

CONTENTS

PREFACE	VII
INTRODUCTION	IX
CHAPTER 1 DELTA MODULATION SYSTEMS.....	1
1.1 LINEAR DELTA MODULATION SYSTEMS	1
1.1.1 The Principle of L Δ M	1
1.1.2 Basic Parameters of L Δ M	2
1.2 DELTA-SIGMA MODULATION SYSTEMS.....	9
1.2.1 The Principle of Δ - Σ M	9
1.2.2 Basic Parameters of Δ - Σ M	13
1.2.3 Linear model of Δ - Σ M.....	16
1.2.4 Anti-Aliasing Requirements.....	18
1.3 MULTI-LEVEL DELTA MODULATION SYSTEMS	19
1.3.1 Signal-to-Noise Ratio	20
1.3.2 Ternary Δ M System (T Δ M)	20
1.3.3 Tri-level Delta-Sigma Modulation	22
1.4 BAND-PASS DELTA-SIGMA MODULATION	24
1.4.1 Band-pass Sampling Theorem.....	24
1.5 CONCLUSION	27
REFERENCES	28
CHAPTER 2 LINEAR ARITHMETIC OPERATIONS.....	29
2.1 INTRODUCTION.....	29
2.2 EXISTING ARITHMETIC CIRCUITS SOLUTIONS.....	30
2.2.1 The Approach of Kouvaras	35
2.3 CONCLUSION	38
REFERENCES	39
CHAPTER 3 BASIC TERNARY LOGIC CIRCUITS.....	41
3.1 INTRODUCTION	41

3.2 MULTI-VALUED ALGEBRA AND FUNCTIONAL COMPLETENESS	43
3.3 IMPLEMENTATION OF TERNARY FULL ADDER.....	45
3.4 MEMORY ELEMENT BASED ON T-GATE	46
3.5 CONCLUSION	49
REFERENCES	50
CHAPTER 4 MULTIVALUED ARITHMETIC OPERATIONS.....	51
4.1 INTRODUCTION	51
4.2 ADDITION OF TWO OR MORE $T\Delta M$ SEQUENCES....	51
4.2.1 Addition of Two Ternary ΔM Sequences.....	52
4.2.2 Addition of Several Ternary ΔM Sequences.....	57
4.2.3 Multiplication of $T\Delta M$ Signal With a Constant	59
4.2.4 Synthesis of Ternary Delta Multiplier	60
4.2.5 Ternary Delta Tripler.....	63
4.3 ADDITION OF MULTIVALUED $T\Delta M$ SEQUENCES....	66
4.4 RESULTS OF SIMULATION	69
4.5 CONCLUSION	71
REFERENCES	72
CHAPTER 5 NONLINEAR ARITHMETIC OPERATIONS..	73
5.1 BASIC $\Delta-\Sigma M$ CONCEPT	73
5.2 MATHEMATICAL PRELIMINARIES	74
5.3 CONSTRUCTION OF NONLINEAR MEMORYLESS DEVICES	79
5.4 SOME SIMULATION RESULTS.....	83
5.4.1 Squaring Operation.....	84
5.4.2 Mapping Of Boolean Functions	87
5.4.3 Multiplication by A Constant Greater than One.....	88
5.4.4 Addition of Several $\Delta-\Sigma M$ Pulse Streams	88
5.5 CONCLUSION	91
REFERENCES	92
CHAPTER 6 MIXED PROCESSING OF $\Delta-\Sigma M$ SEQUENCES.....	93
6.1 INTRODUCTION	93
6.2 FURTHER RESULTS.....	94

6.3 OPTIMIZATION	98
6.4 SOME SIMULATION RESULTS.....	101
6.4.1 Mixed Mode Multiplication	101
6.4.2 Mixed Mode Multiplication of an Arbitrary Analog Signal.....	103
6.4.3 A Robust Amplitude Modulation System	104
6.5 CONCLUSION	111
REFERENCES	112
CHAPTER 7 DECODING OF FIRST-ORDER Δ-Σ SEQUENCES.....	113
7.1 DECODING OF FIRST-ORDER Δ - Σ M SEQUENCES ...	113
7.1.1 Introduction	113
7.1.2 Delta-Sigma Communication Model.....	113
7.1.3 Delta-Sigma Decoder	114
7.1.4 Results of Analysis	116
7.2 SIMPLIFIED IMPLEMENTATION OF Δ - Σ DECODERS	119
7.2.1 Basic Concept.....	119
7.2.2 Implementation of the Delta-Sigma Decoder.....	120
7.2.3 Proposed Implementation.....	121
7.3 CONCLUSION	123
REFERENCES	124
CHAPTER 8 PCM – Δ-ΣM CONVERTERS	125
8.1 PCM - Δ - Σ M CONVERTERS	125
8.1.1 Introduction	125
8.1.2 Proposed Circuit Implementation.....	126
8.2 DIGITAL-TO-ANALOG CONVERTER BASED ON ΔM	129
8.2.1 Introduction	129
8.2.2 A New DAC	130
8.2.3 Simulation Results.....	134
8.3 CONCLUSION	139
REFERENCES	140
CHAPTER 9 STOCHASTIC PROCESSING USING Δ-ΣM.....	141
9.1 INTRODUCTION.....	141

9.2 EXISTING APPROACH	142
9.3 STOCHASTIC Δ - Σ M ANALOG-TO-DIGITAL CONVERTER	144
9.4 UNIVERSAL Δ - Σ M ARITHMETIC UNIT	145
9.5 SIMULATION RESULTS.....	146
9.6 CONCLUSION	148
REFERENCES	149
CHAPTER 10 MEASUREMENTS BASED ON Δ-ΣM.....	151
10.1 DIRECT DYNAMIC MEASUREMENT WITH INTERVAL UNCERTAINTY	151
10.2 THE MAIN IDEA BEHIND DELTA-MODULATION ..	152
10.3 DIRECT DYNAMIC MEASUREMENT AND ITS ERROR ESTIMATE	154
10.4 DELTA MODULATION: FORMAL DEFINITION	156
10.5 FREQUENCY DEVIATION MEASUREMENT BASED ON Δ - Σ M.....	159
10.5.1 Problem Statement	159
10.5.2 Addition of Δ - Σ M Signals	162
10.5.3 Implementation Method.....	163
10.5.4 Performance Comparison.....	167
10.6 CONCLUSION	171
REFERENCES	172
CHAPTER 11 LPΔ-ΣM AND BPΔ-ΣM CIRCUITS.....	173
11.1 INTRODUCTION	173
11.2 TRADITIONAL APPROACH OF COMPANDING	174
11.3 A MIXED MODE COMPANDER APPROACH.....	175
11.4 A DIGITAL SQUARE-LAW COMPANDER	177
11.4.1 Square-Law Compander.....	177
11.5 ADAPTIVE LINEARIZATION OF A POWER AMPLIFIER	180
11.5.1 Existing Approaches to Adaptive Linearization	180
11.5.2 Basic Idea of Compression using BP Δ - Σ M	182
11.6 ARITHMETIC OPERATIONS ON BP Δ - Σ M PULSE STREAMS.....	185
11.6.1 Introduction.....	185
11.6.2 Addition.....	186

CONTENTS XV

11.6.3 Multiplication.....	187
11.7 CONCLUSION	189
REFERENCES	190
Index	193

