I. INTRODUCTION

This work provides the results of the study of a capacitive lumped NLTL for RF generation based on silicon carbide Schottky diodes, verifying the capability of these components to generate higher frequencies oscillations (above 100 MHz).

II. NLTL THEORY

As C decreases with the applied voltage, the propagation velocity will increase with increasing voltage. Thus, the portion of the pulse with higher voltage amplitude will travel faster than the lower initial amplitude and the pulse peak will catch up the low voltage amplitude, forming an output shock wave-front with a very fast rise time.

\[ v_p = \frac{1}{\sqrt{LC(V)}} \quad dT = t_n - t_0 = n \left( \sqrt{LC_0} - \sqrt{LC(V_{\text{max}})} \right) \]

\[ Z_0 = \sqrt{\frac{L}{C(V)}} \quad f_c = \frac{1}{\pi \sqrt{LC(V_{\text{max}})}} \]

III. NLTL CIRCUIT MODEL

- The voltage dependence of the varactor diode capacitance can be modeled from the equation

\[ C(V) = \frac{C_0}{1 + \frac{V}{V_j}}^m \]

where \( V \) is the applied voltage, \( V_j \) is the junction potential, \( C_0 \) is the initial capacitance, and \( m \) is the inclination factor.

- The time charging function \( Q(V) \) is calculated by

\[ Q(V) = \int_0^V C(V) dV = \left( \frac{C_0}{1 - m} \right) \left( \frac{V}{V_j} + 1 \right)^{(1-m)} \]

- For the SiC Schottky diode chosen, model C4D05120E, the best agreement between the theoretical curves and the data provided by the manufacturer’s datasheet is achieved considering, \( V_j = 1 \text{ V} \), \( C_0 = 380 \text{ pF} \) and \( m = 0.45 \).

\[ C(V) = \frac{380 \text{ pF}}{(V + 1)^{0.45}} \quad Q(V) = \left( \frac{380 \text{ pF}}{0.55} \right) \left[ (V + 1)^{0.55} \right] \]

IV. EXPERIMENTAL AND SIMULATION RESULTS

- Experimental setup was implemented using a printed circuit board with 12 sections, with air core linear inductors of 56 nH and SiC Schottky diodes (model C4D05120E) as nonlinear elements.

- Simulations were performed using a Spice circuit modeling software. The nonlinear capacitors were modeled according to their time charging function \( Q(V) \). The better agreement between the simulated and experimental results was reached including an adjustment capacitance \( C_a \) in the simulated circuit showing that in practice the capacitance \( C \) is saturating above the value of the datasheet specification, providing a slower \( C \times V \) curve saturation. The optimized \( C_a \) value is 18.5 pF.

V. CONCLUSION

- Responses in time and frequency domains were analyzed and good agreement between the simulated and experimental results was verified.

- The results demonstrate an oscillation frequency of the order of 200 MHz, which agrees with the calculation of the cutoff frequency, considering the adjusted \( C(V_{\text{max}}) \).

- It was observed that the use of SiC Schottky diodes is a good option for high voltage RF generation, replacing ceramic capacitors.

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