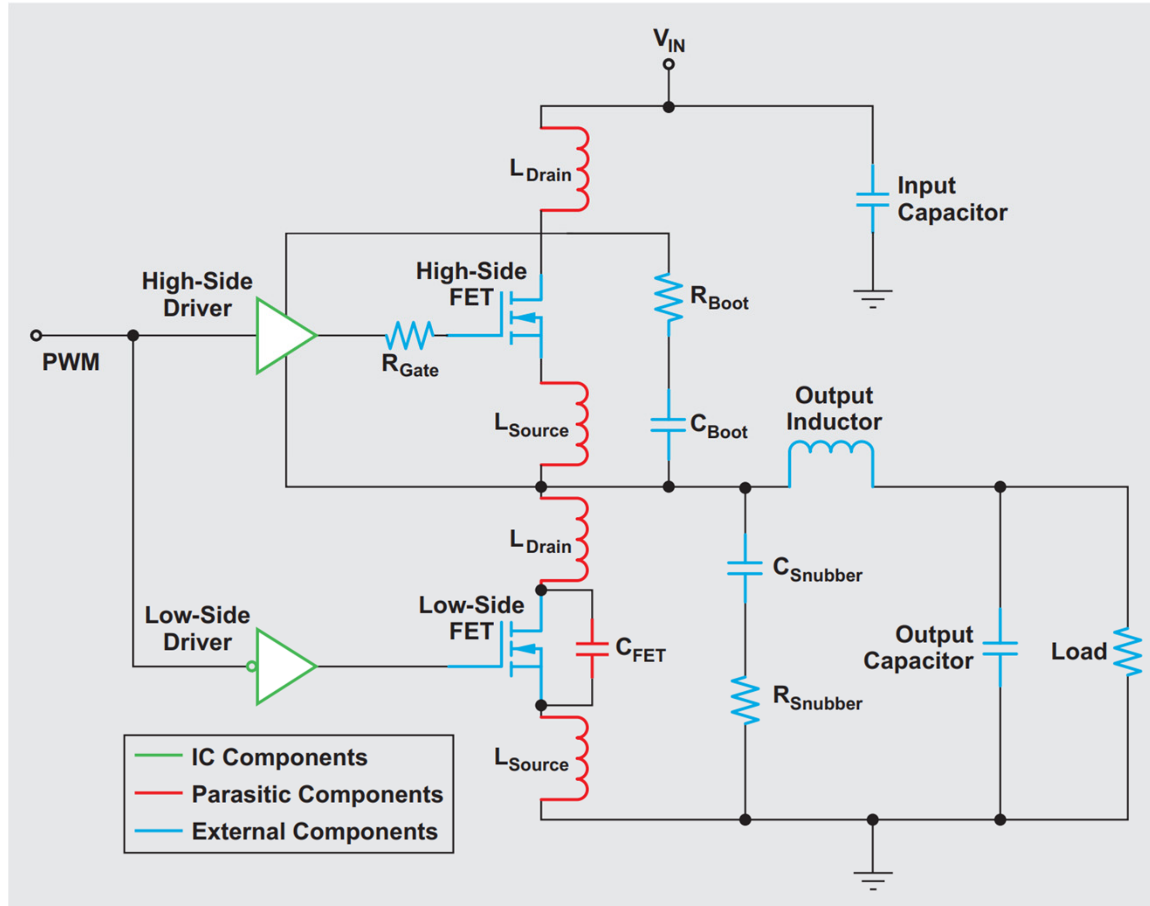
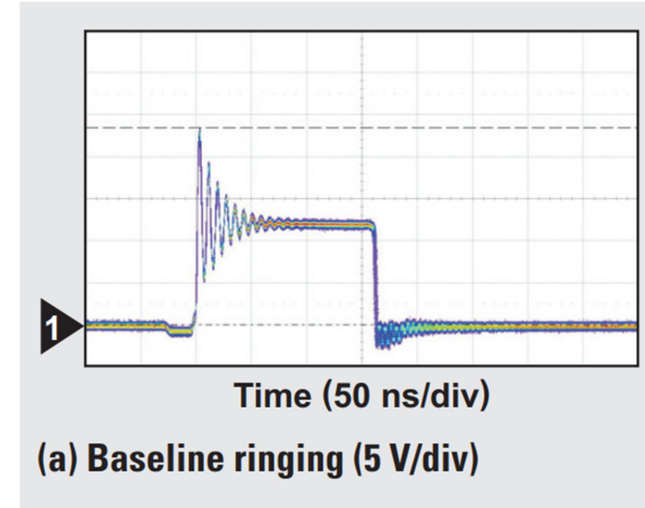
Experimental Switching Waveforms

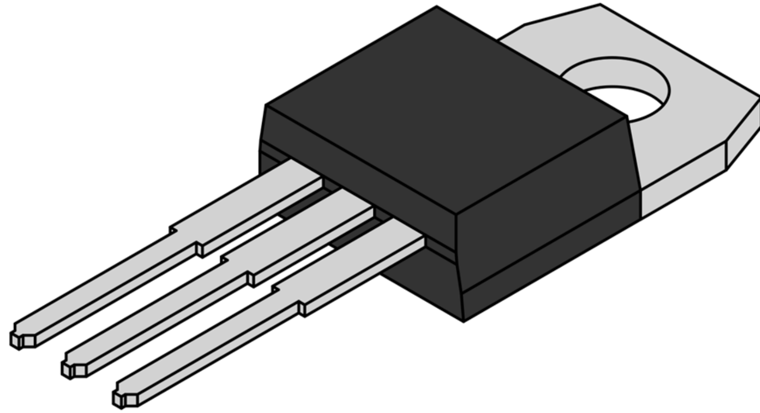


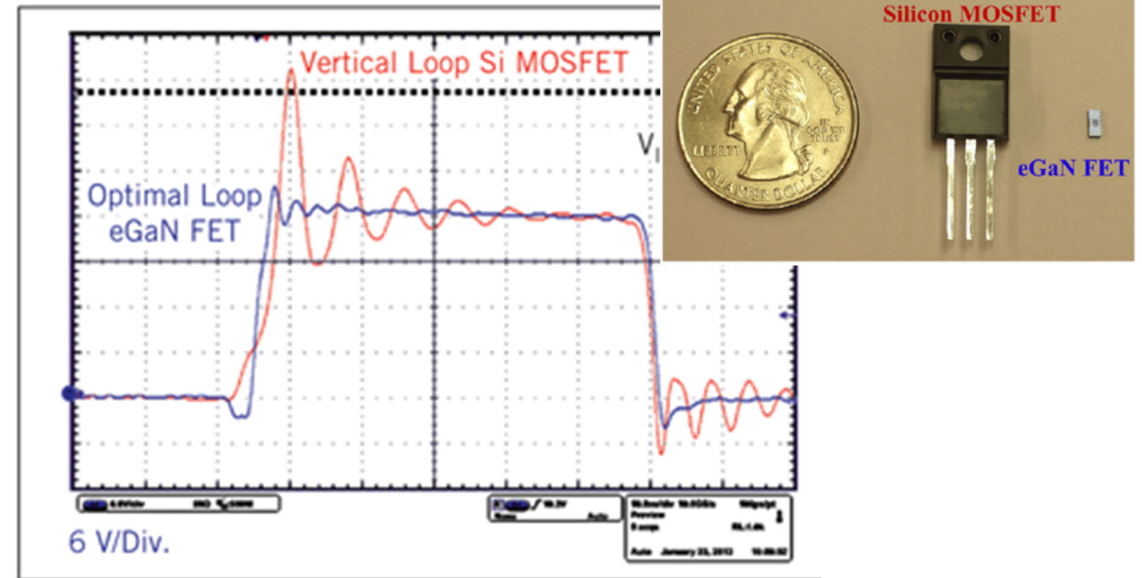


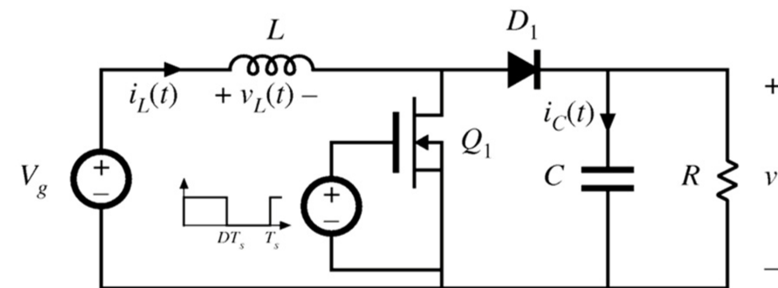
(a) Baseline ringing (5 V/div)

TI, “Controlling switch-node ringing in synchronous buck converters”

Device Packaging and Layout







The Double Pulse Test

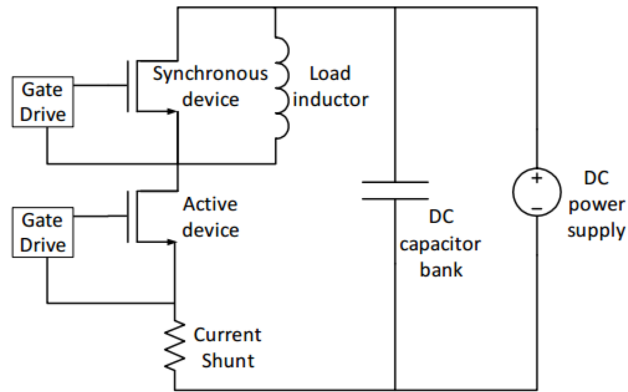


Fig. 7. Double pulse test circuit schematic.

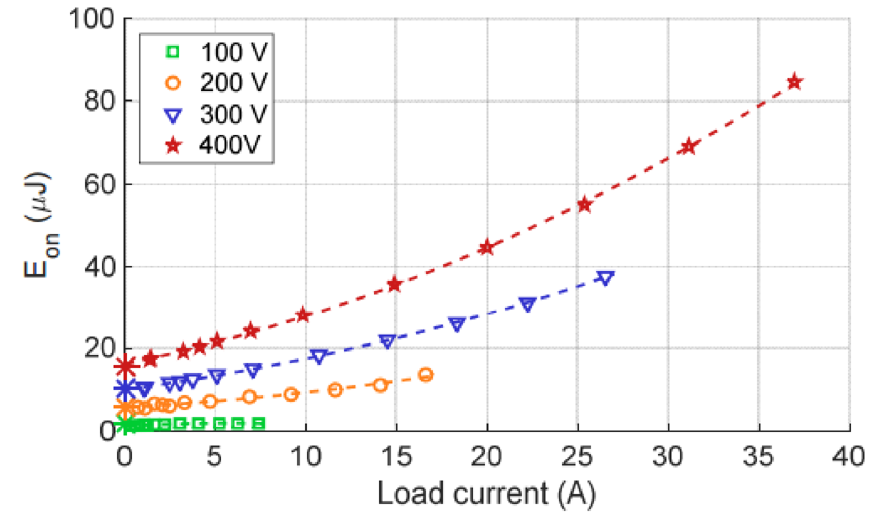
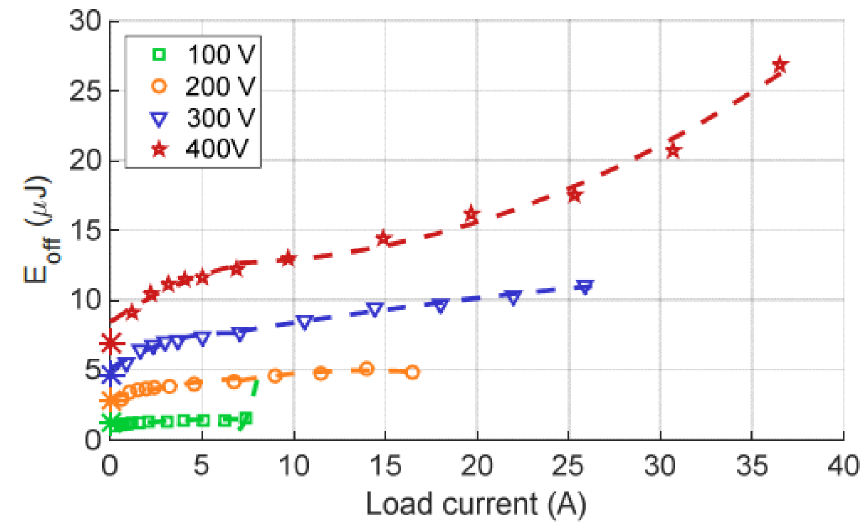
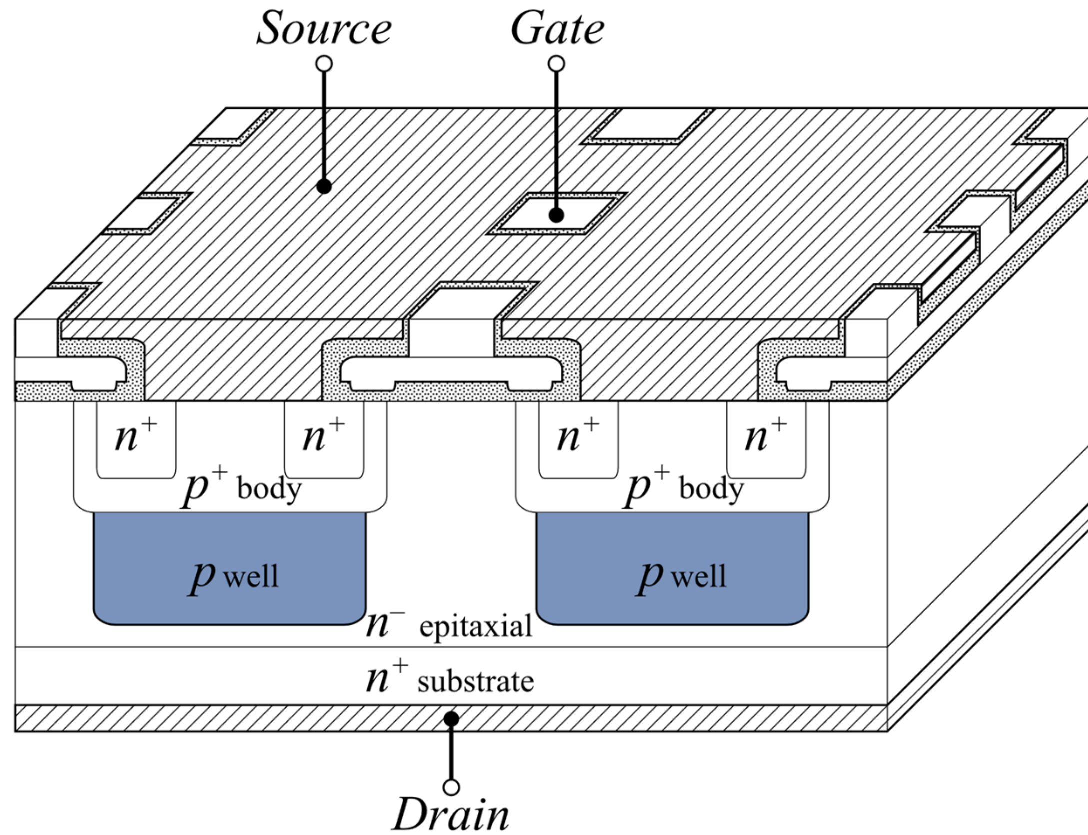
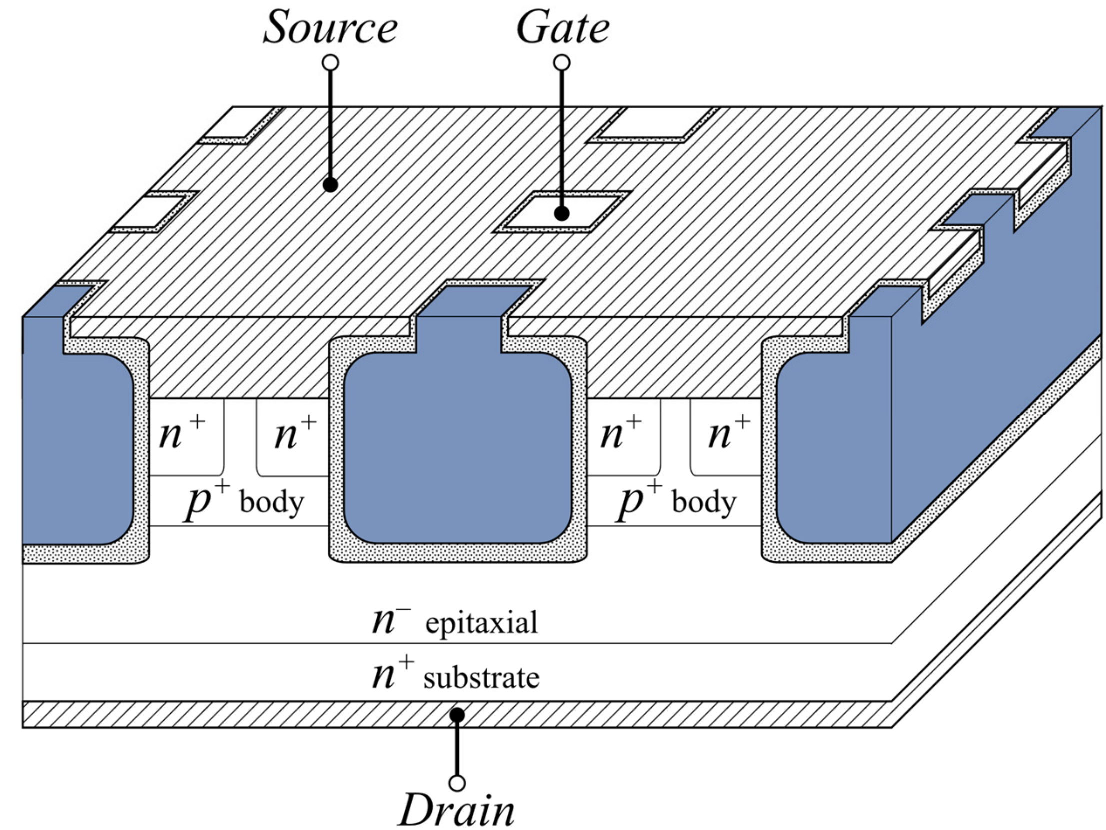


Fig. 16. Turn-on energy E_{on} at 25 ºC.

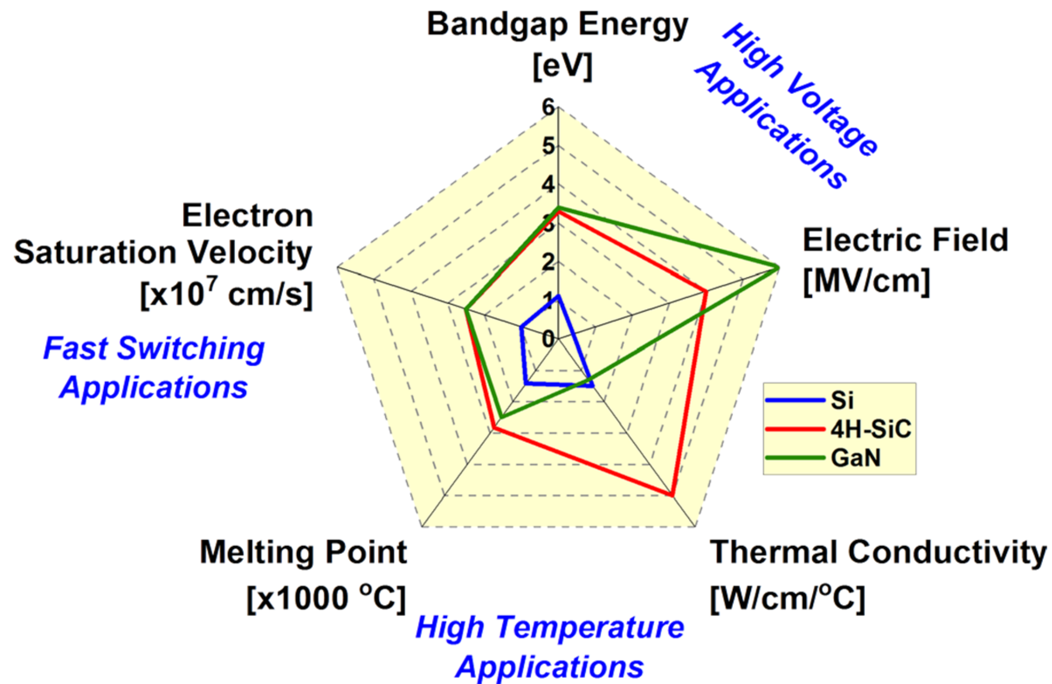


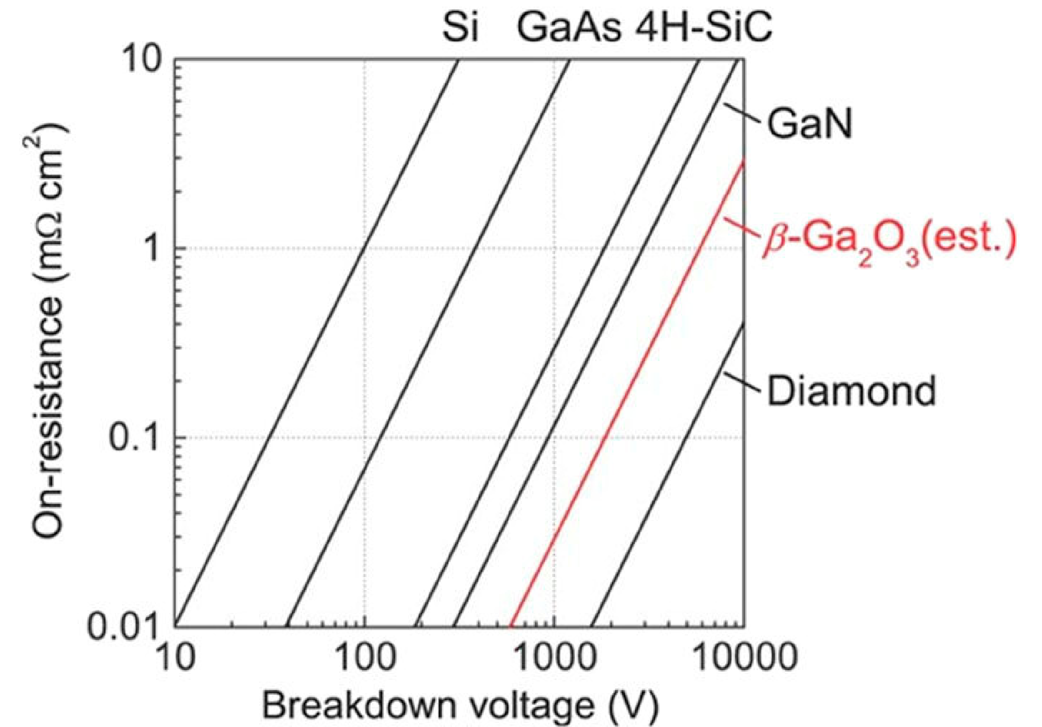
Other Device Structures





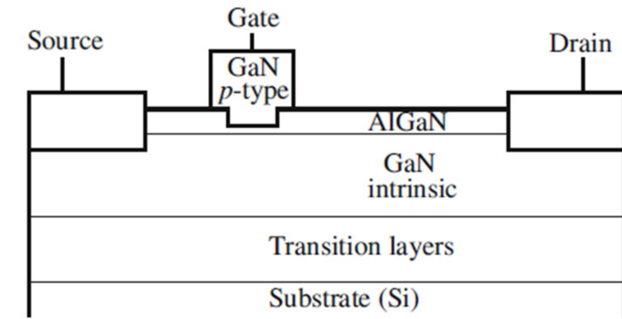
Wide Bandgap Materials

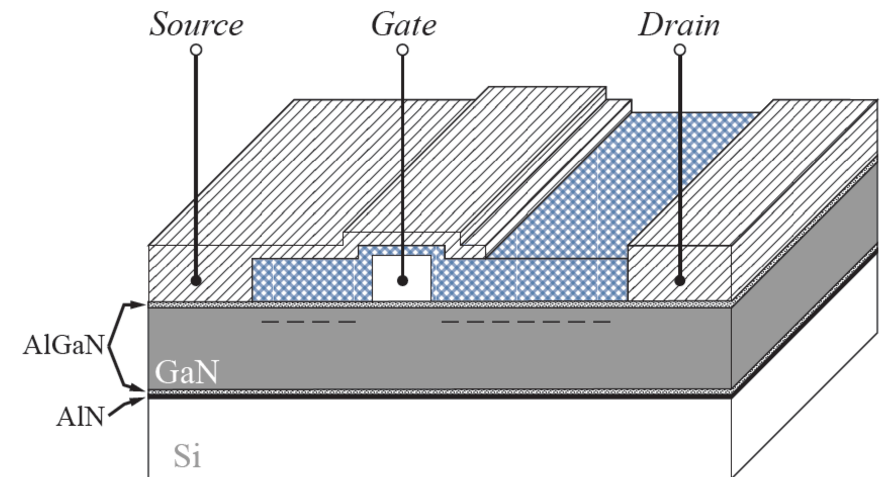




https://potenntial.eecs.utk.edu/About.php?topic=PowerSemiconductors

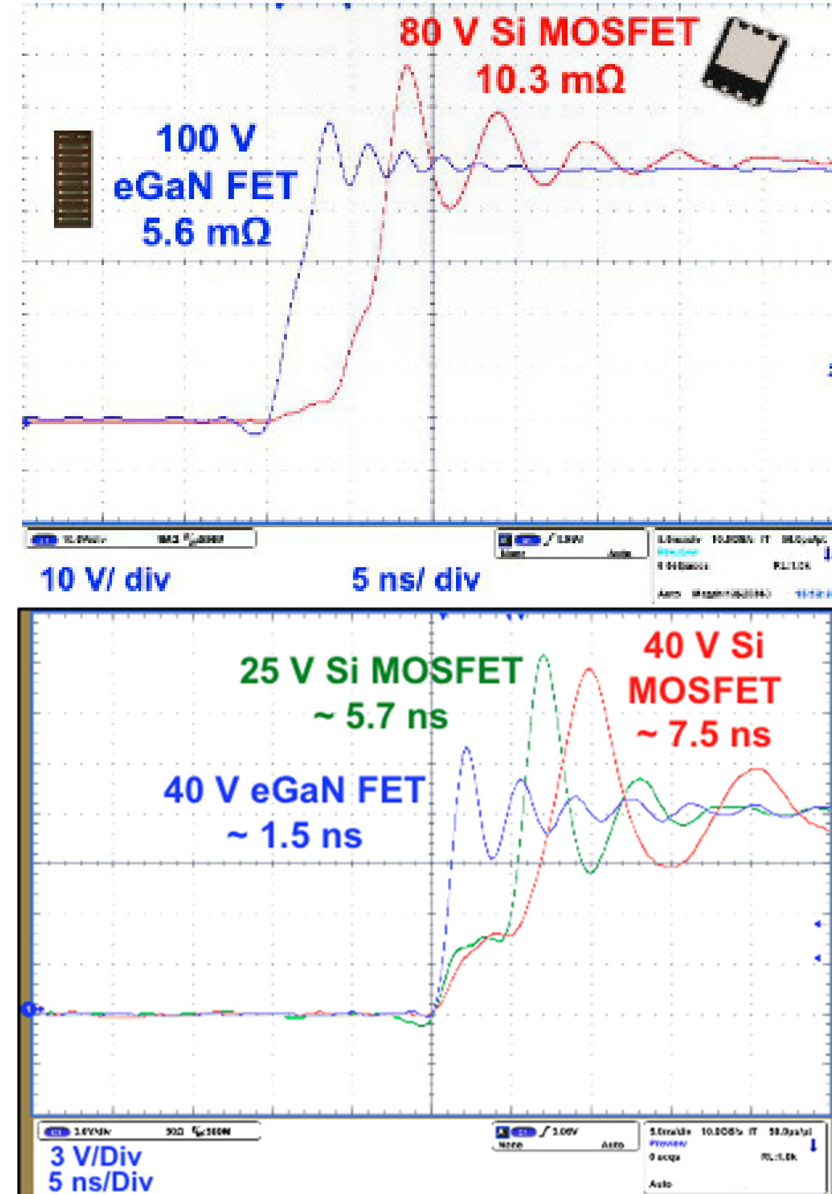
GaN HEMTs





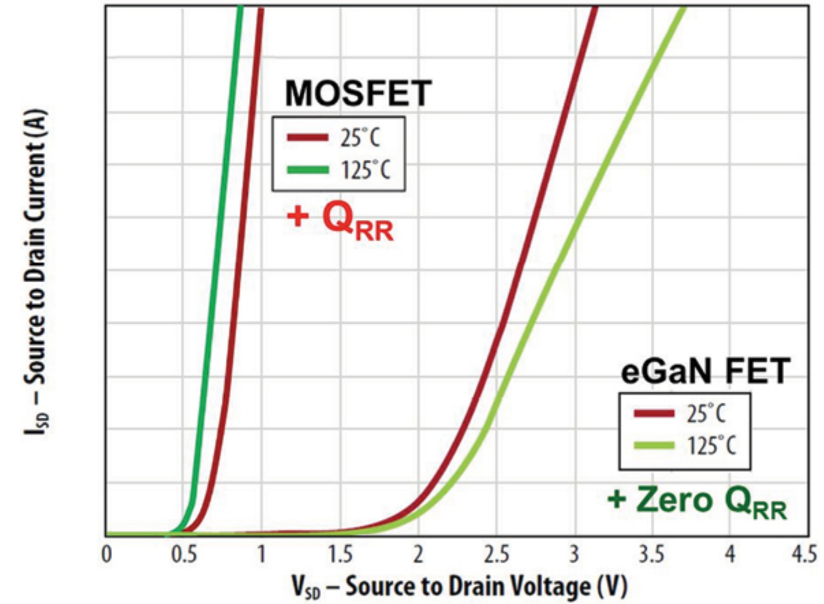
Designing with GaN

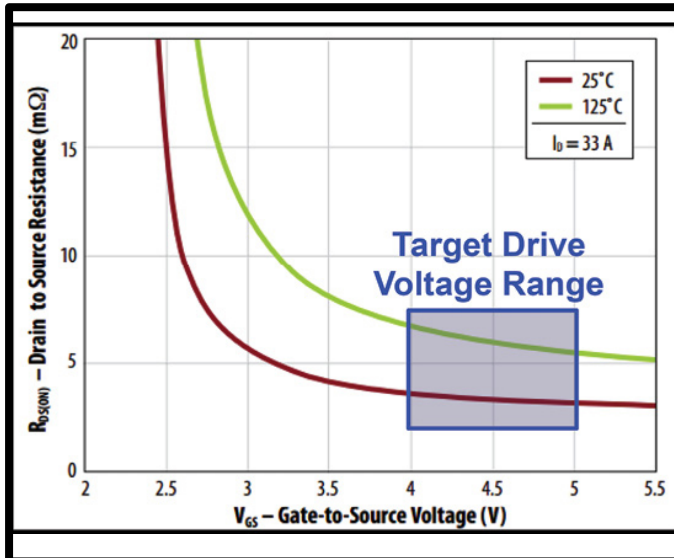
- Because of high electric breakdown field and high electron velocity, GaN devices with comparable R_{on} can be significantly smaller and switch must faster.
- Need **very** good layout to prevent ringing from causing overvoltage and device failure.

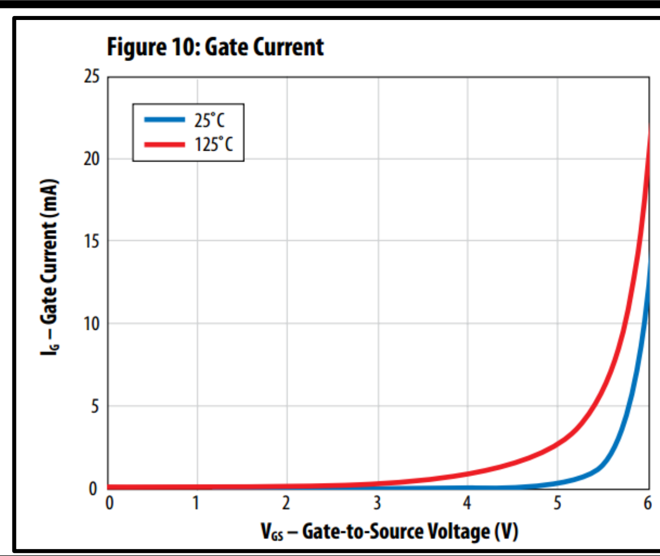


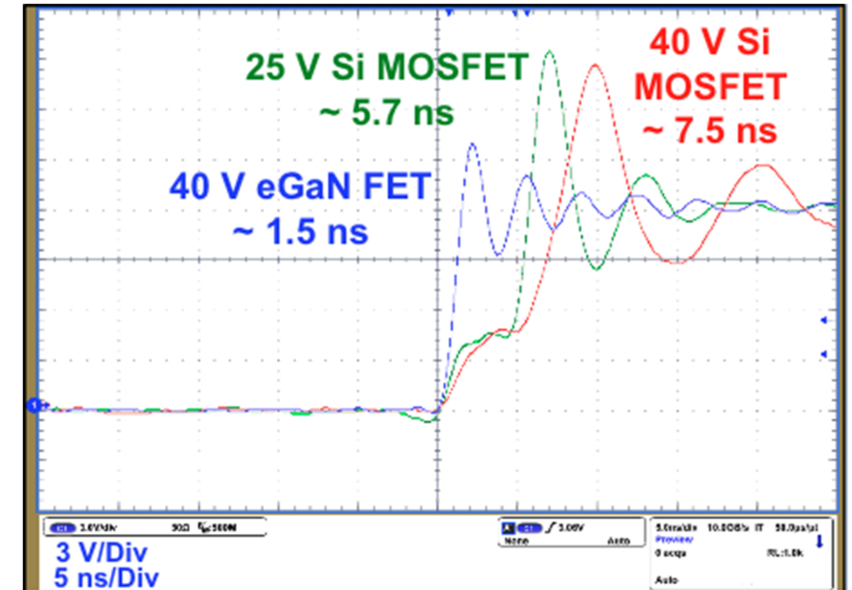
GaN Design Issues

1. Reverse conduction mechanism
2. Sensitivity to parasitics
3. Gate robustness
4. Small size -> Thermal limitations

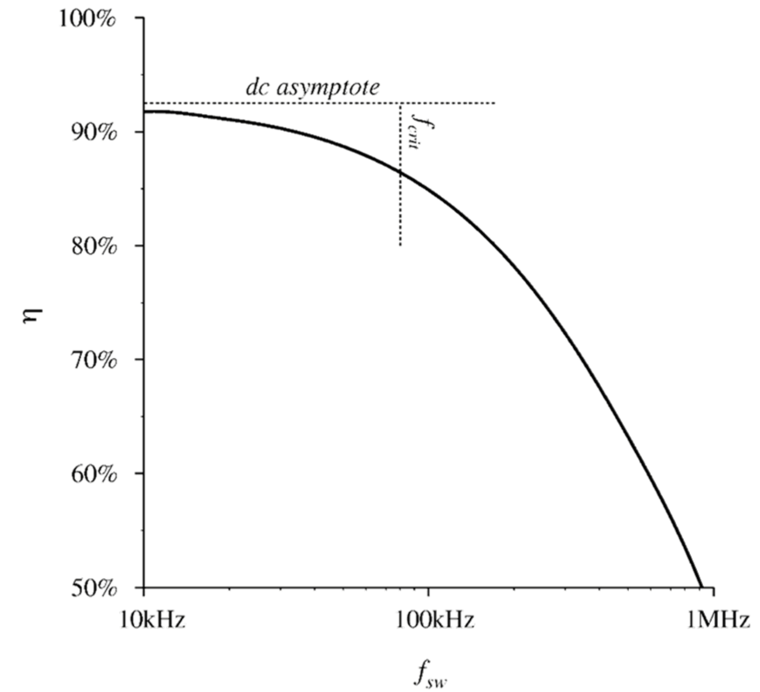




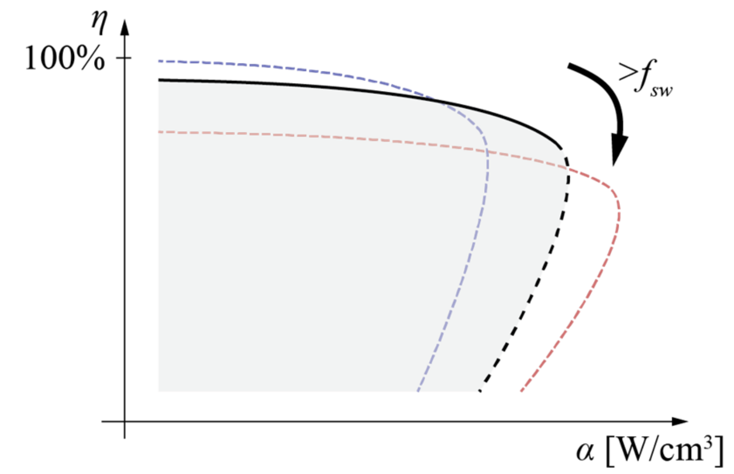




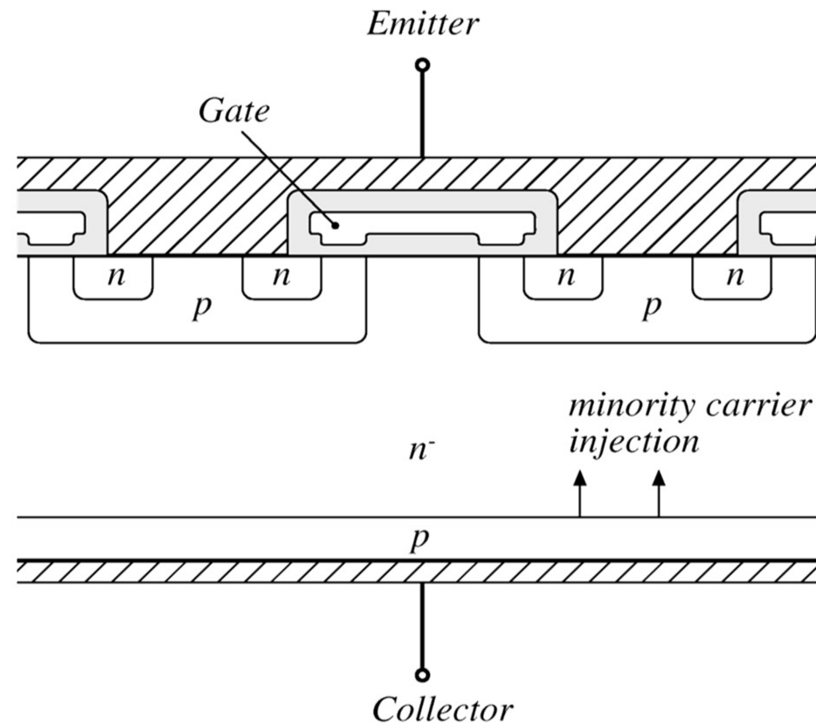
Converter Efficiency Vs. f_s



Converter Optimization

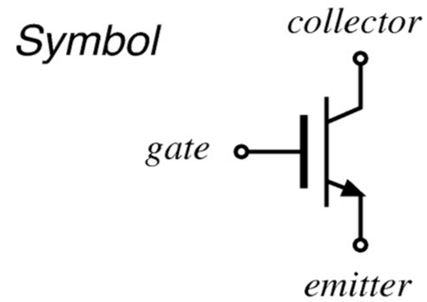


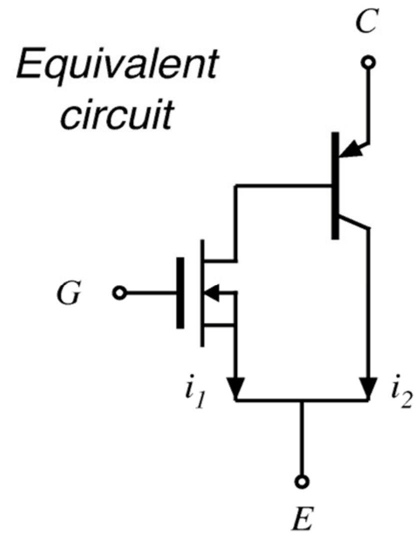
Insulated Gate Bipolar Junction Transistor

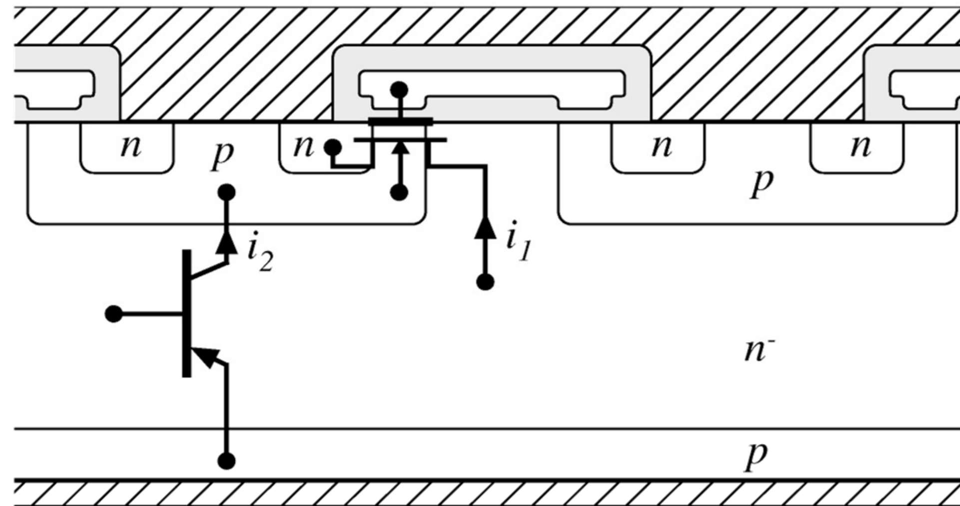


- A four-layer device
- Similar in construction to MOSFET, except extra p region
- On-state: minority carriers are injected into n^- region, leading to conductivity modulation
- compared with MOSFET: slower switching times, lower on-resistance, useful at higher voltages (up to 1700V)

The IGBT







THE UNIVERSITY OF TENNESSEE KNOXVILLE

IGBT: Current Tailing