Shock Wave Generation and Cut off Condition in Nonlinear Series Connected Discrete Josephson Transmission Line

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Abstract — The nonlinear wave propagation in a series-connected Discrete Josephson Junction Transmission Line (DJTL) is investigated. This structure consists of a superconductive Coplanar Waveguide (CPW), that is periodically loaded by either single or lumped arrays of Josephson junctions (JJs). Each junction is represented by the basic circuit model which leads to a nonlinear inductor element. Having a significant number of junctions per wavelength, the discrete transmission line (TL) can be considered as a uniform nonlinear transmission line. The nonlinear wave equations are solved numerically by Finite Difference Time Domain (FDTD) method. Features and characteristics such as cut-off propagation, dispersive behavior and shock wave formation, which are expected from wave propagation through the nonlinear DJTL, are discussed.

Index Terms — Applied superconductivity, Microwave superconductivity, Discrete Josephson transmission line, Finite Difference Time Domain Method, Nonlinear microwave propagation, Josephson junction devices, Nonlinear transmission lines, Shock waves, Dispersion.

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