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I, **Prabhakar Tripathi**, certify that the work embodied in this thesis is my own bonafide work and has been done by me under the supervision of Prof. P. K. Jain and Dr. Smrity Dwivedi from "21/07/2015" to “30/12/2020”, at the Department of Electronics Engineering, Indian Institute of Technology (BHU), Varanasi. The matter embodied in this thesis has not been submitted for the award of any other degree/diploma. I declare that I have faithfully acknowledged and given credits to the research workers wherever their works have been cited in my work in this thesis. I further declare that I have not wilfully copied any other's work, paragraphs, text, data, results, *etc*., reported in journals, books, magazines, reports, dissertations, theses, *etc*., or available at websites and have not included them in this thesis and have not cited as my work.

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Date: **(Prabhakar Tripathi)**

Dedicated
To
My Parents

CONTENTS

List of Figures xvii-xx

List of Tables xxi

List of Abbreviations xxiii-xxiv

List of Symbols xxv-xxvi

Preface xxvii-xxviii

CHAPTER 1 INTRODUCTION 1-26

1.1. An Origin of High Power Microwave (HPM) Sources 3

1.2. Definition of HPM Source 3

1.3. Classification of HPM Sources 4

1.4. Side-Coupled Cavity 6

1.5. Reltron 11

1.5.1. Literature Review 13

1.5.2. Classification of Reltron 18

1.5.3. Key Features 21

1.5.4. Applications 22

1.6. Motivation and Research Objectives 22

1.7. Organization of the Thesis 23

CHAPTER 2 ANALYSIS OF SIDE COUPLED CAVITY (SCC) STRUCTURE 27-50

2.1. Overview 29

2.2. Introduction 29

2.3. Equivalent Circuit Analysis 33

2.3.1. Equivalent Inductance (L_0) 40

2.3.2. Equivalent Capacitance (C_0) 42

2.3.3. Expression for the Magnetic Coupling Coefficient 44

2.3.4. Simulation Study of Coupling Depth 45
2.3.5. Empirical Expression for π/2-mode Frequency 48
2.4. Validation of Theoretical Analysis 49
2.5. Conclusion 50
CHAPTER 3 BEAM-WAVE INTERACTION ANALYSIS OF THE SCC STRUCTURE 51-72
3.1. Overview 53
3.2. Introduction 53
3.3. Analysis 56
3.3.1. EM-Field Expression in the Presence of the Electron Beam 57
3.3.2. Boundary Conditions 62
3.3.3. Dispersion Relation 63
3.3.4. Temporal Growth Rate 65
3.4. Result and Discussion 66
3.4.1. Parametric Study of the Temporal Growth Rate 69
3.4.2. Validation of Derived Analytical Relation 70
3.5. Conclusion 71
CHAPTER 4 DESIGN AND SIMULATION STUDY OF GRID-LESS RELTRON 73-98
4.1. Overview 75
4.2. Introduction 75
4.3. Design Methodology 77
4.4. Working Principle 83
4.5. Simulation Study of the Grid-less Reltron 86
4.5.1. Cold Test Simulation Results 87

4.5.1.1. Results of Eigenmode Solver 88
4.5.1.2. Results of Frequency Domain Solver 89
4.5.1.3. SCC's Structural Parametric Analysis 90
4.5.2. Hot Test Simulation Results 92
4.5.2.1. Electrical Parametric Analysis 96
4.6. Conclusion 97
CHAPTER 5 PERFORMANCE IMPROVEMENT OF GRID-LESS RELTRON 99-122
5.1. Overview 101
5.2. Introduction 102
5.3. Simulation Study 105
5.3.1. Cold Test Simulation Results 108
5.3.1.1. Results of Eigenmode Solver 109
5.3.1.2. Results of Frequency Domain Solver 110
5.3.2. Hot Test Simulation Results 111
5.3.2.1. Electrical Parametric Analysis 117
5.4. Conclusion 121
CHAPTER 6 SUMMARY, CONCLUSION AND FUTURE SCOPE 123-130
6.1. Summary and Conclusions 125
6.2. Suggestions for Future Research 129
References 131-136
Author's Relevant Publications 137-138
Appendix 139-140

LIST OF FIGURES

Figure 1.1: Periodic disc loaded circular waveguide structure: (a) shows the two-gap resonant structure and (b) seven coupled cavities LINAC resonator structure. **7**

Figure 1.2: The normalized axial electric fields associated with different modes in the seven coupled cavities LINAC resonator structure [Miller (2006)]. **8**

Figure 1.3: Typical geometry of SCC. **9**

Figure 1.4: Schematic of the reltron system [Miller *et al.* (1992)]. **11**

Figure 1.5: Different possible ways to classify the reltron source. **20**

Figure 2.1: Different cross-sectional view of SCC: (a) lateral cross-section view, and (b) longitudinal cross-section view with a coaxial probe. **30**

Figure 2.2: Equivalent circuit model of the SCC. **33**

Figure 2.3: Electric field distribution in the SCC: (a), (b), and (c) shows the vector plot of with 0, π/2, and π-mode respectively while (d), (e), and (f) shows the contour plot of the 0, π/2, and π–mode respectively. **35**

Figure 2.4: EM field distribution for the TM_{01} mode inside the cylindrical single-cell resonant structure [Miller (2006)]. **36**

Figure 2.5: (a) Electric field distribution inside the single-cell resonant structure, and (b) its equivalent circuit. **36**

Figure 2.6: S_{11} parameter of the modeled SCC structure at different coupling depths: (a) at 6.0 mm, (b) at 7.6 mm, (c) at 8.6 mm, and (d) at 9.2 mm. **47**

Figure 2.7: Effect of coupling depth on the resonating frequency associated with the π/2-mode. **47**

Figure 3.1: Schematic of periodic SCC structure in the presence of electron beam. **55**

Figure 3.2: Different cross-section views of the unit cell of the SCC structure: (a) lateral cross-section view, and (b) longitudinal cross-section view. **55**

Figure 3.3: The proposed equivalent model of the SCC structure for the RF analysis. **56**

Figure 3.4: Dispersion curve of the periodic SCC structure in the presence of electron beam. **67**

Figure 3.5: Temporal growth rate of the periodic SCC structure. **68**

Figure 3.6: Dispersion curve of the periodic SCC structure in the presence and absence of electron beam. **68**

Figure 3.7 Temporal growth rate at different electron beam radius. **69**

Figure 3.8: Comparison between dispersion curves that have been obtained by simulation and analytical procedure for the special case (i.e. $r_e = 0$). **70**

Figure 4.1: A typical reltron oscillator: (a) 3D schematic, and (b) RF interaction cavity. **78**

Figure 4.2: A typical schematic of the reltron oscillator. **82**

Figure 4.3: RF electric field distribution in the RF interaction cavity: (a) 0-mode, (b) π/2-mode, and (c) π-mode [Miller *et al.* (1992)]. **84**

Figure 4.4: Electric field distribution in the RF interaction cavity (electron beam absent) of the reltron with their respective resonant frequency for different operating modes: (a) 0-mode, (b) π/2-mode, and (c) π-mode. **89**

Figure 4.5: Magnitude of the scattering parameter (S_{11}) versus frequency plot of the RF interaction cavity of the reltron. **90**

Figure 4.6: The effect of different structural parameters of the RF interaction cavity on the resonating frequency of three different modes: (a) effect of hole radius, (b) effect of coupling depth, and (c) effect of idler length. **91**

Figure 4.7: Kinetic energy distribution of the electrons: (a) during the first half of the RF cycle and (b) during the second half of the RF cycle of the designed reltron device. **93**

Figure 4.8: Growth of RF signal recorded by the waveguide port at the extraction cavity. **94**

Figure 4.9: Normalized frequency spectrum of the generated RF signal. **95**

Figure 4.10: RF output power at the extraction cavity. **95**

Figure 4.11: Effect of various electrical parameters on the RF output power of the grid-less reltron, due to variation in (a) post-acceleration voltage, (b) anode-cathode voltage, and (c) applied external magnetic field. **96**

Figure 5.1: 3D schematic of the proposed variant of reltron. **106**

Figure 5.2: 3D schematic view of the RF interaction cavity with coaxial pins. **107**

Figure 5.3: The RF electric field distribution inside the RF interaction cavity: (a) 0-mode, (b) π/2-mode, and (c) π-mode. **109**

Figure 5.4: Scattering parameter (S_{11}) of the RF interaction cavity. **110**

Figure 5.5: Kinetic energy distribution of the electron beam recorded by the inbuilt phase space monitor: (a) axial electron bunching at 58 ns, and (b) axial electron bunching at 980 ns. **112**

Figure 5.6: Generated RF signal when the applied cathode voltage and post-acceleration voltage of 100 kV and 400 kV, respectively: (a) amplitude and operating frequency, and (b) RF output power. **113**

Figure 5.7: Generated RF signal when the applied cathode voltage and post-acceleration voltage of 150 kV and 350 kV, respectively: (a) amplitude and operating frequency, and (b) RF output power. **114**

Figure 5.8: Generated RF signal when the applied cathode voltage and post-acceleration voltage of 200 kV and 300 kV, respectively: (a) amplitude and operating frequency, and (b) RF output power. **115**

Figure 5.9: Generated RF signal when the applied cathode voltage and post-acceleration voltage of 250 kV and 250 kV, respectively: (a) amplitude and operating frequency, and (b) RF output power. **116**

Figure 5.10: RF output power versus cathode voltage (when the applied post acceleration voltage was 400 kV). **118**

Figure 5.11: RF output power and its pulse-width versus post acceleration voltage (when the applied beam voltage of 100 kV). **119**

Figure 5.12: RF output power and its pulse-width versus external applied DC magnetic field (when the applied beam voltage and a post acceleration voltage were 100 kV and 400 kV, respectively). **120**

Figure 5.13. Comparison between the generated RF output power and pulse width of the gridded reltron, grid-less reltron, and proposed variant of the reltron. **120**

Figure A.1: Lateral cross-sectional view of the SCC. **139**

LIST OF TABLES

Table 1.1: Different ways to classify the HPM source [Benford *et al.* (2007)]. **5**

Table 2.1: Structural specification of the SCC. **35**

Table 2.2: Comparison of simulated and numerically obtained results at different coupling depths. **49**

Table 4.1: Electrical specification of S-band grid-less reltron [Miller *et al.* (1995)]. **87**

Table 4.2: Structural specification of S-band grid-less reltron [Miller *et al.* (1995)]. **87**

Table 5.1: Electrical and structural specification of the proposed variant of reltron. **108**

Table 5.2: RF output power and operating frequency at the different applied beam and post-acceleration voltage. **117**

ABBREVIATIONS

Abbreviation	**Details**
3D	Three Dimensional
A	Ampere
A-K	Anode-Cathode
DC	Direct Current
DEW	Directed Energy Weapon
EM	Electromagnetic
EMP	Electromagnetic Pulse
FEL	Free Electron Laser
GHz	GigaHertz
HPM	High Power Microwave
Hz	Hertz
IREB	Intense Relativistic Electron Beam
J	Joules
kJ	Kilo Joule
kA	Kilo Ampere
kV	Kilo Volt
LINAC	Linear Accelerator
MA	Mega Ampere

MHz	Mega Hertz
MILO	Magnetically Insulated Line Oscillator
mm	Millimeter
MW	Megawatt
NM	New Mexico
ns	Nanosecond
PIC	Particle-In-Cell
BWO	Backward Wave Oscillator
RBWO	Relativistic Backward Wave Oscillator
RKO	Relativistic Klystron Oscillator
RTTO	Relativistic Transit Time Oscillator
RF	Radio Frequency
SCO	Split Cavity Oscillator
SWS	Slow Wave Structure
TE	Transverse Electric
TM	Transverse Magnetic
VIRCATOR	Virtual Cathode Oscillator

LIST OF SYMBOLS

Symbol	Details
R_0	Equivalent Resistance
L_0	Equivalent Inductance
C_0	Equivalent Capacitance
$[I]$	Current vector
$[0]$	Zero vector
$[A]$	Matrix vector
ω_{res}	Fundamental resonating frequency of the equivalent circuit
ε_0	Free space permittivity
I_0	Total RF current flows inside the main cavity of the SCC
β_0	Fundamental axial propagation constant of the RF wave
k	Coupling factor
r_c	Cathode radius
r	Radius
r_e	Electron beam radius
r_{mc}	Main cavity radius
r_h	Coupled cavity radius
r_{cc}	Disc hole radius
L	Periodicity of the SCC
E_r	Radial electric field intensity
E_θ	Azimuthal electric field intensity
E_z	Axial electric field intensity
B_r	Radial magnetic field intensity
B_θ	Azimuthal magnetic field intensity
Pz	Axial momentum
γ	Relativistic factor
J_z	Axial current density

n_e	charge number density
v_z	axial drift velocity
c	Speed of light
e	Charge of the electron
m_e	Mass of the electron
k_c	Free space propagation constant
I_e	Beam current
V_e	Beam voltage
$J(\Gamma r)$	Bessel function
Γ	Radial propagation constant of the RF wave
v_e	Electron velocity by $\omega = \beta_0 v_e$) and slow space charge wave (slow
v_{slow_sc}	The velocity of slow space charge wave
f_i	Imaginary resonating frequency
f_r	Resonating frequency/ Real frequency
(r,θ,z)	Cylindrical-coordinate system
χ_m	Eigenvalue of the cylindrical waveguiding system
V_{tube}	Total tube voltage
r_{id}	Idler radius
λ_e	Wavelength of the velocity of an electron
d_{opt}	Optimal disk spacing
d_{AK}	Anode-cathode gap
L_{PA}	Length of post-acceleration region
L_{ext}	Length of the extraction cavity
k_z	Wavenumber
L_{dt}	Length of the drift tube
B_z^*	External magnetic field