URN etd-0407109-183711-898
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Statistics This thesis had been viewed 37 times. Download 0 times.
Department
Year 2002
Semester 2
Degree Master
Type of Document Master's Thesis
Language zh-TW.Big5 Chinese
Title Ka - Band TE01 Gyrotron Traveling Wave Amplifiers
Date of Defense 0000-00-00
Page Count 100

Keyword
gyro-TWT
absolute instability
gyrotron backward-wave oscillation
reflection oscillation
sever
distributed-losses
improved distributed-losses

Abstract
High power and broad bandwidth capability of the gyrotron traveling wave amplifier (gyro-TWT) makes it an attractive source of coherent radiation in the millimeter wavelength range. The mode exhibits the lowest ohmic dissipation in previous gyro-TWT experiment. Moreover, it's field peaks at a radial position of half the waveguide radius, so the quality of electron beam isn't degraded. However, operating of the high current, the output power, gain, and efficiency of gyro-TWT will be degraded where the absolute instability, gyrotron backward oscillation (gyro-BWO) and reflective oscillation occur to cause mode competition. Stability issues comprise the key factors limiting the performance of the gyro-TWT, therefore physical origins of spontaneous oscillations in the gyro-TWT are analyzed and characterized. The structure with distributed interaction wall losses was shown to be effective in suppressing absolute instability in the event. Moreover, the attenuation severs to decrease interaction length of gyrotron backward oscillations in effect. Therefore, the interaction structures with distributed wall losses and attenuating severs were more stability for absolute instability and gyrotron backward oscillations. The improved gyro-TWT (type I) is predicted to yield a peak output power of 155 kW at 32.9 GHz with an efficiency of 15 %, a saturated gain of 45 dB and a bandwidth of 2.2 GHz for a 100 kV, 10 A electron beam with an axial velocity spread . Besides, is the improved gyro-TWT (type II) predicted to yield a peak output power of 418 kW at 33 GHz with an efficiency of 20.9 %, a saturated gain of 77 dB and a bandwidth of 2.6 GHz.
Advisory Committee Yi Sheng Yeh - advisor

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Date of Submission 2003-06-23