DESIGN CONSIDERATIONS FOR TUNNEL DIODE NON-LINEAR TRANSMISSION LINES

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ABSTRACT

A tunnel diode non-linear transmission line has been investigated for second and third harmonic generation purposes. Design criteria are given and performance predictions have been obtained simulating the single diode behavior by means of a polynomial expression. An optimization of the non-linear transmission line as a harmonic generator has been obtained as a function of the number of diodes, their separation distances and the bias voltage.

INTRODUCTION

In recent years electronic devices able to generate millimeter and sub-millimeter waves are often required in many electronic systems.
In order to produce so high frequency signals, non-linear transmission lines (NLTL) have been proposed [1,2,3]. The GaAs NLTL is a MMIC device composed by high impedance (typically about 75 Ω) coplanar waveguide sections, periodically loaded by non-linear capacitors (as, for instance, Schottky varactor diodes). The equivalent circuit of the NLTL is shown in Fig.1.

![Fig. 1 Schematic view of the tunnel diode non-linear transmission line used for the simulation. A dc Feed Unit is used for supplying the cascade of diodes with direct current. It contains a choke for the current supply and an isolating capacitor acting as a dc block.](image)

The number of diodes N as well as their separation distance S strongly affect the non-linear behavior of the whole structure. Recently, Yu et al. have described a NLTL where tunnel diodes are the non-linear elements [4].

In this paper, the possibility to use this tunnel diode non-linear transmission line (TDNLTL) for harmonic generation is investigated. The analysis is carried out by using the time domain analysis implemented in the commercial software HP-MDS-IMPULSE package. In particular, the diode I-V characteristic utilized for the simulation has been obtained by fitting previously reported experimental data [5]. The effect of the diodes number, positioning and bias voltage $V_{dc}$ on the non-linear response of the TDNLTL is discussed, to develop design criteria for harmonic generation.