

宽带速调管放大器三间隙输入腔中束波能量交换研究

摘要

本文提出了一种用于分析宽带速调管放大器三间隙输入腔中电子与电磁场能量交换的方法。通过在每个间隙的轴向驻波电场幅值中添加一个和频率相关的系数，得到了工作频率范围内轴向电场的表达式。基于小信号理论，对电子运动过程进行了分析，推导出了三间隙腔中电子束与电磁场的能量交换表达式。基于计算结果对一个特定结构的三间隙输入腔进行了分析，并利用仿真软件对电子的能量变化情况进行了模拟。模拟结果与理论分析结果吻合良好，验证了方法的有效性。因此本研究可为宽带速调管放大器中的三间隙输入腔设计提供理论指导。

关键词

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Abstract

This paper proposes an analytical method for characterizing the energy exchange between electrons and the electromagnetic field in the triple-gap injection cavity of a broadband klystron amplifier. By adding a frequency-dependent coefficient to the electric field amplitude of the axial standing wave of each gap, the axial electric field expression across the operating frequency band is obtained. Based on small-signal theory, the electron dynamics is analyzed, and an expression for the energy exchange between the electron beam and the electromagnetic field in the triple-gap cavity is derived. The analysis of a triple-gap injection cavity with a specified structure is conducted by the use of the results derived above. To validate the analysis, the energy absorption of electrons is examined in PIC simulations. The outcome is consistent with the results obtained from theoretical analysis. Therefore, the analytical results derived in this work provide guidance for designing triple-gap injection cavities in broadband klystron amplifiers.

Keywords

High power microwave, Broadband klystron, Triple-gap injection cavity, Delf-oscillation

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