
Contents

Preface	ix
----------------------	----

Chapter 1. Motivation and Background: RF Switches and the Need for a Non-Volatile RF Switch	1
--	---

1.1. Introduction	1
1.2. Requirements and definition of a switch at RF and microwave frequencies	2
1.3. Review of RF and microwave switching technologies	4
1.3.1. Electromechanical switches: MEMS	6
1.3.2. Solid-state semiconductor switches	9
1.3.3. Memristive RF switches	14
1.4. State of the art of CBRAM/MIM RF switching technology	24
1.5. Demand for a non-volatile RF switch and selection of CBRAM/MIM technology	30
1.6. Conclusion	37

Chapter 2. Real-World Implementation Challenges of a Low-Cost Non-Volatile RF Switch	41
---	----

2.1. Introduction	41
2.1.1. Conductive bridging random access memory switches based on nafion as ion conductor	42
2.2. CBRAM-based fully passive solid-state RF switch on classic RF substrates: design and process optimization	50
2.2.1. Design of a CBRAM-based shunt mode RF switch	50
2.2.2. Fabrication process	53
2.2.3. Results and discussions	57

2.3. Electrical equivalent model analysis	61
2.4. Effect of filament resistance of CBRAM switches on RF transmission	63
2.5. Time stability, switching cycles and other interesting features.	66
2.5.1. Reason for choice of CPW transmission line for presented switch	69
2.6. Fabrication technique for realization of CBRAM/MIM RF switches on flexible substrates	71
2.6.1. CBRAM-based fully passive solid-state RF switch on flexible paper substrates	71
2.6.2. Results and discussion	75
2.7. Application example: design and realization of solid-state non-volatile SPDT switch	78
2.8. Conclusion	81
 Chapter 3. Solid-State Rewritable Chipless RFID Tags: Electronically Rewritable RF Barcodes	83
3.1. Introduction: chipless RFID technology	83
3.2. Chipless RFID reader system used in this experiment.	85
3.3. Realization of solid-state electronically rewritable chipless RFID tags	87
3.3.1. Electronically rewritable chipless RFID tags on classic rigid substrates	88
3.3.2. Electronically rewritable chipless RFID tags on flexible substrates	93
3.4. Effect of CBRAM/MIM filament resistance on RCS characteristics of presented electronically rewritable resonators	98
3.5. Electrical equivalent model of electronically rewritable chipless RFID tags	99
3.6. Discussion of data encoding strategies for electronically rewritable chipless RFID tags based on CBRAM/MIM technology	107
3.7. Advantages of using integrated CBRAM/MIM switches for chipless RFID applications	111
3.8. Conclusion	116
 Chapter 4. Fully Passive Solid-State Electronically Reconfigurable Filter and Antenna Models	119
4.1. Introduction	119
4.2. CBRAM-MIM switches for electronically reconfigurable filter applications	119

4.2.1. Electronically reconfigurable band-stop filter	120
4.2.2. Discussion of extension of the proposed idea of CBRAM/MIM RF switching to more efficient filter topologies.	139
4.3. MIM switches for electronically pattern reconfigurable antenna applications	146
4.3.1. Electronically radiation pattern steerable antenna using CBRAM/MIM RF switches (design and fabrication)	147
4.4. Advantages of using proposed CBRAM RF switch technology for reconfigurable antenna and filter applications	162
4.5. Conclusion	165
Conclusion	167
Appendix	171
References	181
Index	195