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Abstract
A gyrotron traveling wave amplifier (gyro-TWT) is a high-power, broadband, millimeter-wave amplifier, applied in communication, military radar and satellite. Harmonic Multiplying gyro-TWT drives a fundamental TE11 wave in the input section and a second harmonic TE21 wave in the output section. This operation has two advantages. First, the magnetic field requirement can alleviate efficiently. Second, tuning the output waveguide radius achieves the multiplying frequency, relative to the input frequency. However, operating of the high current, the output power, gain, and efficiency of gyro-TWT will be degraded where the absolute instability oscillation occur to cause mode competition. Stability issues comprise the key factors limiting the performance of the gyro-TWT. The structure with distributed interaction wall losses, the length of interaction section and attenuation servers was shown to be effective in suppressing instability oscillation in the event. Therefore, the interaction structures with distributed wall losses and attenuating severs were more stability for instability oscillation. A harmonic multiplying gyro-TWT design with distributed-loss and severed structures is proposed to stabilize the amplification. This study presents a nonlinear analysis of typical oscillations, including analysis of instability oscillation. The lossy and severed sections of the harmonic multiplying gyro-TWT seem to increase effectively the start-oscillation currents of the instability oscillation. The harmonic multiplying gyro-TWT is predicted to yield a peak output power of 230 kW at 33.65 GHz with an efficiency of 30 %, a saturated gain of 40 dB and a bandwidth of 0.8 GHz for a 60 kV, 13 A electron beam with an axial velocity spread ?vz/vz=8 %.
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