Power Enhancement of Planar Gunn Oscillators Using Injection Locking

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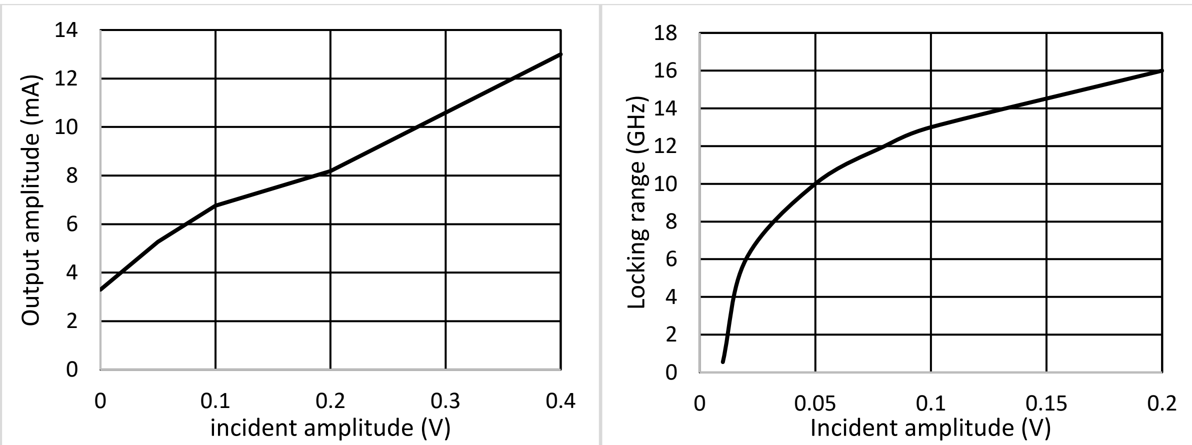
Self-mixing effect has been found in many oscillator devices such as Gunn diodes [1], resonant tunnelling diodes [2] and CMOS-based oscillators [3] due to their intrinsic nonlinear properties. When an external signal, f_{RF} is present onto such an oscillator device that produces an oscillation, f_{LO} , mixed signals $f_{RF} \pm f_{LO}$ can be generated. In most applications, only the differential element, f_{IF}, (f_{RF} - f_{LO}) is used provided an appropriate low pass filter is implemented. However, if f_{RF} is closer to f_{LO}, the self-mixing effect will be replaced by another physical mechanism called injection locking effect: the self-oscillation of an oscillator device can capture the incident RF signal, causing it to have essentially identical frequency as the self-oscillation [3]. In this paper, we investigate the injection locking effect of planar Gunn diode oscillators using COMSOL. The simulation results show a 1.3 μm long planar Gunn diode can not only generate an oscillation frequency of 95 GHz but also lock up an input signal whose frequency is between 92 GHz to 101 GHz. Furthermore, we also discovered that the power of the input RF signal can be enhanced within a certain range of frequencies. This phenomenon is very similar parametric amplification [3]. Fig. 1 show the relationship between locking range and incident amplitude and the linearity between incident amplitude and enhanced amplitude. The injection locking effect can be used to improve the overall performance of output by reducing the phase noise and enhancing the output power. The latter could be useful for sensing weak signals as well as building new signal sources with appropriate circuitry e.g., feedback loops for terahertz applications. Greater details will be elucidated at the conference.



(a) (b)

Fig.1 PGD injection locking effect (a) Locking range vs incident amplitude (b) linearity between Incident amplitude and enhanced amplitude.

References

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