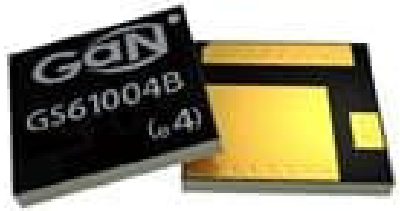
Prelab for Experiment 5: Redesign with GaN

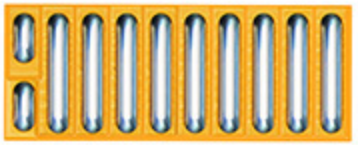
GaN Systems GS61004T

- 15 mOhm
- 100V/40A
- Q_g = 6.2 nC
- C_{oss} = 140 pF (50V)

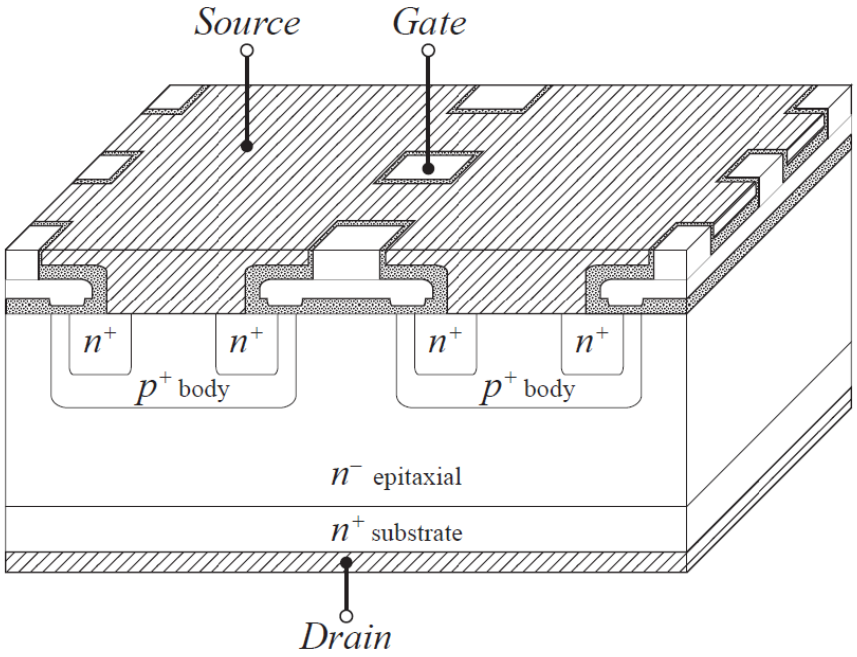


EPC EPC2001C

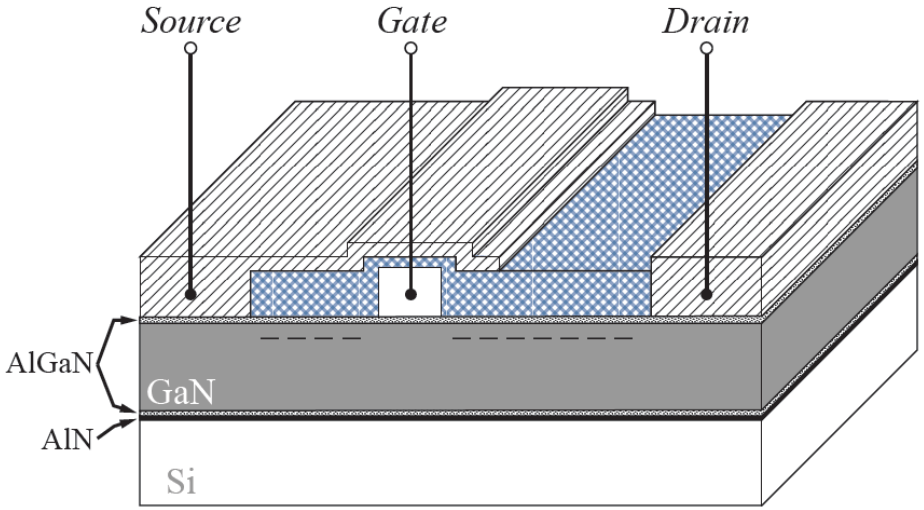
- 7 mOhm
- 100V/36A
- Q_g = 9 nC
- C_{oss} = 375 pF (80V)



GaN Devices



Vertical Silicon Power MOSFET



Lateral GaN HEMT

- No body diode (reverse conduction due to $V_{gd} > V_{gd,th} \approx 2V$)
  - Use antiparallel (schottky) diode or precise dead time
- Significantly faster switching

Designing with GaN

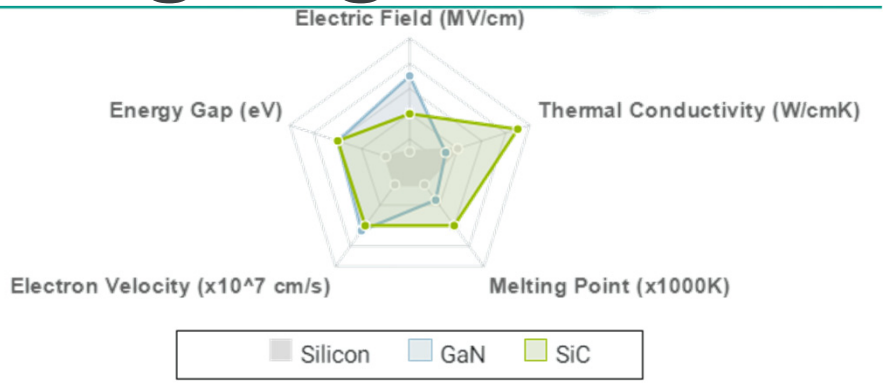
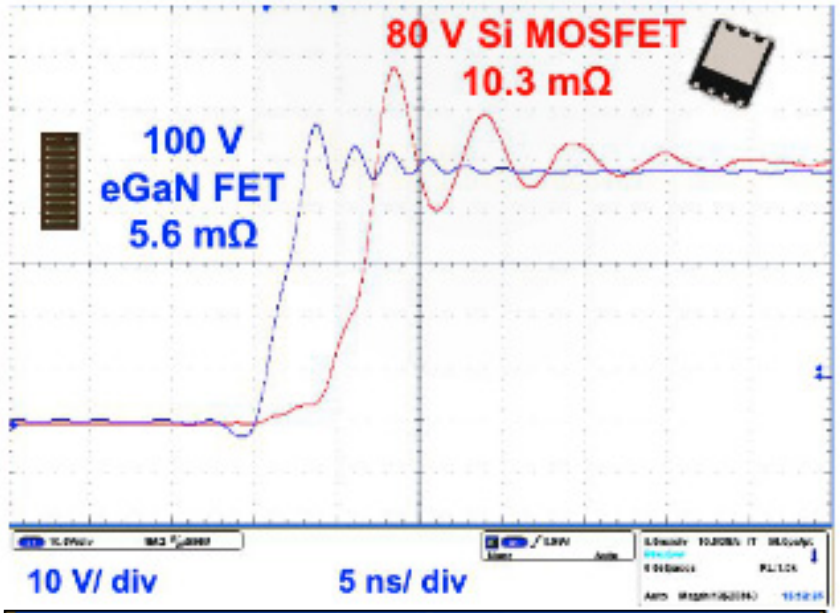
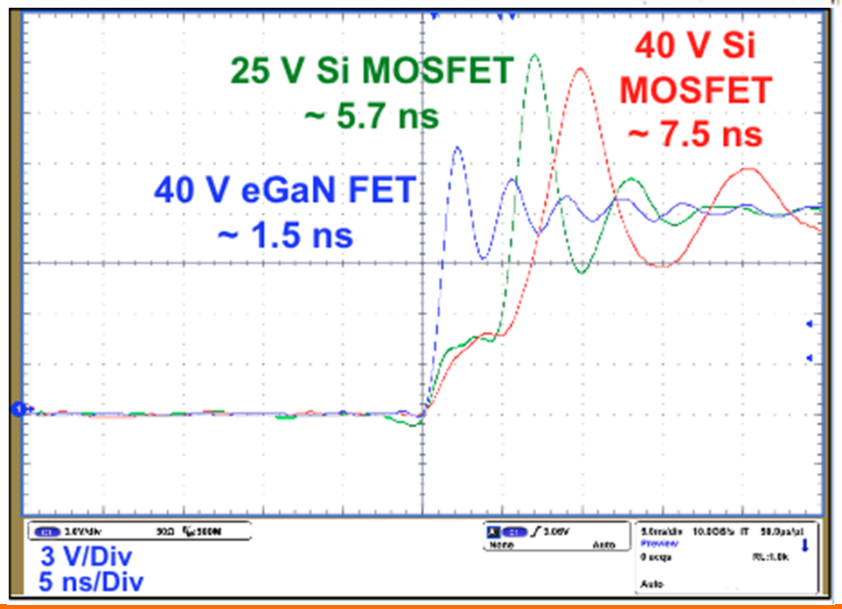


Fig. 1: Material properties of silicon, silicon carbide, and gallium nitride.





- 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.
- More information:
  - http://potenntial.eecs.utk.edu/About.php?topic=PowerSemiconductors

GaN Design Issues

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