

# **Study of High Power, Two-Stage, TWT X-Band Amplifier \***

P. Wang, Cz. Golkowski, Y. Hayashi, J. D. Ivers, J.A. Nation,  
Cornell University

and L. Schachter, Technion, Israel

School of Electrical Engineering, Cornell University, Ithaca, NY 14853, USA

Department of Electrical Engineering, Technion- IIT, Haifa 32000, ISRAEL

A disk loaded slow wave structure with a cold wave phase (without electron beam) velocity of the  $TM_{01}$  wave greater than the speed of light ( $1.05c$ ) is used as the electron bunching stage of a two stage X-band amplifier. The high phase velocity section produces well defined electron bunches. The second section, where the cold wave phase velocity is ( $0.84c$ ), i.e. less than beam velocity of  $0.91c$ , is used to generate the high output power microwave radiation. The tightly bunched beam from the high phase velocity section enhances the beam energy conversion into microwave radiation compared to that obtained with a synchronous electron-wave buncher.

The amplifier is driven by a 7mm diameter 750 kV, 500A pencil electron beam. The structure, which has a 4 GHz bandwidth, produces an amplified output with a power in the range of 20-60 MW. At higher output powers ( $>60MW$ ) pulse shortening develops. We suspect that the pulse shortening is a result of excitation of the hybrid mode,  $HEM_{11}$ , which overlaps ( about 0.5 GHz separation) with the frequency domain of the desired  $TM_{01}$  mode.

A new amplifier with similar phase velocity characteristics but with a 1 GHz bandwidth and an  $HEM_{11}$ ,  $TM_{01}$  mode frequency separation of 3.3 GHz has been designed and constructed. The interaction frequency for the HEM mode is above the passband of the TM mode. Testing is in progress. The performance of the new amplifier will be compared with results obtained using the earlier configuration.

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