Voltage Switching Limits in Lateral GaN Power Devices

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Lateral Gallium Nitride (GaN) power transistors rated up to 600 volts and vertical GaN power diodes rated up to 1,700 volts are currently available in the commercial market in low volumes [1-3]. These devices are being applied for power conversion electronics at substantially higher switching frequencies and ambient temperatures than feasible with silicon and Silicon Carbide (SiC) power devices. Important performance advantages of GaN power switching devices are low on-state resistance and inter-electrode capacitances compared to similarly rated silicon and SiC power devices. However, low capacitances also result in high switching dv/dt across the device which may cause long-term field-reliability problems. This paper reports on trade-offs in performance and reliability when using GaN power devices in power converters, especially at higher switching frequencies and ambient temperatures.

[1] K. Shenai, R. S. Scott, and B. J. Baliga, "Optimum Semiconductors for High-Power Electronics," IEEE Trans. Electron Devices, vol. 36, no. 9, pp. 1811-1823, September 1989.

[2] K. Shenai, "Made-to-order Power Electronics," IEEE Spectrum, vol. 37, No. 7, pp. 50-55, July 2000 (**invited paper**).

[3] K. Shenai, "Switching megaWatts with Power Transistors," to appear in The Electrochemical Society Interface Magazine, vol. 22, no. 1, pp. 47-54, Spring 2013 (**invited paper**).