

# CONTENTS

*List of Figures*

*List of Tables*

*List of Symbols*

*Abbreviations*

*Preface*

<b>CHAPTER-1</b>	<b>INTRODUCTION AND LITERATURE REVIEW</b>	<b>1-54</b>
1.1	Introduction	2
1.2	Overview of HPM System	4
	1.2.1. Prime Power Supply	4
	1.2.2. Pulse Power Supply	5
	1.2.3. HPM Sources	6
	1.2.4. Mode Convertor	7
	1.2.5. Antenna	7
1.3	Narrowband HPM Sources	8
	1.3.1. Present Status of HPM Devices	10
1.4	Different Types of HPM Devices	13
	1.4.1. Relativistic Magnetron	13
	1.4.2. Relativistic Backward Wave Oscillator	14
	1.4.3. Relativistic Klystron	15
	1.4.4. Free Electron Laser	18
	1.4.5. Relativistic Gyrotron Devices	20
	1.4.6. Virtual Cathode Oscillator	23
1.5	Magnetically Insulated Line Oscillator (MILO)	26
	1.5.1. MILO Components	26
	1.5.2. Principle of Operation	31
	1.5.3. Principle of Self Magnetic Insulation	33
1.6	Literature Review of MILO	35
1.7	Motivation and Objective	50
1.8	Plan and Scope	51

<b>CHAPTER-2</b>	<b>DEVICE DESIGN METHODOLOGY AND ITS BEAM-WAVE INTERACTION ANALYSIS OF MAGNETICALLY INSULATED LINE OSCILLATOR (MILO)</b>	<b>55-106</b>
2.1	Introduction	56
2.2	Motion of Particle in Crossed Field Devices	58
	2.2.1. Classical Approach	58
	2.2.2. Relativistic Approach	61
2.3	Motion of Particle in MILO	63
2.4	Device Design Methodology of MILO	77
	2.4.1. Condition for Explosive Emission	77
	2.4.2. Condition for Critical Current	80
	2.4.3. Condition for Parapotential Current	81
	2.4.4. Cathode Design	86
2.5	Condition for Relativistic Brillouin Flow and Magnetic Insulation	87
	2.5.1. Hull Cut-off and Buneman-Hartree Condition	94
2.6	Beam-Wave Interaction Mechanism of MILO	99
	2.6.1. Magnetic Cut-off	99
	2.6.2. Beam Instability (Diocotron Effect)	103
	2.6.3. Mode of Oscillation	103
2.7	Design Flow Chart for S-Band MILO	105
2.8	Conclusion	106
<b>CHAPTER-3</b>	<b>PIC SIMULATION OF S-BAND MILO AND STUDY OF EFFICIENCY ENHANCEMENT TECHNIQUES</b>	<b>107-131</b>
3.1	Introduction	108
3.2	Description of Numerical Techniques	111
3.3	Design Methodology	115
3.4	Modeling and Simulation of Conventional MILO	122
	3.4.1. Electron Beam Absent (Cold) Simulation	122
	3.4.2. Electron Beam Present (Hot) Simulation	123

3.5	Efficiency Enhancement Technique for MILO	126
3.6	Conclusion	130
<b>CHAPTER-4</b>	<b>OPTIMIZATION OF MILO USING PARTICLE SWARM OPTIMIZATION (PSO) ALGORITHM</b>	<b>132-153</b>
4.1	Introduction	133
	Different Artificial Neural Networks (ANN) techniques for Optimization	134
	4.2.1. Genetic Algorithm (GA)	134
	4.2.2. Back-Propagation(BP)	135
	4.2.3. Simulated Annealing (SA)	136
	4.2.4. Tabu Search (TS)	136
	4.2.5. Particle Swarm Optimization (PSO) Algorithm	137
	4.2.6. PSO parameters control	139
	4.2.7. Flow Chart of PSO Algorithm	141
4.3	Fitness Function for PSO of RF interaction structure	142
4.4	Design Optimization of RF interaction Structure using PSO Algorithm	144
	4.4.1. Parameters Selection for Design Optimization of RF interaction Structure	145
	4.4.2. Effect of Parameter Variation	146
4.5	Performance Evaluation of S-band MILO using Particle Swarm Optimized Parameters	150
4.6	Conclusion	153
<b>CHAPTER-5</b>	<b>BEAM ABSENT (Cold) EM SIMULATION AND CHARACTERIZATION OF RF INTERACTION STRUCTURE OF S-BAND MILO</b>	<b>154-172</b>
5.1	Introduction	155
5.2	Development of RF Interaction Structure	156
5.3	Resonant Perturbation Technique	158
5.4	Cold Characterization of RF Interaction Structure of S-Band MILO	164

	5.4.1. Network Analyzers	164
	5.4.2. Measurement Set-up	166
	5.4.3. Measurement of Reflection Coefficient	167
5.5	Simulated Dispersion Characteristics of RF Interaction Structure and Validation by Cold Test Measurement	169
5.6	Conclusion	172
<b>CHAPTER-6</b>	<b>REALIZATION AND EVALUATION OF EXPERIMENTAL MILO</b>	<b>173-194</b>
6.1	Introduction	174
6.2	Design and Simulation of MITL for Self-Magnetic Insulation Concept	175
	6.2.1. Analytical Design of MITL	176
	6.2.2. Numerical Simulation of MITL	177
	6.2.3. Electrical Testing of MITL	178
6.3	Diagnostic set-up for MILO	180
	6.3.1. Pulsed Power Diagnostics	180
	6.3.2. RF Power Diagnostics	182
6.4	Design and Simulation of Vlasov Antenna and Window	183
	6.4.1. Design of Bevel-cut Vlasov Antenna and Window	183
	6.4.2. Simulation of Vlasov Antenna with Window	185
6.5	Development of S-Band MILO	186
6.6	Testing and characterization of S-Band MILO	189
6.7	Conclusion	194
<b>CHAPTER-7</b>	<b>SUMMARY AND CONCLUSIONS</b>	<b>195-204</b>
7.1	Limitations of the Present Study and Scope for the Future Work	203

*References*

*Author's Relevant Publications*

*Paper-I*

*Paper-I*

*Bio-Data*