IMPROVING THE VOLTAGE MODULATION DEPTH AND RF POWER GENERATED ON NONLINEAR TRANSMISSION LINES

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OBJECTIVE
The objective of this paper is to generate RF using low power NLTLs improving the voltage modulation depth \textit{v} – VMD. For this three types of low power NLTLs were designed, the first one uses parallel link capacitors with the varactor diodes, and the second employs parallel link capacitors with the inductors and finally, the third one uses cross link capacitors intercalating adjacent NLTL sections.

INTRODUCTION
Recently Nonlinear Transmission Lines (NLTLs) have been studied for several applications such as in satellite communications, military radars and biomedical area. This system is interesting due to its simple construction with the use of passive components composed by a network of inductors and capacitors, where at least one of these components needs to be nonlinear. The line using nonlinear capacitor C(V) is denominated a nonlinear capacitive line (NLCL) and another one using inductor L(I) called nonlinear inductive line (NNIL). The experimental work was performed in a line configured of hundreds of MHz and can reach hundreds of kWs for RF peak power, however, to study their behavior in low power range varactor diodes are used as nonlinear elements. In this work three types of low power NLTLs were tested to obtain higher Voltage Modulation Depth (VMD). The first one uses parallel link capacitors with the varactor diodes, and the second employs parallel link capacitors with the inductors and finally, the third one uses cross link capacitors intercalating adjacent NLTL sections.

EXPERIMENTAL SETUP

EXPERIMENTAL RESULTS

RESULT AND DISCUSSION

For standard line, the experimental result shows a soliton generation with frequencies of the order 30 MHz and VMD of approximately 8.8 V as seen in Fig. 6. The results using parallel capacitor with diode are shown in Figs. 7 & 8 for experiment and simulations respectively. The best case (experiment) was for the 10 pF capacitor considering the compromise between higher 9.54 VMD and frequency of the order of 23.2 MHz. The second configuration tested to improve RF generation is the tuning line presented in the Fig. 3. The results using parallel capacitor with inductor are shown in Figs. 9 & 10 for experiment and simulations, respectively. Again, as in former configuration, the best case for higher VMD (10.18V) was with the 10 pF ceramic capacitor, but with a drastic frequency decrease of 50% approximately (lowering to 15.62 MHz). The third line tested, known as cross-link configuration, where the capacitors are placed in parallel with two adjacent sections in such a way that their link terminals are cross-linked. The experimental results using cross link capacitor is shown in Fig. 11. The best VMD was obtained for C=1 pF with a value of about 11.6 V, showing an increase of 42% compared to the standard line. However, as before in former cases as VMD is increased the oscillation is decreased. In this case, for 1 pF capacitance frequency decreased from 30 MHz for standard line to 24 MHz approximately, having a drop of 20% in frequency.

CONCLUSION

As shown by experimental results, there is a good agreement with the corresponding simulations. In the first configuration tested with link ceramic capacitors in parallel with varactors, the best-case scenario was found for C= 10 pF with increased VMD of the order of 1.40 V, giving approximately 37% of increase in peak power. For the second configuration, the better result obtained was also for 10pF capacitor with an increase in VMD of about 2.04 V and in respective peak power of approximately 56.40 %. For the last configuration the better result was achieved with 1pF capacitor, providing an increase of 3.48 V in VMD and of 103 % approximately in peak power. In short, this work shows the prospect of increasing VMD and respectively the peak power employing mainly cross-link configuration for NLTLs. This technique may be very useful for the development of high power NLTLs for applications as pulsed RF sources in electronic disruption systems for small defense platforms in trucks, ships, airplanes.