Spatial Power Combining of Two GaN FET Grid Oscillators in an Over-Moded Rectangular Cavity

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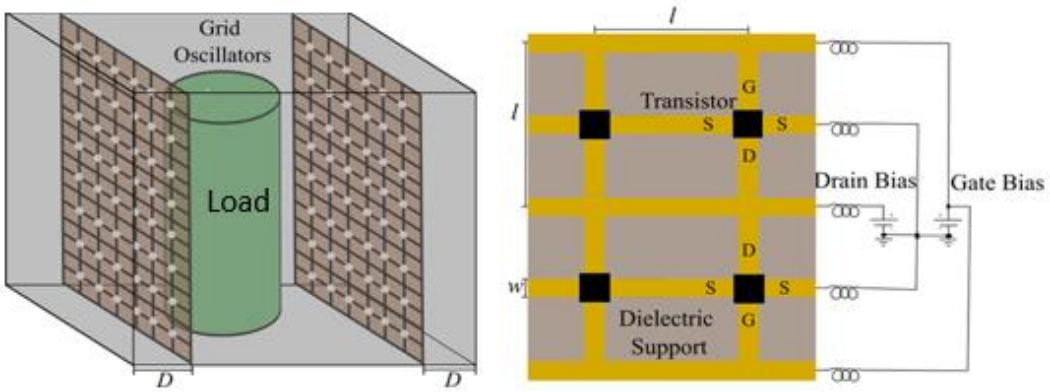
A grid oscillator consists of an array of transistors biased in parallel with a reflector enabling global feedback that locks all devices to the same frequency. A reflector positioned a distance on the order of one wavelength of the oscillation frequency and parallel to the grid provides the feedback (Z. Popovic, et al., "A 100-MESFET planar grid oscillator," *IEEE Trans. Microwave Theory Techn.*, pp.193-200, Feb. 1991). The output power of each transistor combines coherently upon radiation and with a radiation pattern corresponding to a uniform current sheet. Up to four closely spaced parallel grids were shown to have good power combining radiating efficiency in free space (Shiroma et al, "A 100-transistor quadruple grid oscillator," *IEEE Microwave Guided Wave Lett.*, vol. 4, pp. 350–351, Oct. 1994). This paper explores a configuration of two equal grids that form the walls of an overmoded rectangular waveguide resonator. The goal is to investigate locking and power combining inside the cavity with an absorptive load as would be done in heating applications.

The transistor lattice is much smaller than a free-space wavelength (e.g. λ/10), with 25 devices in each square grid, and a simple biasing of all devices in parallel. A 50cm x 25cm x 20cm metal cavity using two 10cm x 10cm grids at a distance (*D*) from two cavity walls is populated with GaN devices (Qorvo QPD1022). Oscillations build up from noise and the transistors lock to 2.45GHz through feedback provided by the cavity walls. The frequency can be tuned by gate and drain bias, as well as distance (*D*). The total power scales by device choice and number of devices. A simple equivalent circuit is used for steady-state nonlinear simulations and predicts the free-space measured oscillation frequency. The effects of cavity loading on frequency of locking and harmonic content are examined experimentally.



(a) (b)

Fig. 1. Left: Sketch of a rectangular over-moded cavity with transistor grid-oscillator walls. Right: detail of four unit cells of the grid with GaN transistors.