PREFACE

The requirement of high power microwave sources find applications in defence as well as civilian needs. These HPM sources include both conventional microwave tubes in the relativistic regime as well as specialized HPM devices. The use of intense relativistic electron beam (IREB) has significantly enhanced the RF output power of the conventional devices. Relativistic klystron, relativistic magnetron, and relativistic backward wave oscillators are few such devices in the slow wave category. The IREB gyrotron and free electron laser (FEL) are in the fast wave category. Virtual cathode oscillator (vircator) is a popular HPM device; however, its efficiency is rather low. Also, vircator high output impedance value makes RF output coupling difficult with the load. Magnetically insulated line oscillator (MILO) is a compact HPM source capable of generating gigawatts of power, but it suffers from the problem of pulse shortening as well as the requirement of additional mode converter to couple the RF power with the external antenna.

In recent years, reltron has emerged as a potential HPM source which is equally simple and compact with high- efficiency capability. The attractive features of the device are: external magnetic field is not required, no need of mode converter, provides pulse power in excess of 100 ns duration and frequency tuning is very easy. Apart from these features, it provides a good impedance match with the external devices.

The author has presented a brief device description and operating principle of the reltron, then the concept of oscillation condition has been developed. An analytical model to calculate the electronic efficiency of the device has been demonstrated. A device design methodology of reltron has been presented and subsequently used to design the reltron. A reltron with an explosive emission model has been simulated using

commercial 3D PIC code CST Particle Studio to validate the design constraints and to evaluate the device performance. The electron beam and electromagnetic wave interaction process is analyzed starting from the basic principles which include bunching mechanism, modulation process, and associated RF energy developed. The results obtained through analytical calculations are validated through PIC simulation of the device. A brief study of the virtual cathode formation mechanism is also presented to show the multistage virtual cathodes in the different sections of the cavity.

The author, from time to time, has reported the present work part-wise at national and international conferences as well as in reputed journals, namely, IEEE Transactions on Plasma Science, and AIP Physics of Plasmas.

The author will consider his modest effort a success, if it proves to be useful both in the understanding as well as the design and development of the potential HPM oscillator — reltron.