

LIST OF FIGURES

Figure 1.1:	Schematic of a relativistic klystron.	6
Figure 1.2:	Schematic of Relativistic magnetron.	7
Figure 1.3:	Schematic of relativistic backward wave oscillator.	10
Figure 1.4:	Basic configuration of virtual cathode oscillator.	11
Figure 1.5:	Schematic of MILO device.	13
Figure 1.6:	Schematic of the reltron.	15
Figure 1.7:	Classification of reltron.	17
Figure 2.1:	Schematic diagram of a reltron.	30
Figure 2.2:	Electric field amplitudes of (a) 0-mode, (b) $\pi/2$ -mode, and (c) π - mode in the side coupled modulation cavity.	33
Figure 2.3:	Plot of the normalized saturation amplitude (A_s) versus phase shift (α).	46
Figure 2.4:	Amplitude of the induced gap voltage of the first grid spacing in the modulation cavity versus the normalized time.	46
Figure 2.5:	Phase of the induced gap voltage of the first grid spacing in the modulation cavity versus normalized time.	47
Figure 2.6:	Amplitude and phase of the induced gap voltage of the first grid spacing in the modulation cavity versus normalized time including the effect of nonlinear saturation.	47
Figure 2.7:	Normalized momentum versus normalized time in the modulation cavity of the reltron.	48
Figure 2.8:	RF Output power and efficiency as function of cathode voltage.	50
Figure 3.1:	3D schematic diagram of a reltron.	56
Figure 3.2:	Flowchart describing the reltron design procedure.	61
Figure 3.3:	Electric field patterns in (a) 0-mode (b) $\pi/2$ -mode (c) π -mode conditions.	65
Figure 3.4:	Plot of electron's phase space (a) first half cycle (b) second half cycle.	66

Figure 3.5:	Current signal developed in the (a) anode-cathode gap (b) first grid spacing in modulation cavity (c) second grid spacing in modulation cavity (d) post-acceleration gap.	67
Figure 3.6:	Electric field amplitude versus time plot at the output port.	68
Figure 3.7:	Frequency spectrum of electric field amplitude.	68
Figure 3.8:	RF output power developed at the output port.	69
Figure 3.9:	RF output power and efficiency as a function of the post-acceleration voltage.	70
Figure 3.10:	RF output power and efficiency as a function of the cathode voltage.	71
Figure 4.1:	3D schematic diagram of a reltron.	76
Figure 4.2:	Basic schematic diagram of the modulation cavity of a reltron.	77
Figure 4.3:	Electron Trajectories of two electrons A and B in presence of DC potential in the modulation cavity.	82
Figure 4.4:	Simulated reltron structure model and electrons' position obtained during the PIC simulation.	90
Figure 4.5:	Frequency spectrum at the output port of the device.	90
Figure 4.6:	Plot of electrons' kinetic energy at (a) 3 ns (b) 4 ns (c) 11 ns (d) 12 ns time during the PIC simulation of the reltron.	91
Figure 4.7:	Variation of the normalized RF electric field along the axial direction in the side-coupled modulation cavity.	93
Figure 4.8:	Distance-time graph for the electron beam movement in the side-coupled modulation cavity.	93
Figure 4.9:	Field enhancement factor as a function of normalized static potential in the side-coupled modulation cavity.	94
Figure 4.10:	RF energy developed in the reltron, for the typically selected device parameters, Table 4.1.	94
Figure 4.11:	RF output power and the electronic efficiency of the reltron, as function of cathode voltage, for the typically selected device parameters, Table 4.1.	95
Figure 5.1:	Basic schematic diagram of a reltron.	102
Figure 5.2:	Behaviour of the virtual cathode in reltron (a) double virtual cathode condition, (b) single virtual cathode condition (c) axis representation.	108

Figure 5.3:	Plot of space charge limiting current (I_{sc}) versus γ_{inj} for different main cavity to cathode radii ratio r_m/r_c .	118
Figure 5.4:	Plot of the function $F\{\omega\bar{\tau}\}$ versus phase angle ($\omega\bar{\tau}$) which is proportional to the average momentum of the electron beam.	119
Figure 5.5:	Plot of average momentum (p_{av1}) versus phase angle ($s_1 = \omega\bar{\tau}$) for different value of $A_1 (= E'_0 / E_{mc})$.	120
Figure 5.6:	Plot of average momentum (p_{av2}) versus phase angle ($s_2 = \omega\bar{\tau}$) for different value of $A_2 (= E''_0 / E_{mc})$.	121
Figure 5.7:	TM ₀₁ mode of operation in the side coupled modulation cavity (a) vector plot, (b) contour plot.	122
Figure 5.8:	Electric field distribution in the reltron oscillator (a) vector plot (b) contour plot.	123
Figure 5.9:	Plot of electrons phase space at (a) 3.3 ns (b) 4.9 ns (c) 11.1 ns (d) 11.3 ns time duration.	125
Figure 5.10:	Plot of RF electric field developed at the extraction port.	125
Figure 5.11:	Plot of the device oscillation frequency spectrum.	126
Figure 5.12:	Plot of RF power developed at the extraction port.	126
Figure 5.13:	Plot of electron's momentum to visualize the process of virtual cathode formation in the reltron oscillator at different instant of time before the saturation of oscillation. In the present device the three metal grids (G1, G2, and G3 as shown in Fig. 5.1) are at the positions 0 mm, 18.70 mm and 37.40 mm, respectively, along the longitudinal direction.	128
Figure 5.14:	Plot of electron's normalized momentum at (a) 11.1 ns (b) 11.3 ns (c) 11.5 ns (d) 11.7 ns (e) 49.6 ns (f) 49.8 ns.	129