
Contents

Quotation	ix
Preface	xi
Introduction	xv
Chapter 1. The Memory Function	1
1.1. Main characteristics	1
1.1.1. Memory medium	1
1.1.2. Storage capacity and units of measurement.	2
1.1.3. Organization.	5
1.1.4. Access policies	6
1.1.5. Types of access	8
1.1.6. Data permanence	8
1.1.7. Timing characteristics	8
1.2. Modeling	12
1.3. Technological and historical aspects	13
1.3.1. Mechanical calculator technologies	14
1.3.2. Main memory technologies in modern computers	14
1.4. Memory in a microcomputer	27
1.5. Memory hierarchization.	31
1.6. Conclusion	40
Chapter 2. Internal Organization of a Random-Access Semiconductor Memory	41
2.1. Basic internal organization	42
2.2. Detailed internal organization	53
2.2.1. Static logic versus dynamic logic	53
2.2.2. Column charge and precharge systems	58

2.2.3. The delay line	62
2.2.4. The address transition detector.	63
2.2.5. The data-transition detector	64
2.2.6. Address decoding	64
2.2.7. The column selector	70
2.2.8. The sense amplifier	73
2.2.9. The write circuitry	81
2.3. Conclusion	81
Chapter 3. Additional Functional Blocks	83
3.1. The phase-locked loop	83
3.2. The delay-locked loop.	83
3.3. Internal voltage generators	85
3.3.1. Wordline boost circuit	86
3.3.2. Mid- V_{DD} generator	88
3.3.3. Internal voltage regulators	89
3.4. Implementation	90
3.5. Conclusion	92
Chapter 4. Advanced Internal Organization	93
4.1. Data format expansion	93
4.2. Block partitioning	93
4.3. Bank partitioning	95
4.4. Multithreaded architectures	98
4.5. Conclusion	113
Chapter 5. External Aspects of a Memory System	115
5.1. Interfacing	115
5.1.1. Basic control signals	115
5.1.2. Signal conditioning	118
5.1.3. Address decoding	119
5.1.4. Serial interfaces	123
5.1.5. Multiple-access memory	124
5.2. External performance improvements.	131
5.2.1. Data width increase	131
5.2.2. Capacity increase	132
5.2.3. Rank organization.	132
5.2.4. Interleaving and address offset	133
5.3. Coupling	141
5.4. Conclusion	141

Chapter 6. Additional Concepts	143
6.1. Data alignment	143
6.2. Information storage order: a matter of endianness!	145
6.3. Memory topography of a computer system	150
6.4. EDAC.	152
6.5. Conclusion	157
Conclusion	159
Appendix 1.	163
Appendix 2.	193
List of Acronyms.	207
References.	223
Index.	241