Abstracts

Power Amplification with Anomalous Avalanche Diodes

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The experiment described in this paper is performed for the purpose of obtaining additional information that might help to elucidate the operating principle of the anomalous mode. The diodes under investigation are of a silicon p/sup +/-n-n/sup +/ mesa structure. The breakdown voltage is 160 volts; the punch-through voltage is 60 volts. The test setup is similar to a conventional reflection-type amplifier with the diode mounted in a coaxial-cavity-like circuit. The reverse-bias pulse drives the diode to a low avalanche current level at which anomalous operation would normally commence. In this case, however, the tuning and loading of the cavity and its associated stubs is intentionally arranged to minimize free-running oscillations. Any residual RF power is reduced to the level of weak instabilities without any strong harmonics or subharmonic. Only in the presence of an input driving power with a frequency at or near the resonance frequency of the system, does an amplified power of the same frequency appear at the output port. Starting from the residual level the output power increases proportionally with the input power until at higher drives a saturation level is reached. In this particular case, operating at 410 MHz, saturation is reached at 18.5 watts with a maximum power gain of 12 dB and a bandwidth of 26 MHz. This output is approximately 20 to 30 dB higher in amplitude than any observable peak in the residual broad-band frequency spectrum Operating the diode as a free-running "hard" oscillator at the same current level and frequency, 18.8 Watts of RF power is obtained. The initial and steady-state power levels are substantially the same for both amplifier and oscillator. A plausible evaluation of these results can be obtained following van der Pol's differential equation for a forced negative-resistance oscillator.

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