

Design of a Low Cathode Loading, High Compression Ratio Electron-Optical System for D-Band TWTs

Kunqing Duan^{1,2}, Jun He¹, Qinglun Liu¹, Yongliang Liu¹, Dehui Zhai¹, Cha Gao¹, Muguang Li¹

¹ Discipline and Technology Center of Vacuum Electronic Devices and Systems, Aerospace Information Research Institute, Chinese Academy of Sciences

No.5 Yanqi East 2nd Road, Huairou, Beijing 101407, China

²University of Chinese Academy of Sciences

No.1 Yanqihu East Rd, Huairou District, Beijing, 101408, China

E-mail of corresponding author: skyboyhj@163.com

ABSTRACT

This paper presents the design of a D-band electron optics system (EOS) for geostationary orbit (GEO) satellite applications using CST Studio Suite. A Pierce-type electron gun with an area compression ratio of 204 was developed, generating a 74-mA beam with a cathode emission current density below 2 A/cm². A periodic permanent magnet (PPM) focusing system with a peak axial magnetic field of 5020 Gs was designed for beam confinement. Simulation results demonstrate stable, zero-interception transmission over a 40 mm distance with a 100% transmission rate. This design provides a viable solution for high-power, long-life D-band traveling-wave tubes.