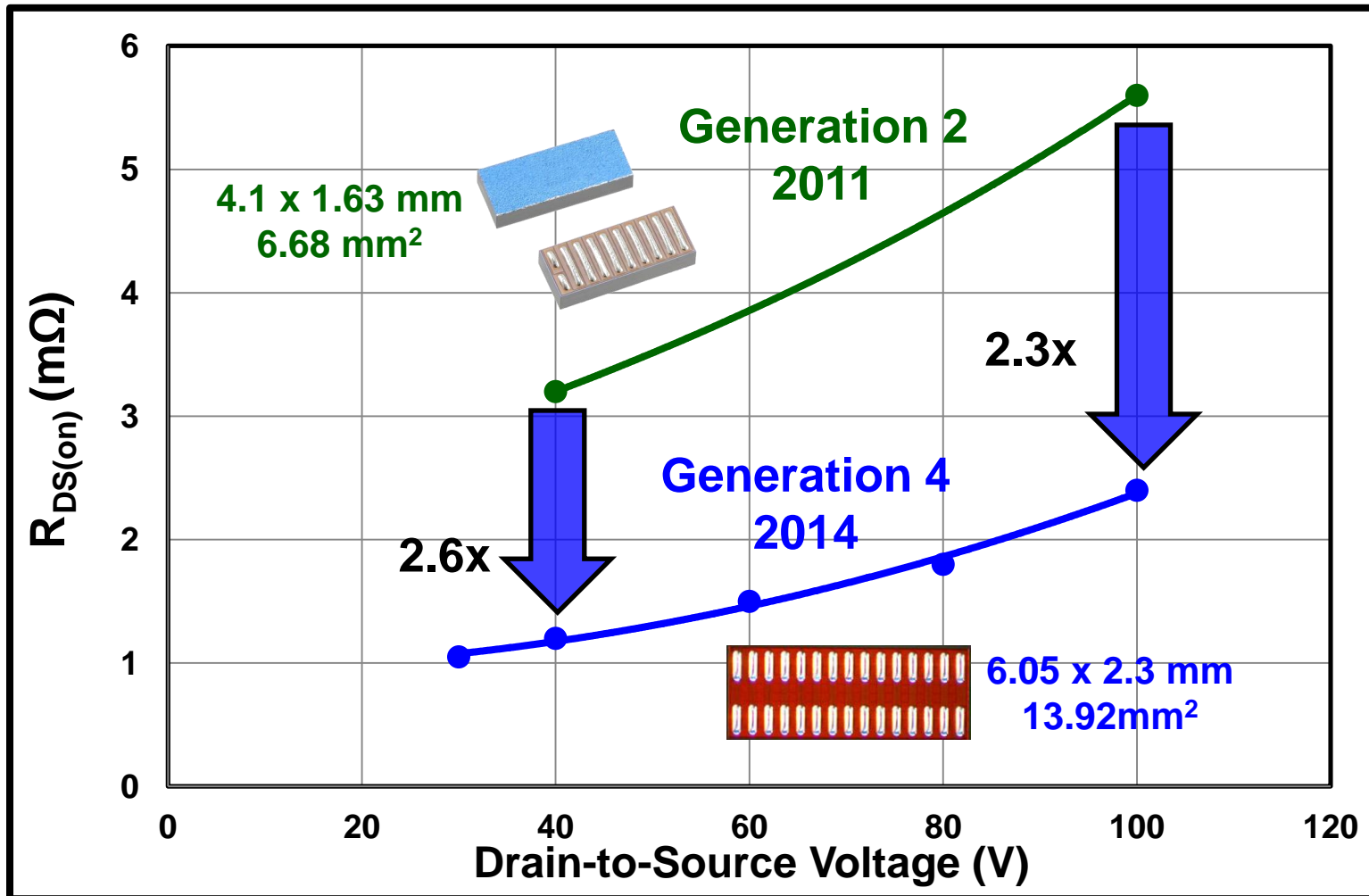
A green road sign with white text is mounted on a wooden post. The sign reads "The eGaN® FET Journey Continues". The background is a desert landscape with a road leading towards a building at sunset. The sky is blue with white clouds, and the sun is low on the horizon, creating a golden glow. The building in the distance has a grid-like facade.

The eGaN® FET
Journey Continues

Advances in DC-DC converters with eGaN FETs
David Reusch
Efficient Power Conversion Corporation

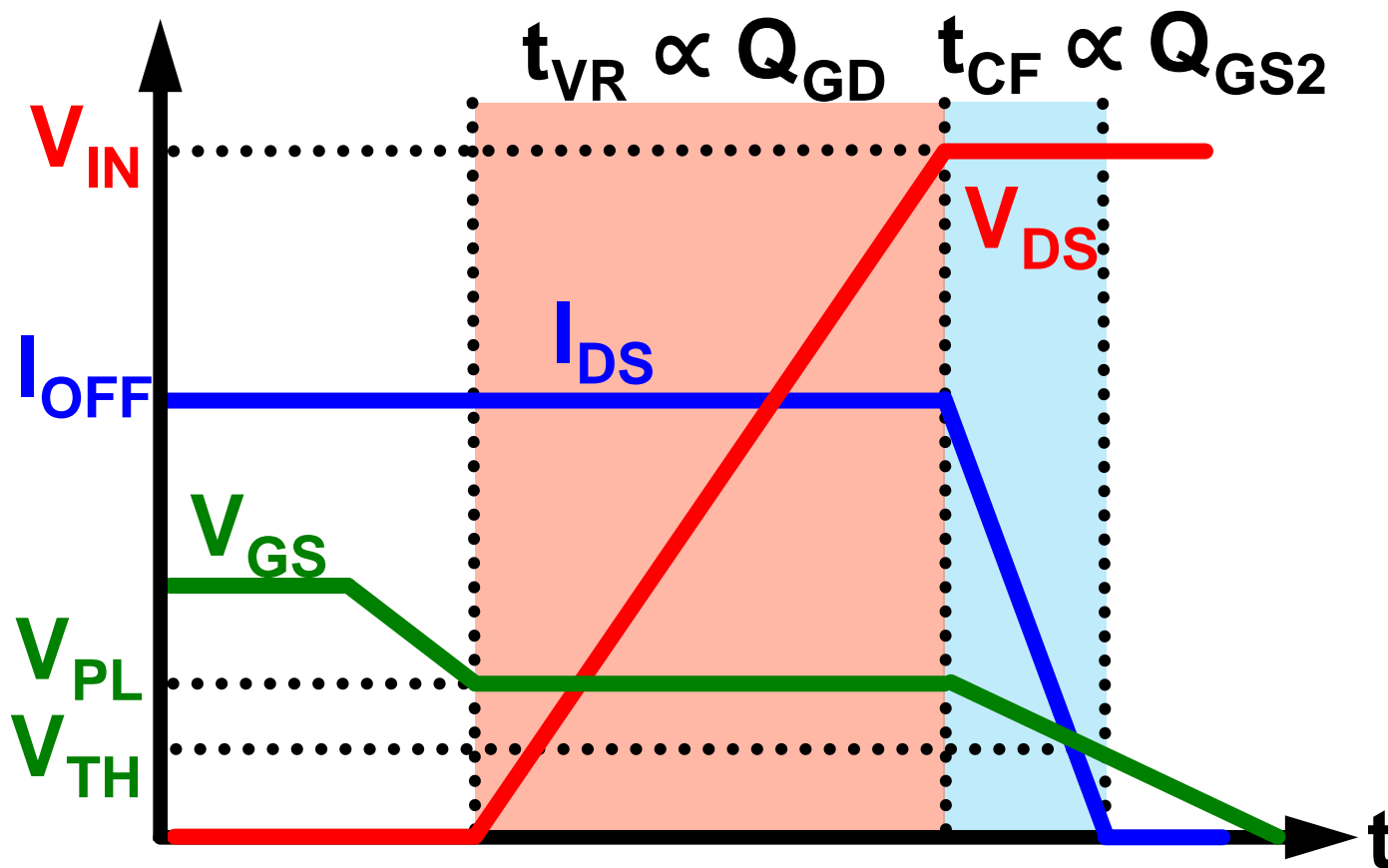
- Lower On Resistance
- Faster
- Less Capacitance
- Smaller
- Lower Thermal Impedance
- Lower Cost

On-Resistance Comparison



$V_{GS}=5\text{ V}$

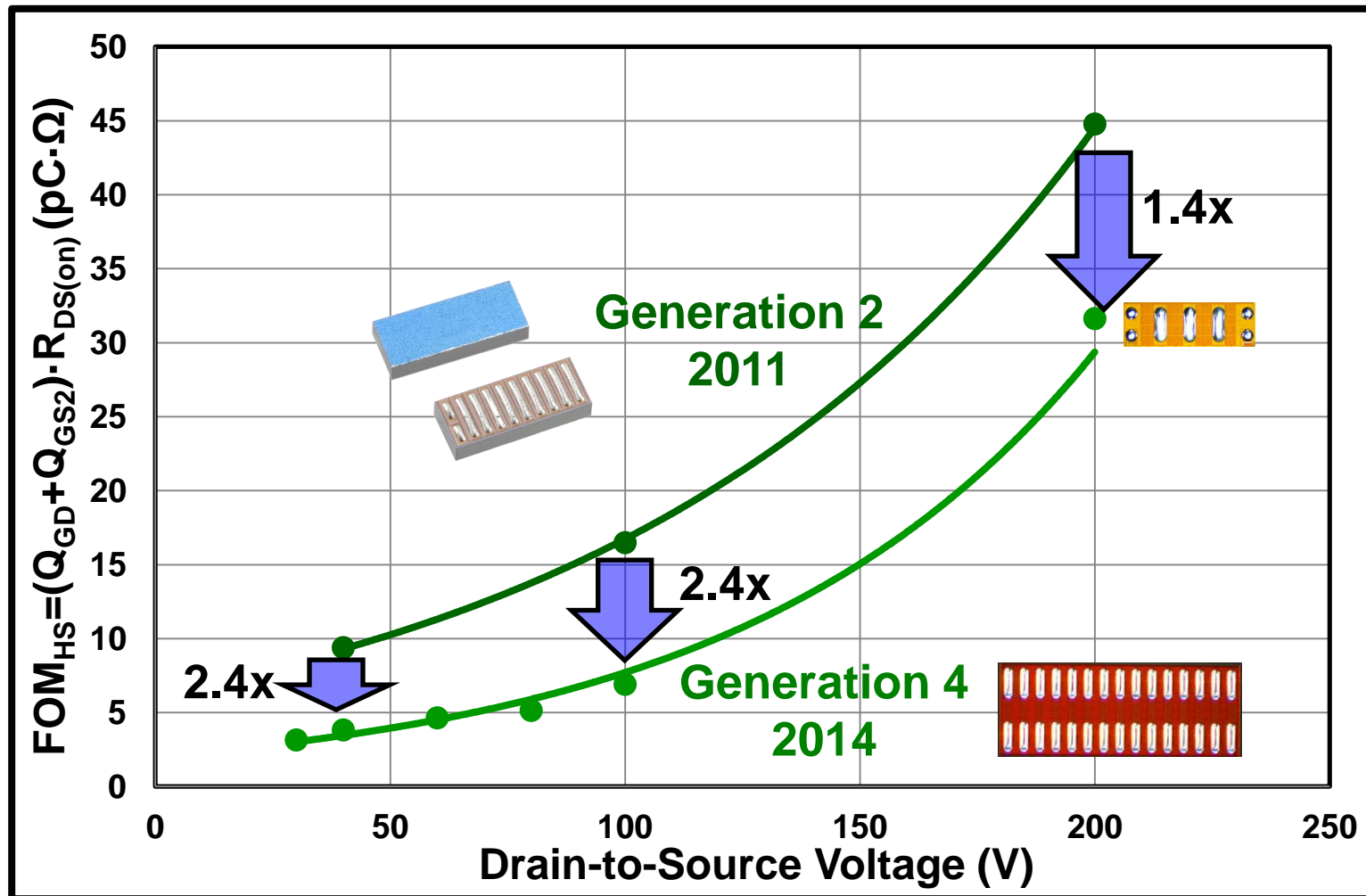
Ideal Hard Switching



$$P_{t_{VR}} \approx \frac{V_{IN} * I_{OFF} * Q_{GD}}{2 * I_G}$$

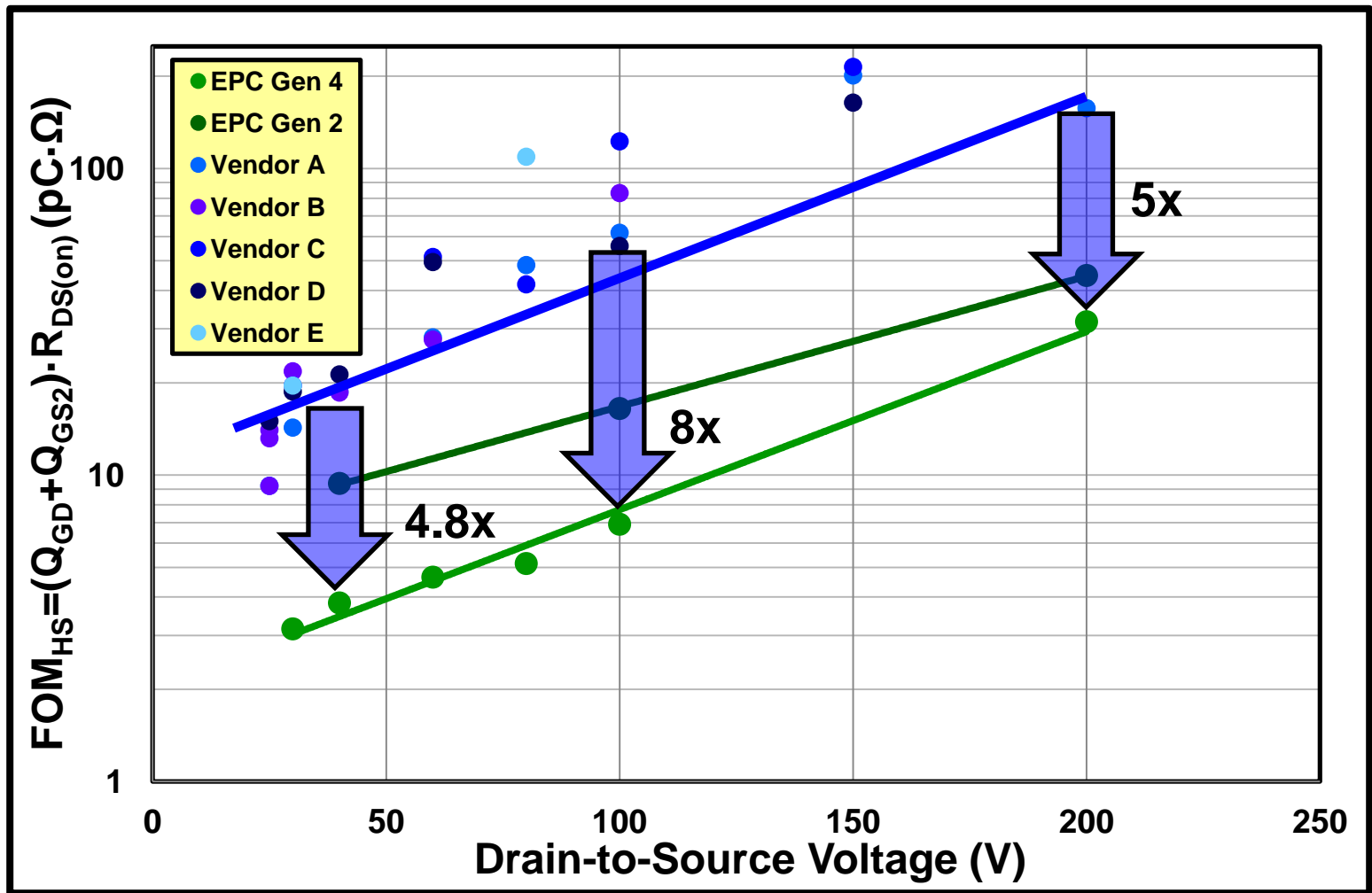
$$P_{t_{CF}} \approx \frac{V_{IN} * I_{OFF} * Q_{GS2}}{2 * I_G}$$

Hard Switching FOM



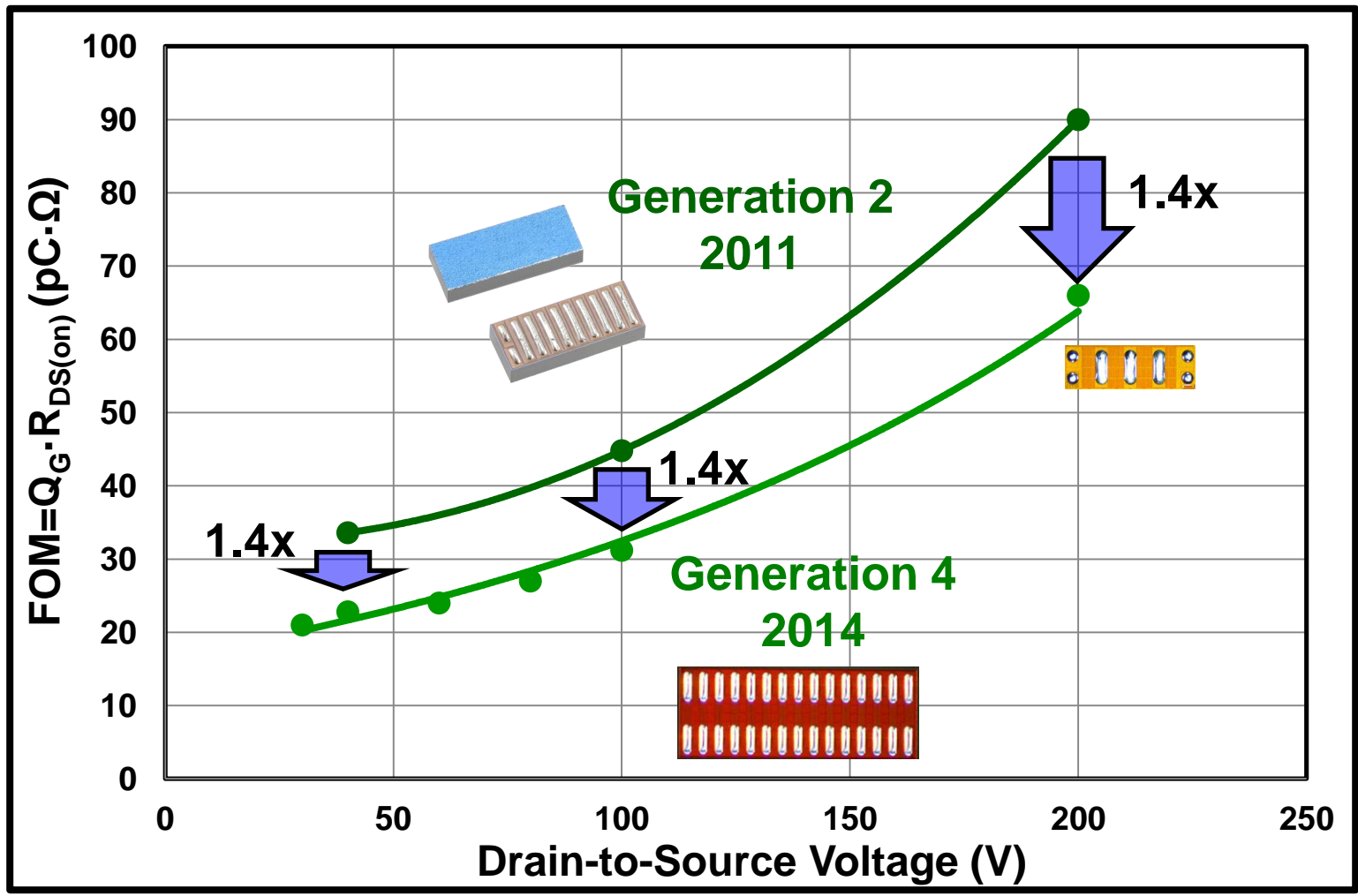
$$V_{DS} = 0.5 \cdot V_{DSS}, I_{DS} = 20 \text{ A}$$

Hard Switching FOM

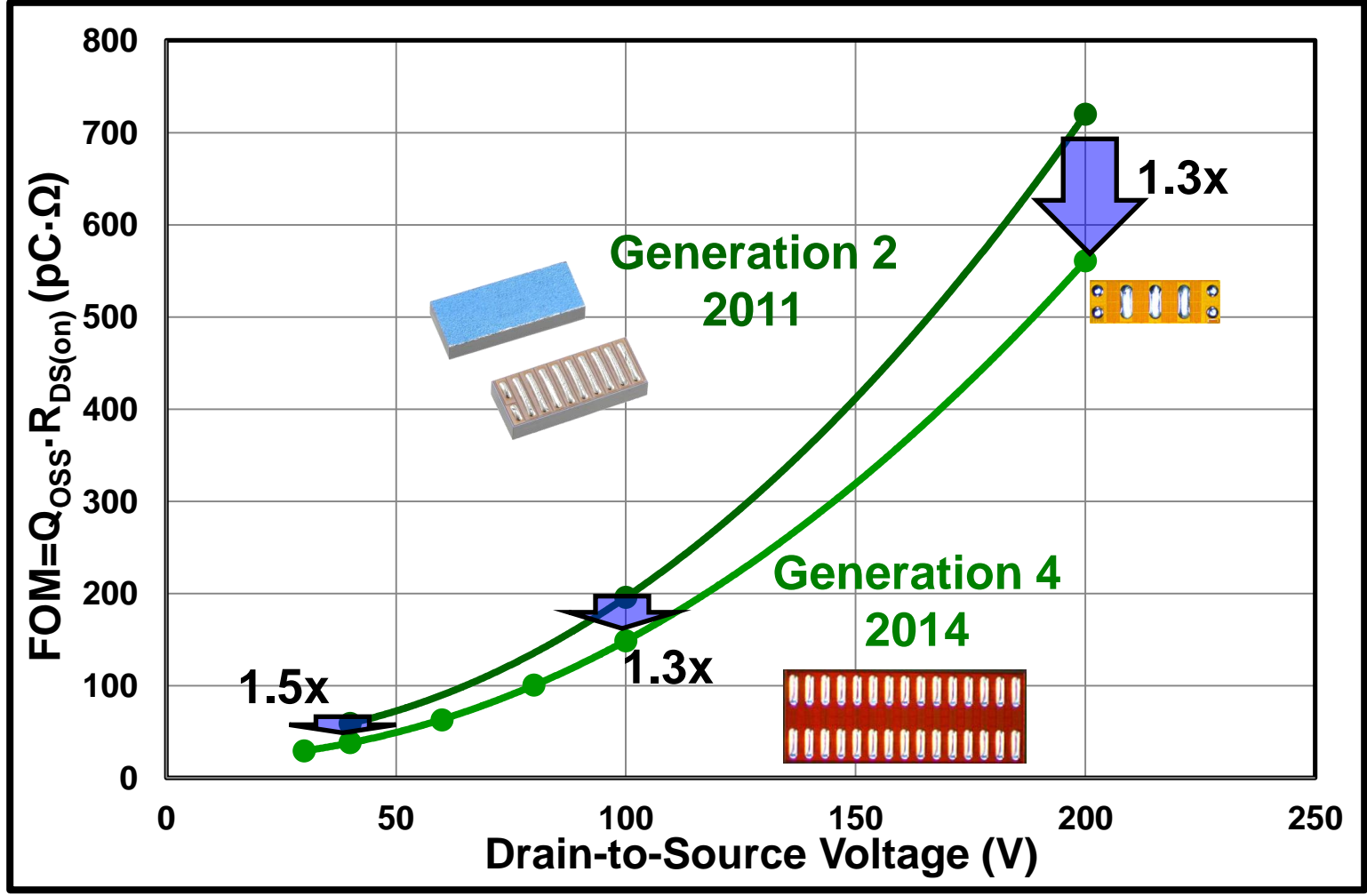


$V_{DS} = 0.5 \cdot V_{DSS}, I_{DS} = 20 \text{ A}$

Gate Charge FOM

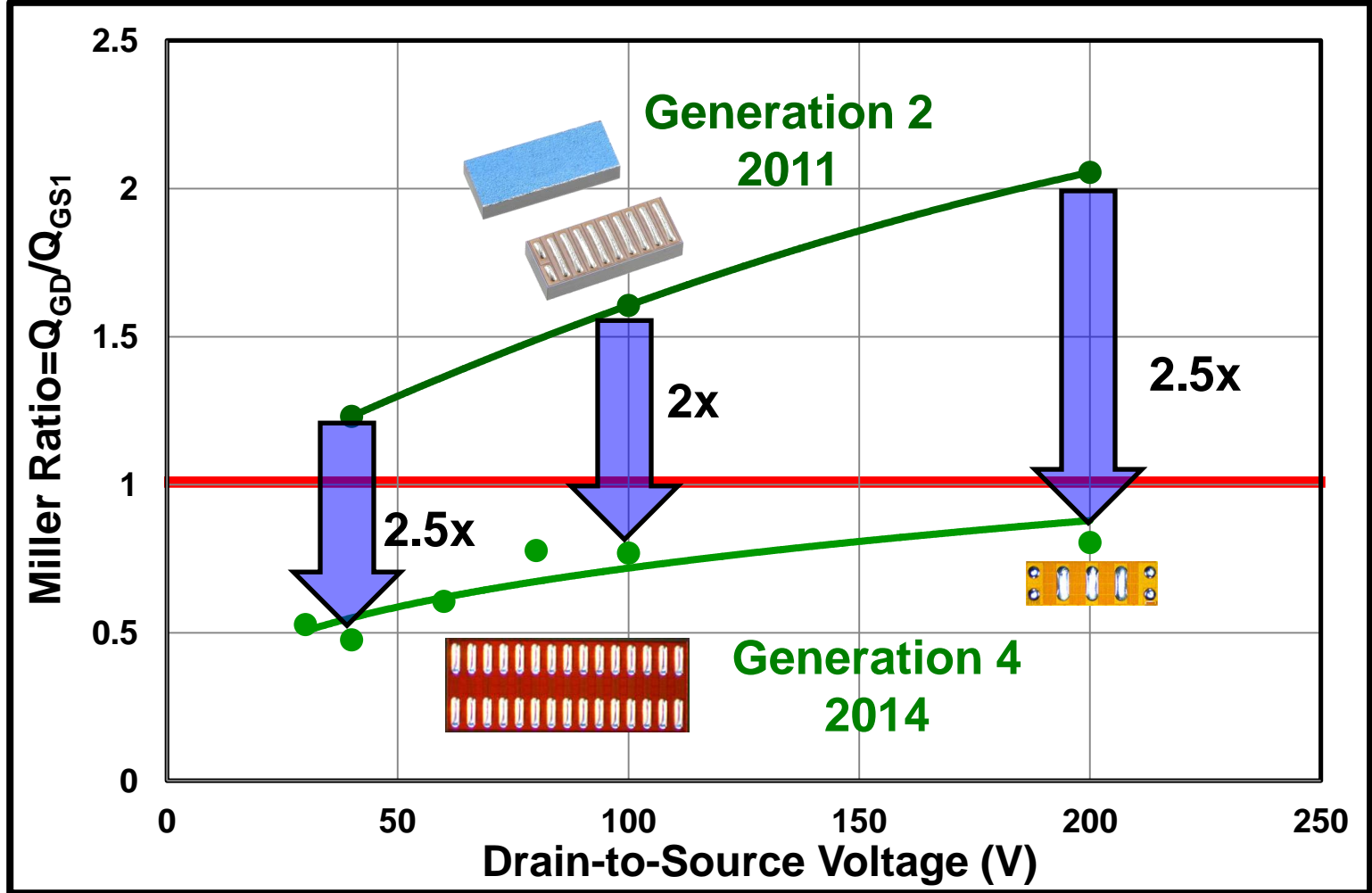


Output Charge FOM



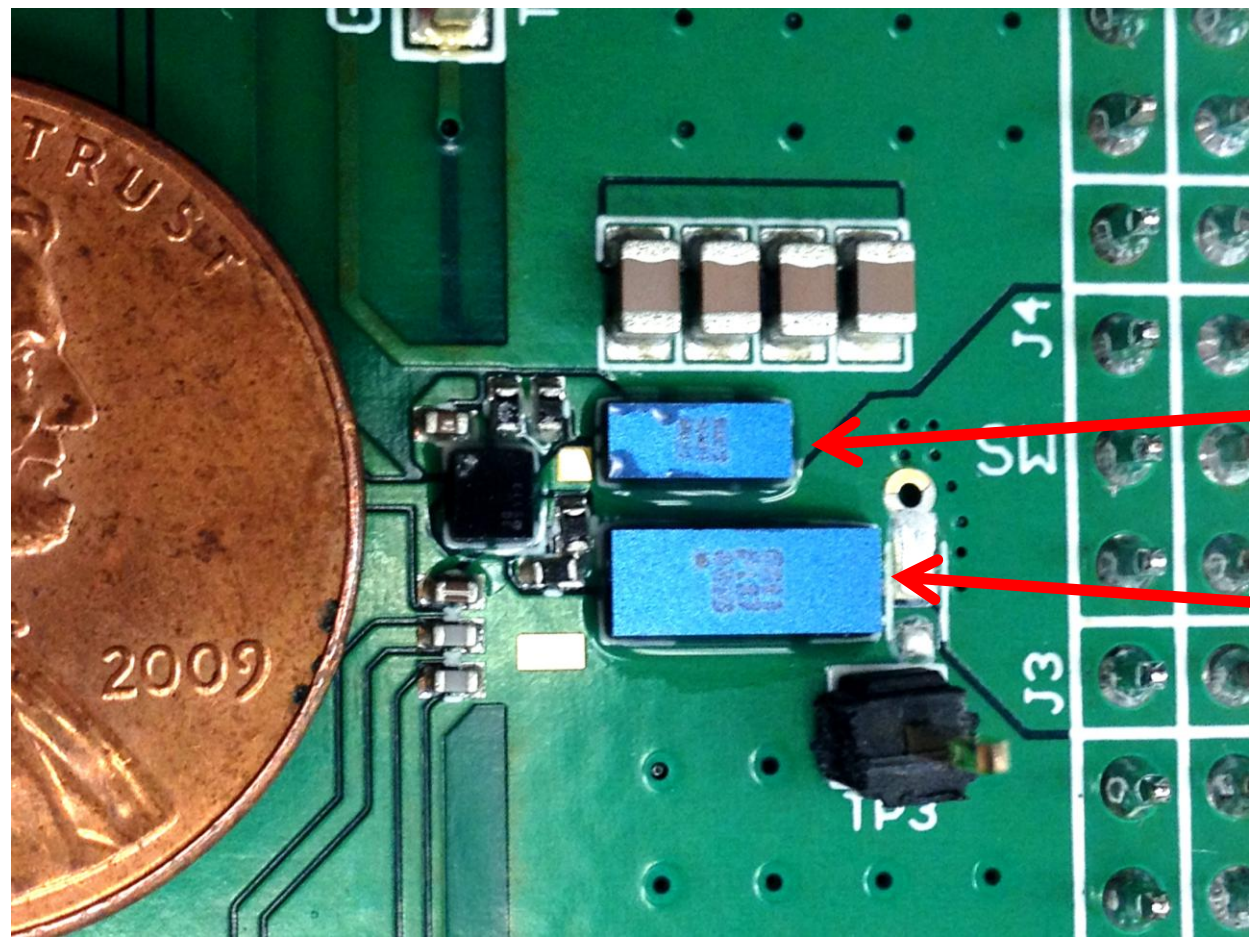
$$V_{DS} = 0.5 \cdot V_{DSS}$$

Miller Ratio



$$V_{DS} = 0.5 \cdot V_{DSS}, I_{DS} = 20 \text{ A}$$

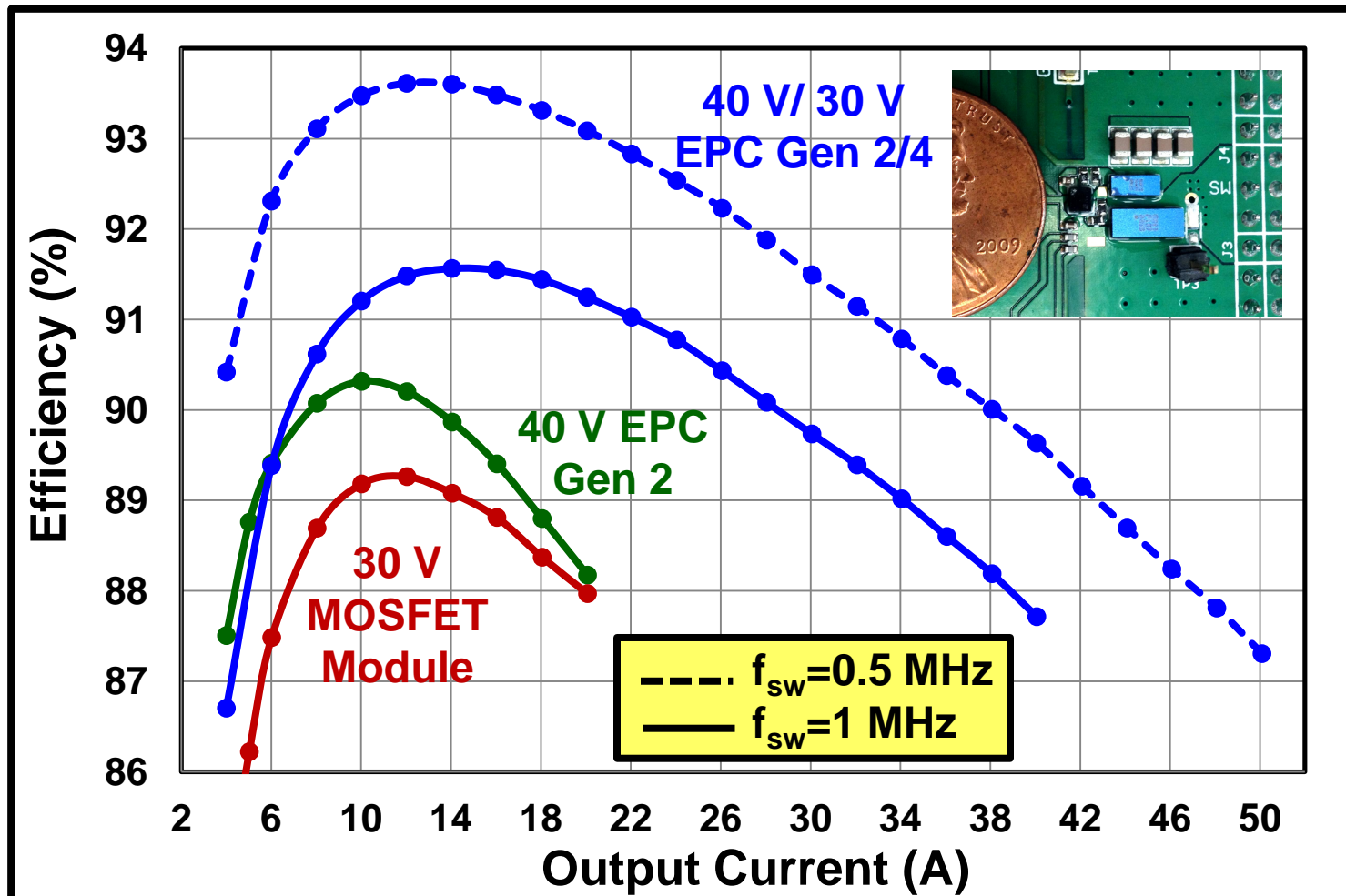
Hard Switching Buck Converter



Gen 2

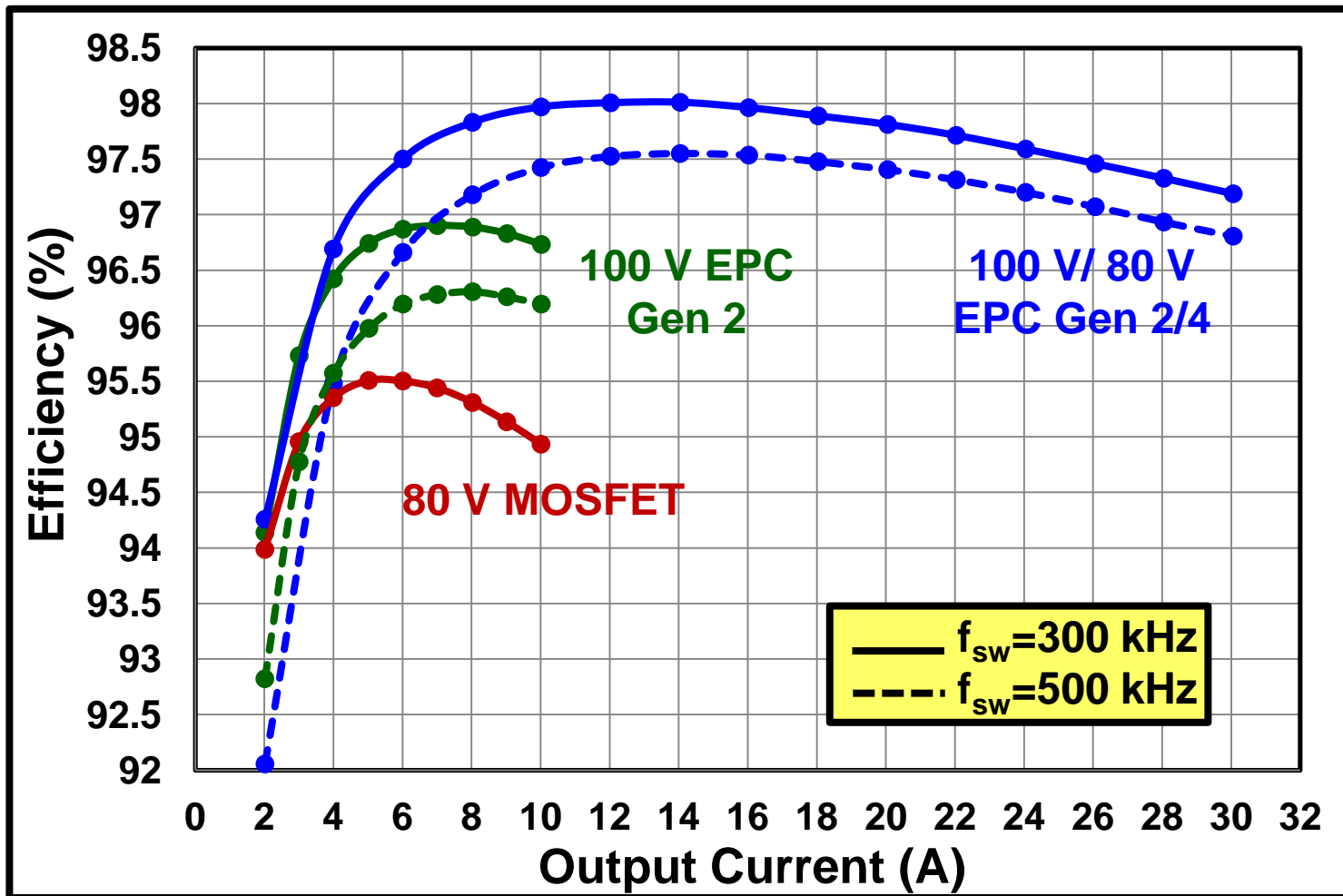
Gen 4

Lower Voltage Performance



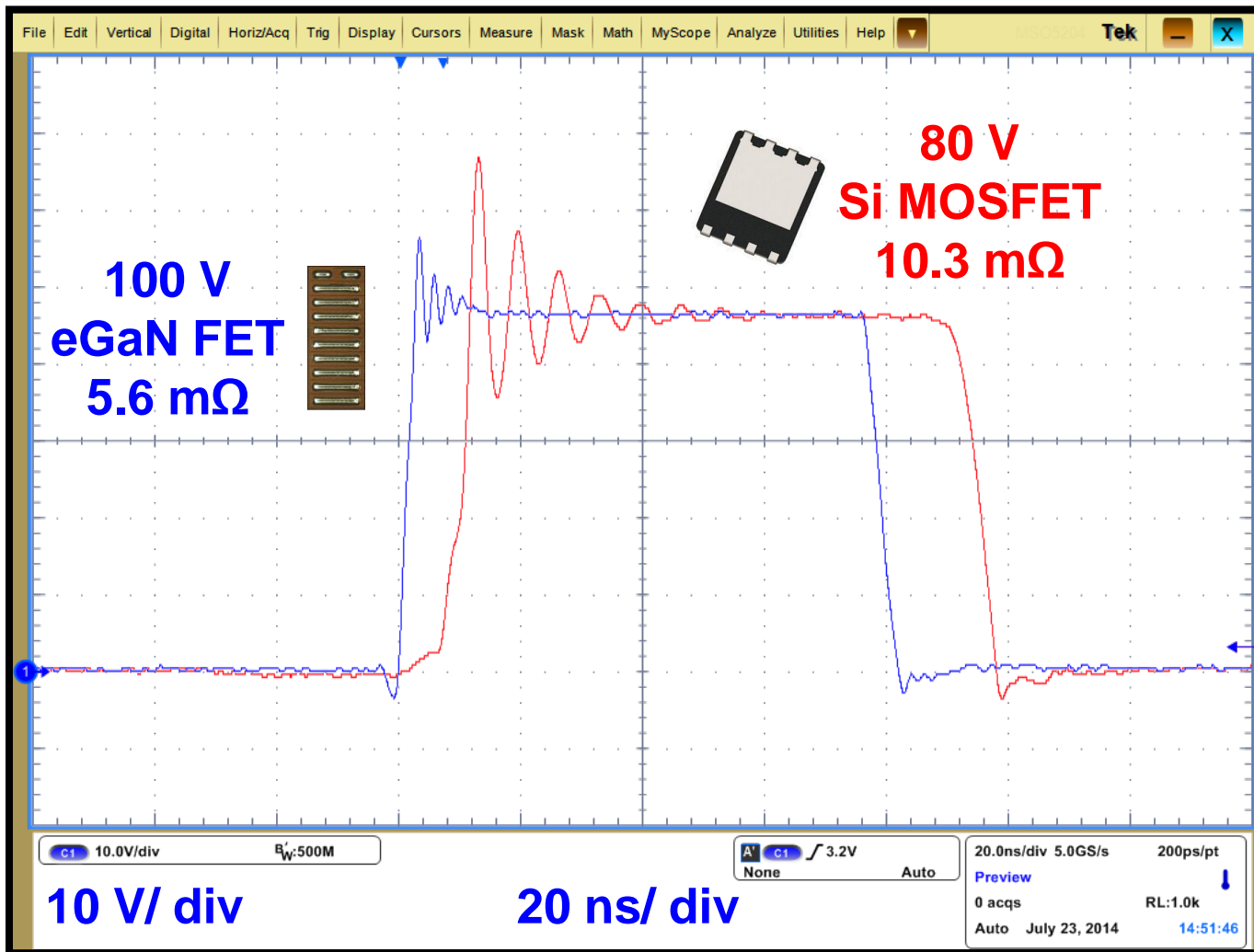
$V_{IN}=12$ V $V_{OUT}=1.2$ V

Higher Voltage Performance



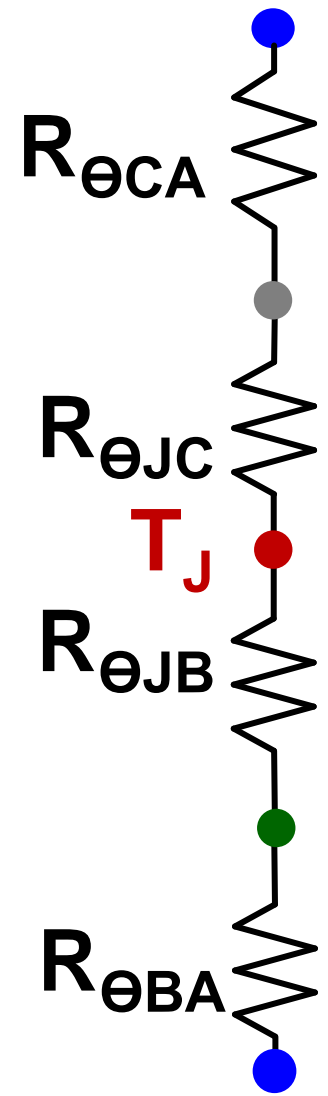
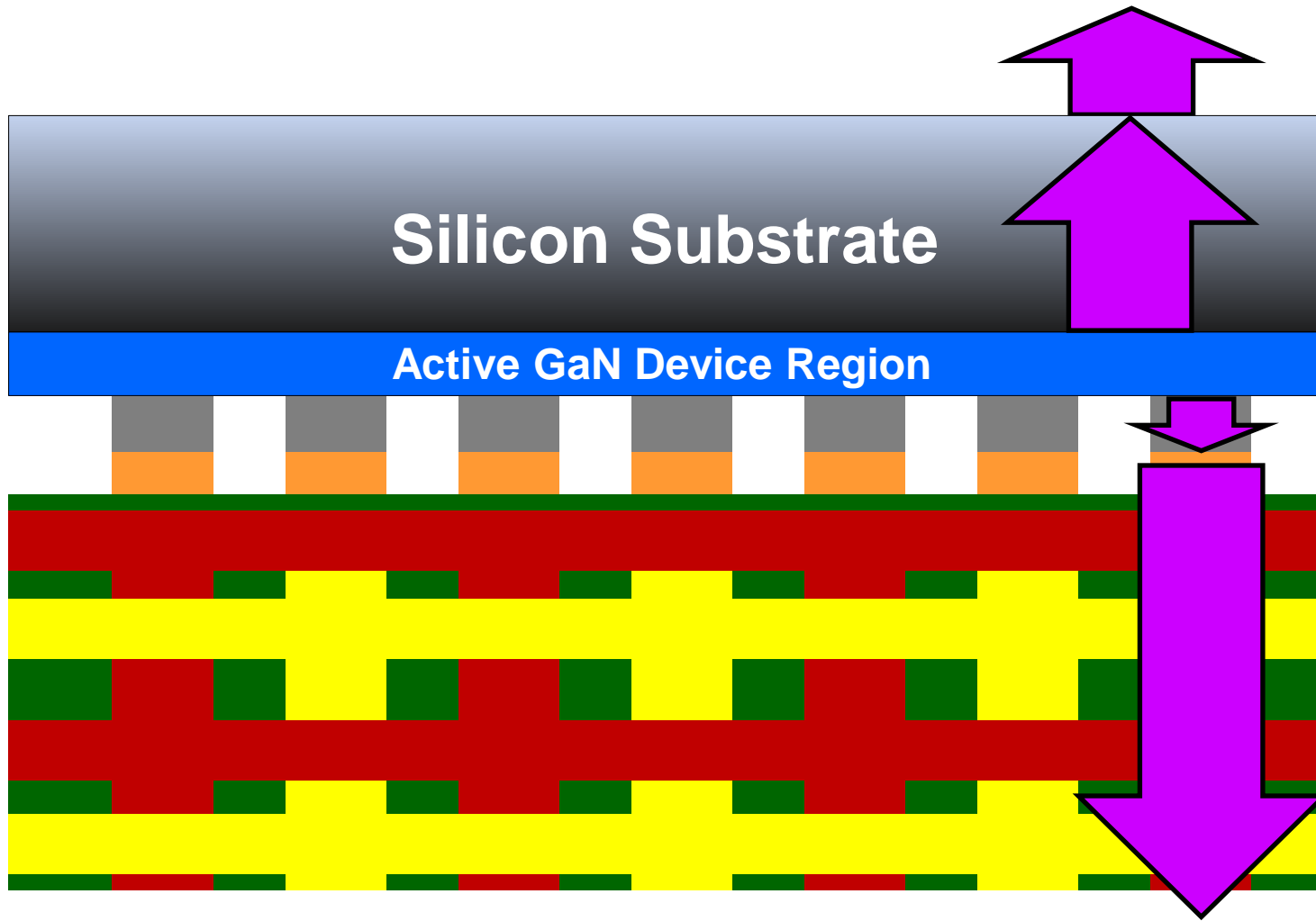
$V_{IN}=48\text{ V}$ $V_{OUT}=12\text{ V}$

Switching Comparison

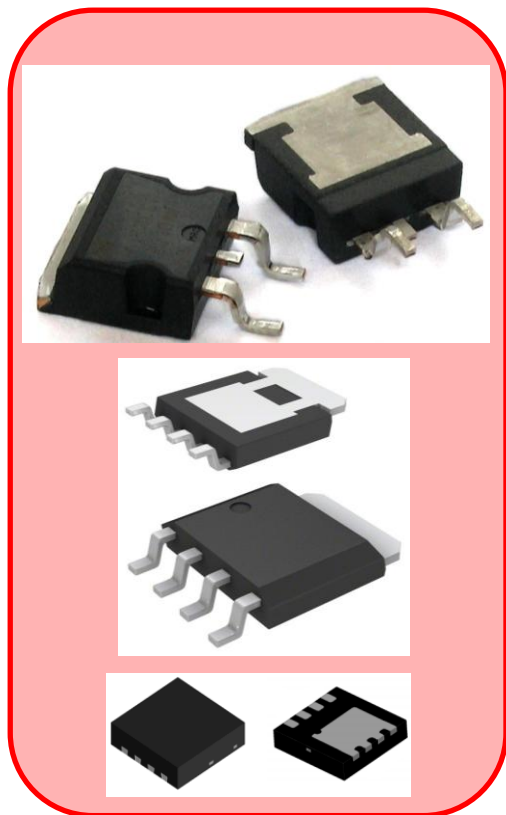


$V_{IN}=48\text{ V}$ $V_{OUT}=1\text{ V}$ $I_{OUT}=10\text{ A}$ $f_{sw}=300\text{ kHz}$ $L=10\text{ }\mu\text{H}$ eGaN FET T/SR: 100 V EPC2001
MOSFET T/SR: 80 V BSZ123N08NS3G

Thermal Management



Single Sided Cooling



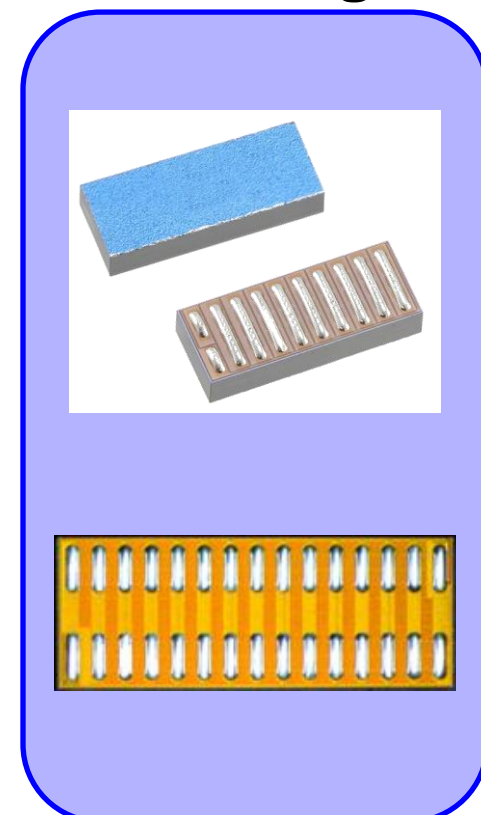
$$R_{\theta JB} \downarrow \ll R_{\theta JC} \uparrow$$

Double Sided Cooling



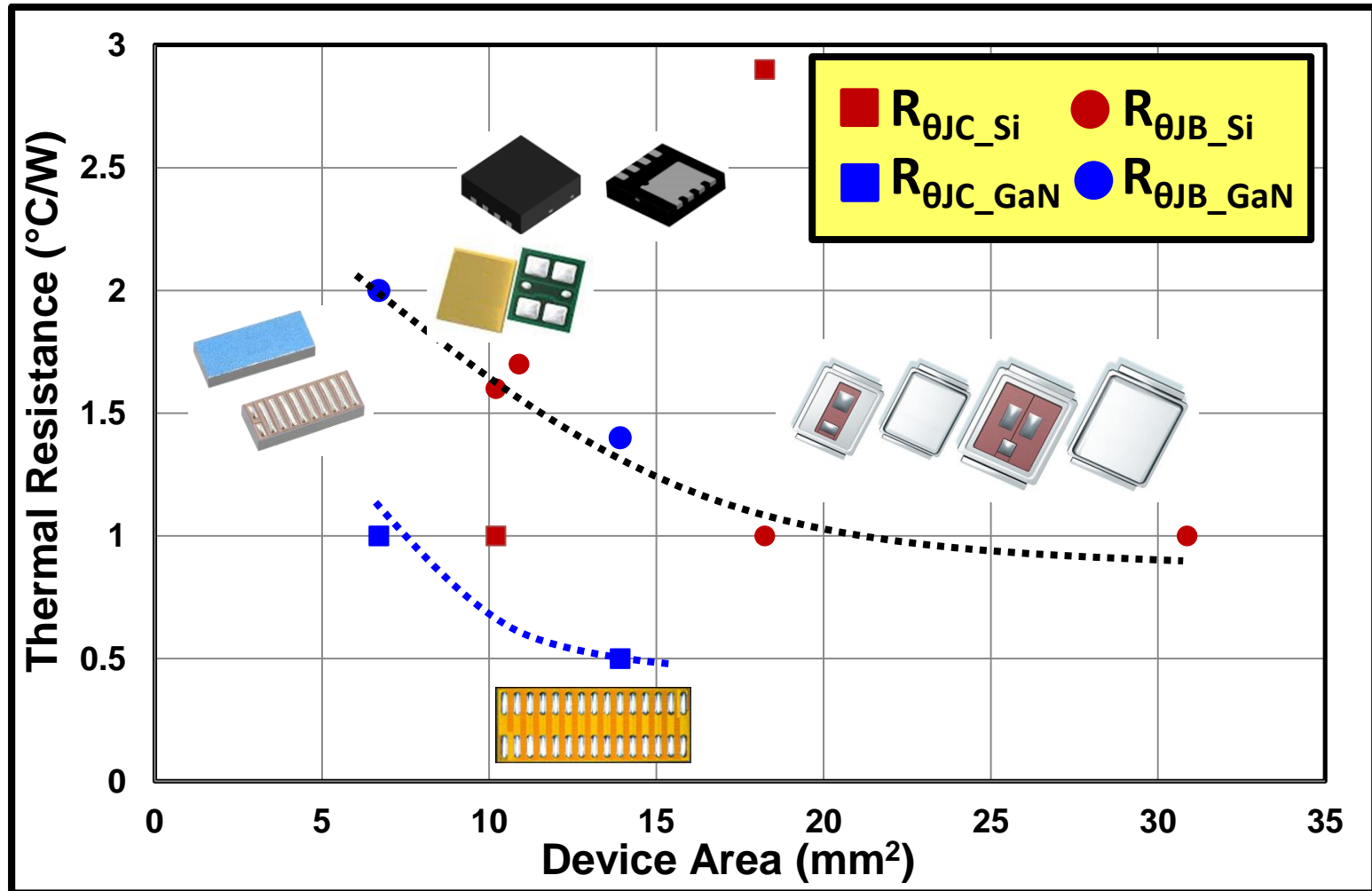
$$R_{\theta JB} \downarrow \quad R_{\theta JC} \downarrow$$

Double Sided Cooling

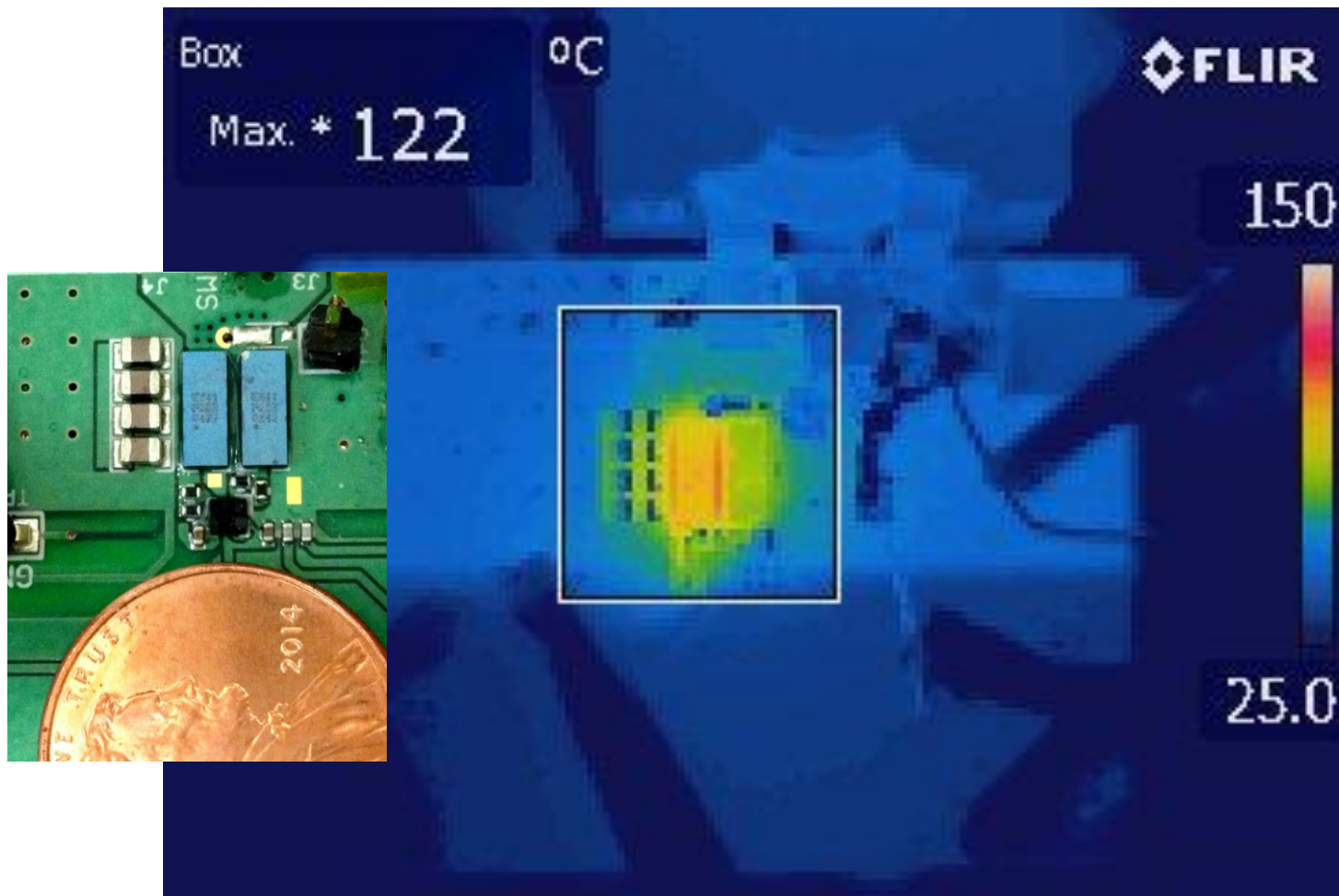


$$R_{\theta JB} \downarrow \quad R_{\theta JC} \downarrow$$

Package Comparisons



Improved Thermal Performance

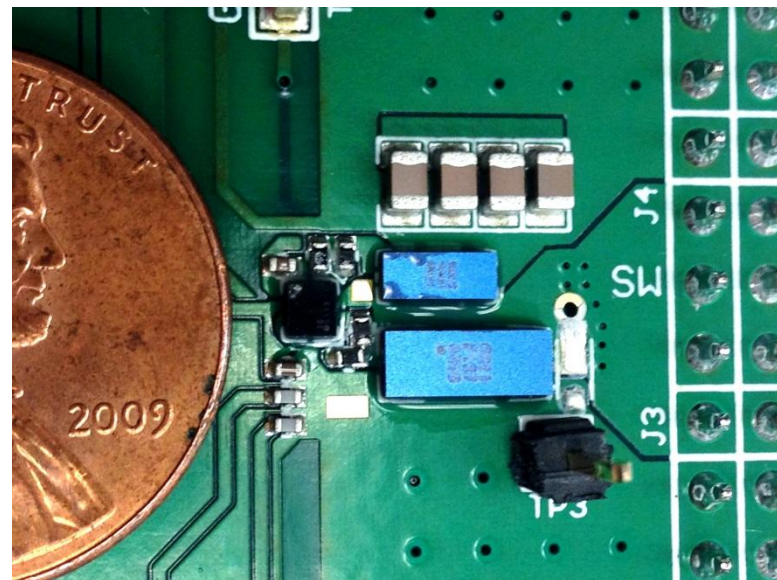
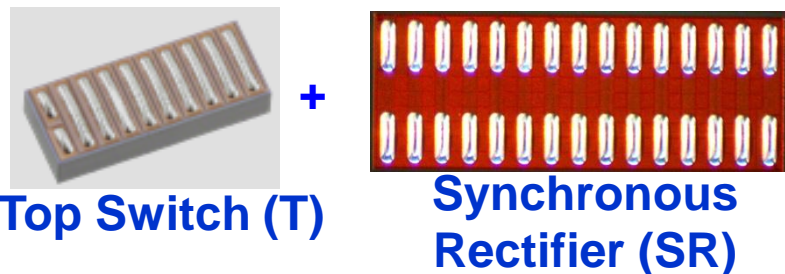


Fan Speed=200 LFM $f_{sw}=300$ kHz $V_{IN}=48$ V $V_{OUT}=12$ V $I_{OUT}=30$ A

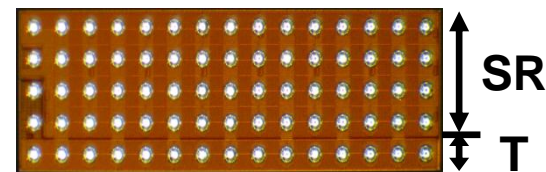
A Look Into the Future

GaN Integration

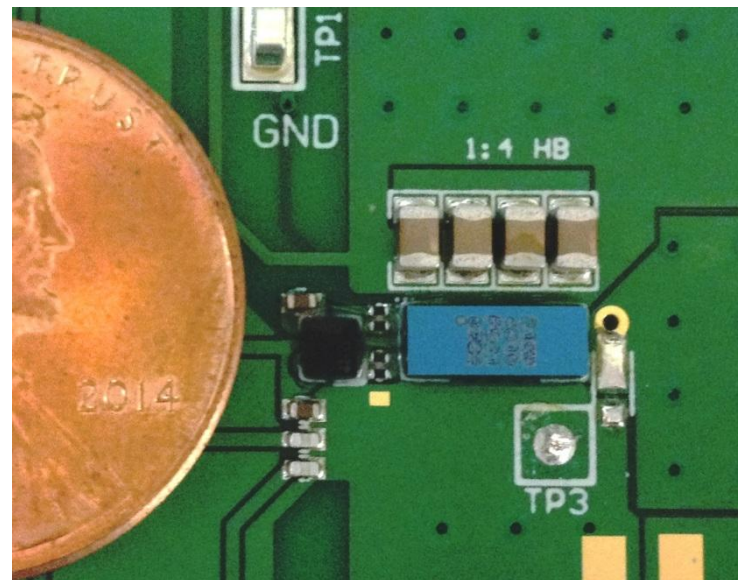
Generation 2/4 Discrete HB



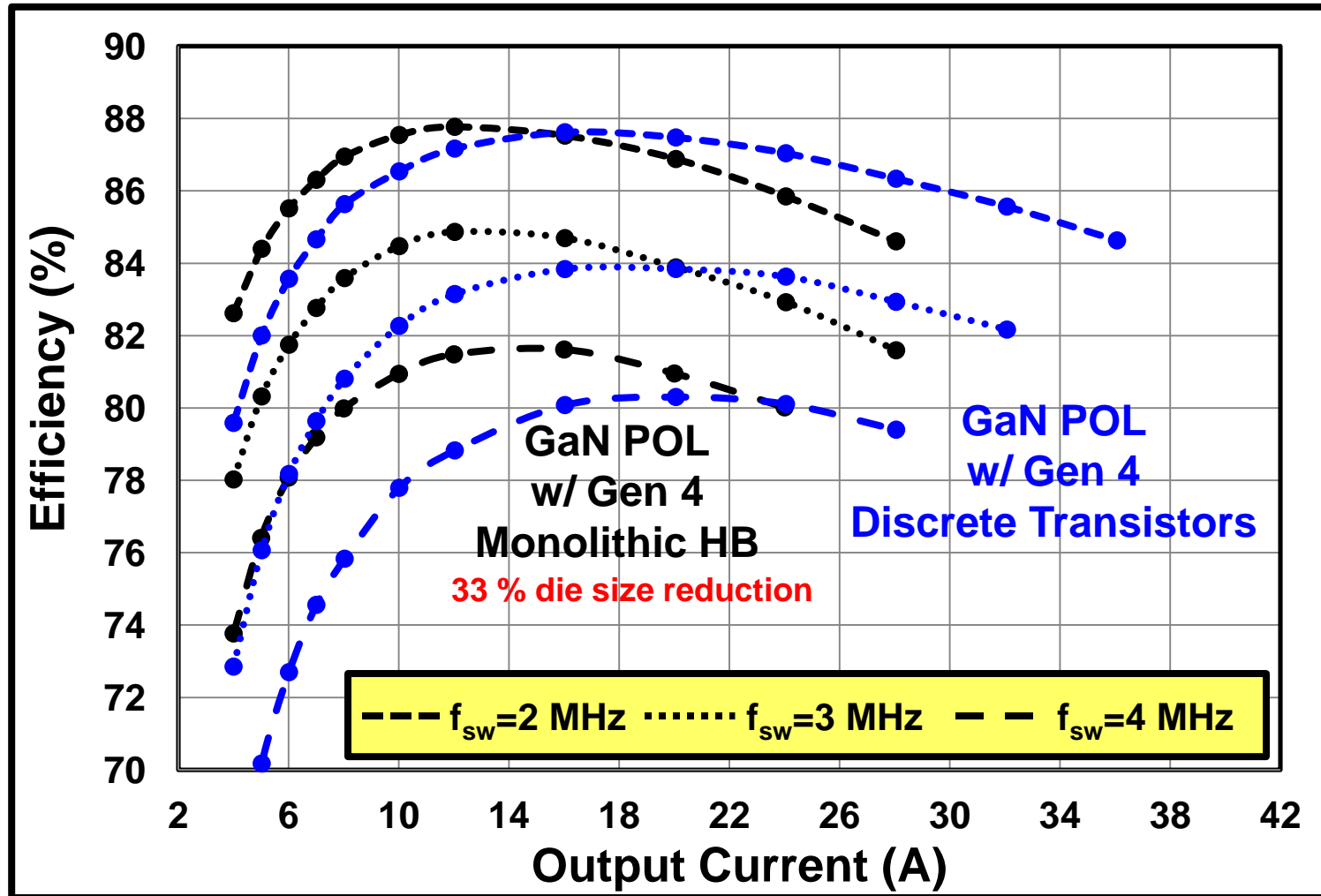
Generation 4 Monolithic 4:1 HB



33 % die size reduction

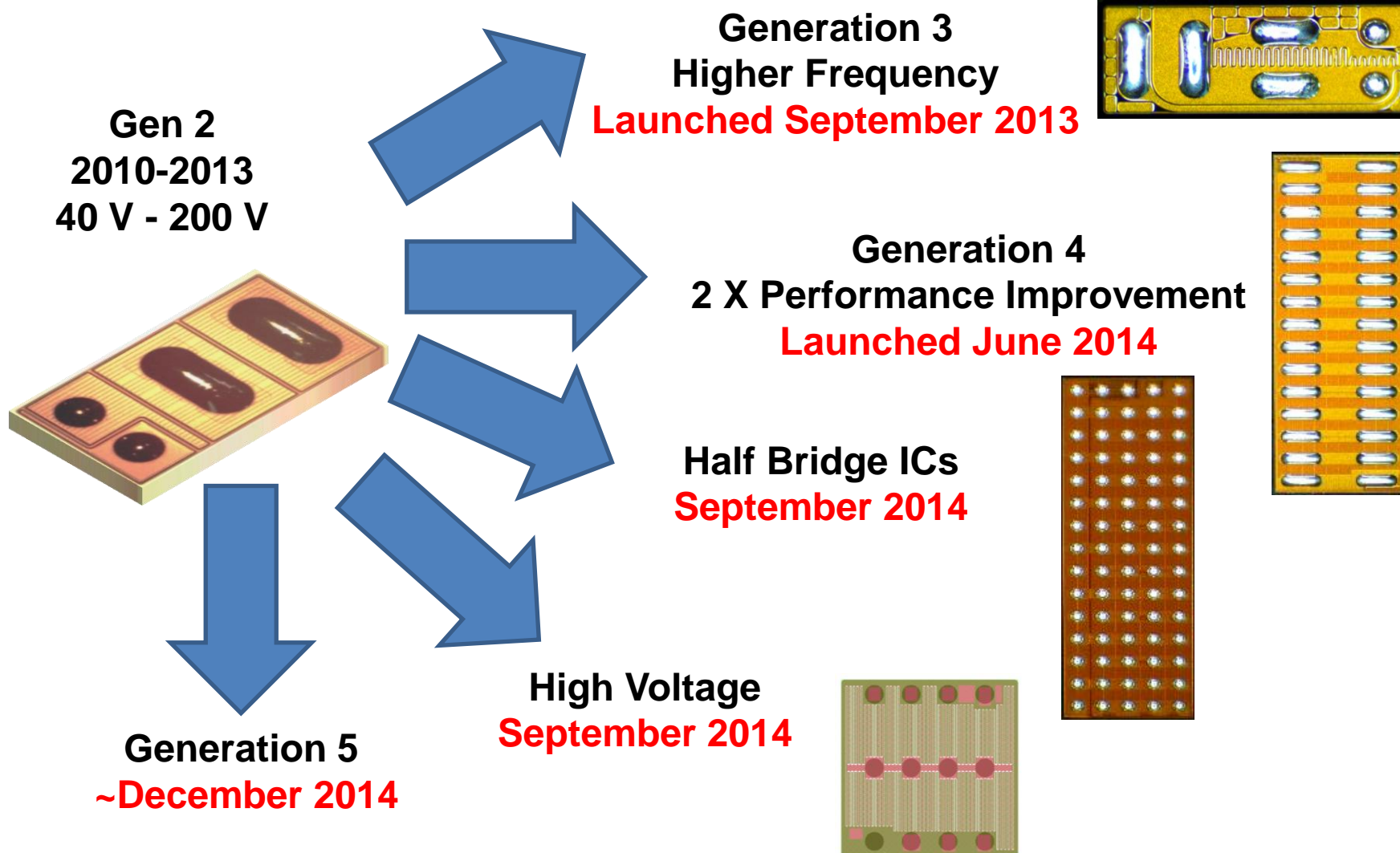


Monolithic Half Bridge



$V_{IN}=12$ V $V_{OUT}=1.2$ V $L=100$ nH

Moore's Law Revival



- eGaN FETs continue to raise the bar for power conversion performance
- eGaN technology is moving quickly. The latest generation of products more than doubles DC-DC converter power density.
- eGaN technology is proving to be very thermally efficient and reliable.
- More advances are coming soon with higher voltage devices and higher power density solutions.

EPC

EFFICIENT POWER CONVERSION

Where is GaN going...

