PREFACE

High-power microwave (HPM) has been very popular in the microwave community due to its various civilian and military applications. The generation of RF in millimetre-wave ranges and dual-frequency generation through a single HPM device drag the attention of researchers and academia around the world for R&D in this domain. HPM source is the device that can generate RF power more than 100 MW in a frequency range from 1-100 GHz. HPM application domains are mainly in communication, Radar, UWB, Power beaming, linear colliders, fusion heating, and indirect energy weapons (DEW). The whole process of HPM generation and application uses different sub-systems starting with prime power supply and followed by pulsed DC power formation, a microwave source, mode converter, and antenna. These different sub-systems of the whole HPM system have a unique role in the whole process of RF generation and application. Microwave or HPM source is the main sub-system in the whole microwave generation process. The different HPM sources which can generate RF power are relativistic magnetron, relativistic klystron, relativistic backward wave oscillator, relativistic gyrotron devices, Vircator, Reltron, and magnetically insulated line oscillator (MILO). The different radiation process followed by these HPM sources is mainly classified as Cherenkov radiation, transition radiation, and Bremsstrahlung radiation. This work is mainly based on the HPM source, MILO, which uses the Cherenkov radiation process. Comparing the other HPM source, the MILO does not require any external magnetic field which makes it compact, lightweight, and compatible to use on different mobile platforms.

MILO is a crossed-field high power microwave device that is similar in operation and theory of magnetron. It operates by combining the technology of magnetically insulated electron flow and slow-wave tubes. Microwave oscillator which requires an external DC magnetic field employs two DC power sources for exhibiting magnetic insulation and also gives rise to electrical breakdown as higher voltages are approached. These oscillators are having a very high inherent impedance that severely limits the power level at which the oscillator will operate. Thus, for efficient operation at higher power levels, it would be desirable to have an oscillator that will operate at the lower impedance and also eliminate the problem of voltage matching. To overcome the above problems, MILO has been used, in which the required magnetic field is supplied by the electron-beam current itself, rather than by a separate magnet and thus makes the device more compact and lightweight.

The designing improvement of MILO to avoid some critical issues like pulse shortening problem, asymmetric mode generation and mode competition, shot-to-shot reproducibility, the requirement of high pulse rate frequency and long life of cathode are still consider as a challenge for device development. The performance improvement of MILO and bi-frequency MILO is the prime work to be done. In order to carry out the aforementioned work, the author has considered the optimization of the MILO device sub-section and impedance matching between different sections using an equivalent circuit approach. Further, the study of beam-wave interaction for the generation of bi-frequency through MILO device has also been taken as the objective for current work.

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 transaction on plasma science.

The author will consider his modest effort a success if it proves to be useful in the design of MILO and bi-frequency MILO.