

# GENERATION OF A 5A, 10kV HOLLOW ELECTRON BEAM BY A PIERCE GUN

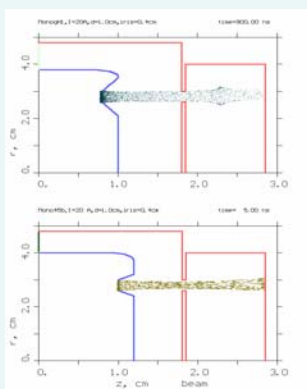


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## MOTIVATION

Consisting of a cylindrical cavity driven by a rectilinear electron beam, the monotron is the simplest microwave generator, whose principle of operation relies on transit-time effects experienced by the electron beam propagating across the cavity. Here we describe a Pierce gun used to accelerate and inject a hollow electron into a cylindrical cavity to generate high-power microwaves at 6.7 GHz, a frequency suitable for communications, medical and industrial applications.

## Electron Beam Particle-in-Cell Simulation



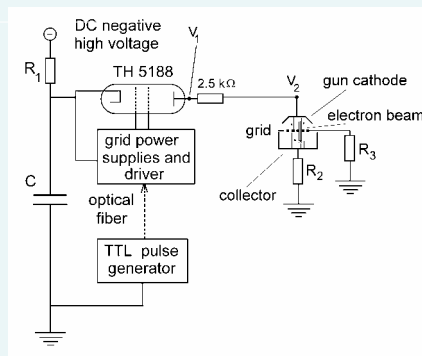
## MONOTRON COMPONENTS



## PULSE GENERATOR VIEW

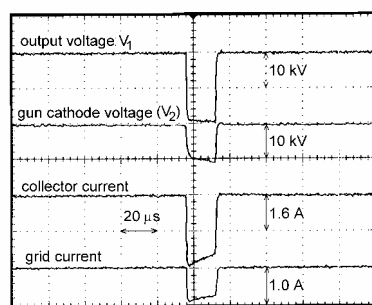


A capacitor bank C (2.0  $\mu$ F/ 100 kV) discharges through a tetrode tube TH5188 in series with the beam impedance. A DC high voltage power supply (100 kV/50 mA) charges the capacitor bank where the resistor R1 of 60 k $\Omega$  limits the transient charging current. A second resistor of 2.5 k $\Omega$  in series with the tetrode and the beam load protects the system against the risk of short-circuits.



## GUN OPERATION

The gun cathode voltage is fixed at the nominal value of 10 kV, while the current supplied by the emitter is freely adjusted by varying the cathode temperature. The current drawn by the cathode is inferred by the voltage drop  $V_2 - V_1$  across the 2.5 k $\Omega$  ballast resistor and then compared with the grid and collector currents (directly determined from voltage measurements on resistors consistent with the sum of the current components, namely, the grid (~0.9 A) and collector (~ 3.1A) currents.



## CONCLUSION

- The tests have indicated that a substantial fraction of the injected current is intercepted by the cavity's input grid, made up of a slotted circular plate.
- The pulses are regularly shaped by approximate rectangles such that this desired characteristic defines unambiguously the corresponding pulsed beam power.
- Although limited to 10 A, the 25 kV pulse generator described here has proven to be well suited for driving a high-power electron gun, which is a critical component in all microwave tubes.
- A new circuit design for the pulse generator is currently under development to provide beam currents at 10kV in excess of 20A, by using a cascade type circuit with three tetrodes in parallel.