VCO based on Composite Right/Left-Handed Metamaterial Transmission Lines loaded with RTD

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Abstract- This paper proposes a voltage control oscillator (VCO) at high frequency consists of nonlinear composite right/left-handed transmission line (CRLH-TL) loaded with Resonant Tunneling Diode (RTD). The system has equals input and output resistance. In this work, we used OrCAD and ADS software to analyze the proposed circuit. The VCO capable of generating oscillation at frequency equals 14.4 GHz.

Voltage controlled oscillator (VCO) has several applications in communications and sensing network. It plays an important role in converting DC values that detected from thermometer, pH sensor, or pressure sensor into frequencies. In this work, we proposed a compact voltage controlled oscillator (VCO) based on hybrid composite right/ left metamaterials transmission lines (CRLMTL) loaded with resonant tunneling diode (RTD). RTD has interesting applications referring to its high switching speed where it can reach up to 2.2 THz and to its I-V characteristic that often exhibits negative differential resistance regions [1]. The RTD is placed parallel with shunt inductor of CRLH-TL hybrid approach as shown in Fig. 1. The hybrid resonant unit cell consists of a microstrip line with a series gap and two shunt stubs etched in the strip and a complementary split-rings resonators (CSRR) printed in the ground plane[2]. The desired system has been achieved by loading the unit by input and output impedances that have equal value. In this work, we take it equals 50 Ω. We used OrCAD and ADS softwares to analyze the proposed circuit. The output of the oscillator is measured at different values of the biasing voltage of the RTD. The biasing is used to ensure that RTD operates in the negative differential region.

Fig.2 displays the lumped circuit equivalent to the proposed VCO. The DC biasing is tuned until the desired design is achieved. Fig. 3 exhibits the output voltage of the proposed structure in both time and frequency domain. We do the calculations at two different biasing voltages. In both cases, we found that the oscillator works at 14.4GHz. Our results show that our proposed model operates as VCO. Where, the VCO operates at 14.4 GHz that achieved at different biasing voltages mainly 0.9V and 1.1 V.

REFERENCES

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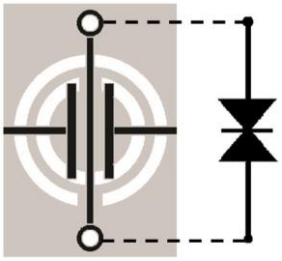

Fig. 1: RTD at shunt with grounded stubs of the hvbrid CRLMTL cell.

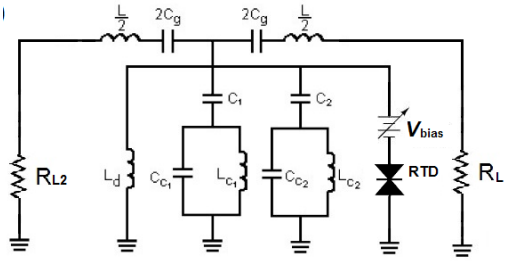

Fig. 2: VCO Equivalent circuit consists of the CLRTL unit cell loaded with RTD (Fig. 1) surrounded by two 50 Ω load resistances at the

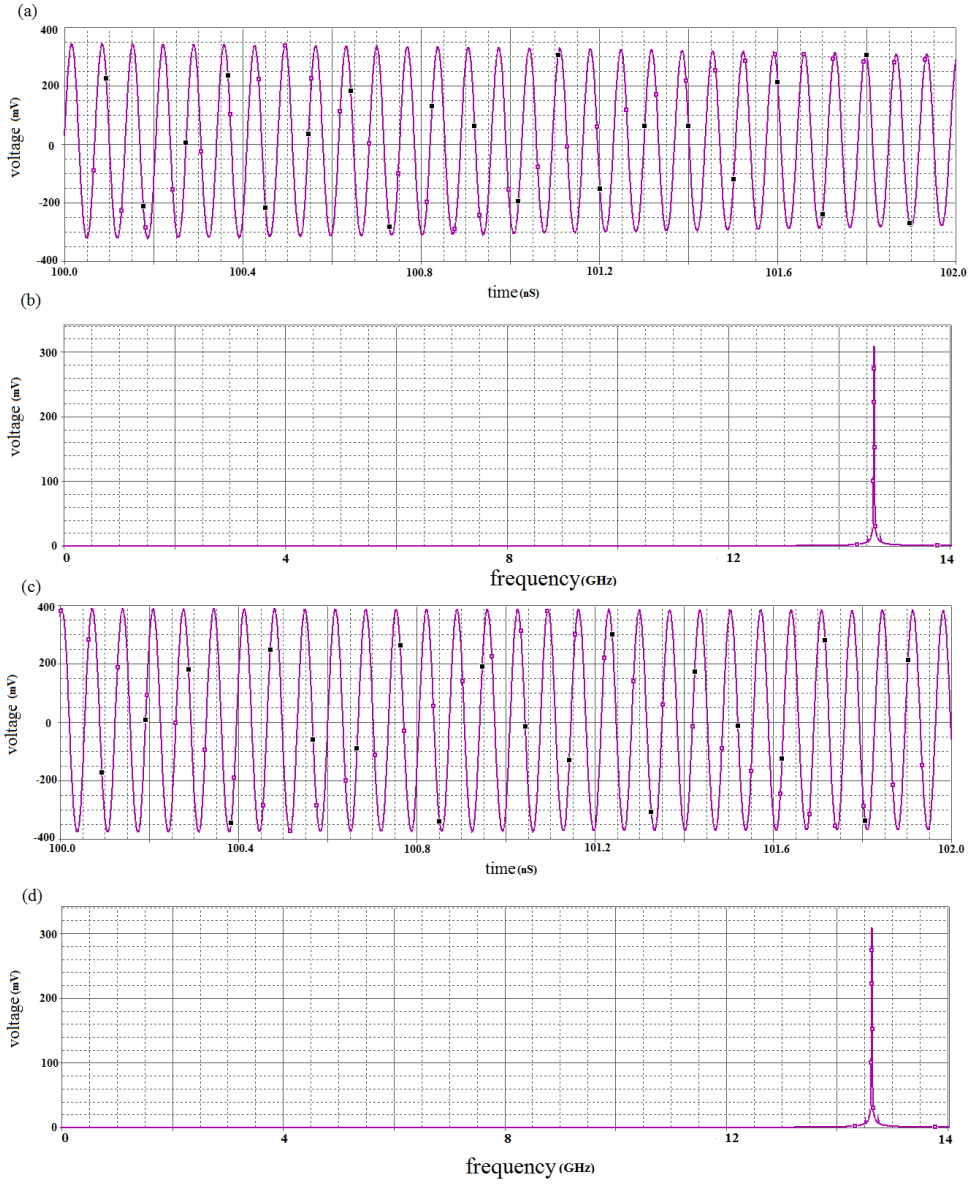

Fig. 3: The output voltage of our simulation measured in time domain and in frequency domain at two different values of $V_{bias.}$ (a, b) V_{bias} equals 0.9V (c, d) V_{bias} equals 1.1V.