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Title:Modeling investigation of an ultrawideband terahertz sheet beam traveling-wave tube amplifier circuit
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Abstract: Extensive numerical analysis has demonstrated that a terahertz (H-band) sheet beam traveling-wave tube (TWT) amplifier circuit, composed of a staggered double grating array waveguide, has very broad bandwidth (~30%) of the fundamental passband (TE mode) with a 7:1 aspect ratio sheet beam without excitation of n = 1 space harmonic backward-wave modes. Particle-in-cell (PIC) simulations utilizing MAGIC3D and CST PS predict that the designed circuit produces ~150-300-W output power, corresponding to ~3%-5.5% intrinsic electronic efficiency (~35-38-dB saturated gain from 50-mW input driving power), over ~25% bandwidth, which is in good agreement with CHRISTINE 1-D code predictions. Simulations, using a perfectly matched layer boundary (~ -30-dB return loss), show that the circuit stably operates without noticeable oscillation. With a more realistic matching condition (~ -9.5-dB return loss), it becomes unstable. However, simulations show that the incorporation of an attenuating sever with tapered conductivity suppresses the instability in tube operation.
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