

TABLE OF CONTENTS

| | |
|---|-------------|
| ACKNOWLEDGEMENTS----- | I |
| ABSTRACT ----- | II |
| LIST OF TABLES----- | VII |
| LIST OF FIGURES----- | VIII |
| CHAPTER 1 INTRODUCTION ----- | 1 |
| 1.1 Research Background ----- | 1 |
| 1.2 Soft Switching Inverter Topologies ----- | 6 |
| 1.2.1 Load Resonant Inverters ----- | 7 |
| 1.2.2 Resonant Transition Inverters ----- | 10 |
| 1.2.3 Resonant Link Inverters ----- | 18 |
| 1.3 Recent Trends in Soft-Switching Inverter Topology ----- | 21 |
| 1.4 Uninterruptible Power Supply (UPS) Systems ----- | 23 |
| 1.5 Power Loss in Inverter ----- | 27 |
| 1.5.1 Switching losses ----- | 27 |
| 1.5.2 Conduction loss ----- | 28 |
| 1.6 Motivation of Research ----- | 30 |
| 1.7 Thesis Outline ----- | 31 |
| | |
| CHAPTER 2 HARD SWITCHED SPWM INVERTER ----- | 33 |
| 2.1 Introduction ----- | 33 |
| 2.2 Inverter Design with Hybrid Darlington Switches ----- | 36 |
| 2.2.1 Estimation of distortion ----- | 36 |
| 2.2.2 Effect of waveform distortion on spectral component ----- | 46 |
| 2.3 Dead time circuit suitable for low cost inverter ----- | 50 |
| 2.3.1 Uses of dead time circuit for PWM generation ----- | 54 |
| 2.3.2 Effect of driver circuit delays on the output pulse ----- | 55 |
| 2.4 Inverter Design with IGBT Switches ----- | 56 |
| 2.5 Filter Design ----- | 63 |
| 2.6 Output Voltage Control with Variation in Modulation Index ----- | 65 |

| | |
|--|------------|
| 2.7 Parameters for the designed SPWM inverter ----- | 69 |
| 2.8 Conclusions ----- | 70 |
| CHAPTER 3 SOFT SWITCHING INVERTER ----- | 71 |
| 3.1 Introduction ----- | 71 |
| 3.2 Resonant Snubber Based Soft Switching Inverter ----- | 72 |
| 3.3 Design Criteria ----- | 83 |
| 3.4 Design Procedure ----- | 86 |
| 3.5 Simulation Results ----- | 87 |
| 3.6 Conclusions ----- | 97 |
| CHAPTER 4 WAVELET TRANSFORM APPLICATIONS ----- | 98 |
| 4.1 Introduction ----- | 98 |
| 4.2 Frequency Estimation Using Wavelets ----- | 101 |
| 4.3 Switching Power Loss Analysis ----- | 103 |
| 4.4 Case Study ----- | 109 |
| 4.5 Conclusions ----- | 113 |
| CHAPTER 5 EXPERIMENTAL RESULTS AND DISCUSSION OF ZVT TOPOLOGY ----- | 114 |
| 5.1 Introduction ----- | 114 |
| 5.2 Single-phase SPWM Inverter ----- | 114 |
| 5.3 Experimental Details ----- | 121 |
| 5.3.1 Control Circuit ----- | 121 |
| 5.3.2 Experimental Data ----- | 124 |
| 5.4. ZVT Topology ----- | 125 |
| 5.4.1 Simulation Results ----- | 126 |
| 5.4.2 Experimental Results ----- | 132 |
| 5.5 Instantaneous Power ----- | 139 |

| | |
|---|------------|
| 5.5.1 Hard Switching - ----- | 140 |
| 5.5.2 Soft switching ----- | 140 |
| 5.6 Wavelet Based Power Loss Analysis ----- | 143 |
| 5.7 Experimental details ----- | 149 |
| 5.7.1 Gate Pulse Generation Circuit ----- | 149 |
| 5.7.2 Gate Driver Circuit ----- | 150 |
| 5.8 Experimental data ----- | 151 |
| 5.9 Conclusions ----- | 152 |
| CHAPTER 6 CONCLUSIONS AND FUTURE WORK ----- | 153 |
| 6.1 Conclusions ----- | 153 |
| 6.2 Future Work ----- | 155 |
| REFERENCES ----- | 156 |
| LIST OF PUBLICATIONS ----- | 167 |
| BRIEF BIOGRAPHY OF THE CANDIDATE ----- | 169 |
| BRIEF BIOGRAPHY OF THE SUPERVISOR ----- | 169 |