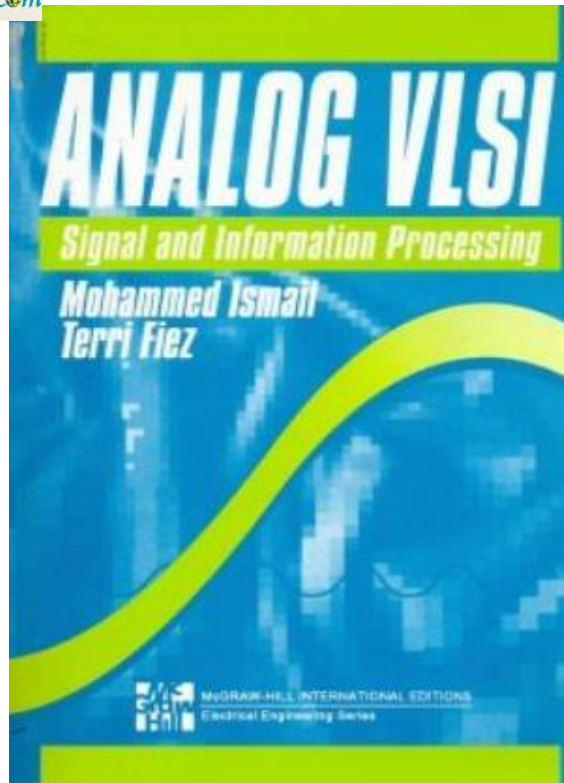




ANALOG VLSI SIGNAL AND INFORMATION PROCESSING

MOHAMMAD ISMAIL
ET
TERRI FEIZ



CONTENTS

Preface	xi
List of Contributors	xii
Acknowledgements	xvi
1 Introduction to Analog VLSI Mohammed Ismail and Terri Feiz	1
1.1 VLSI Microelectronics	1
1.2 Mixed-signal VLSI Chips	3
1.3 Potential of Analog VLSI	5
1.4 The Book Floor Plan	7
1.5 Notation and Symbology	10
References	11
2 Basic CMOS Circuit Techniques Klaa, Bult	12
2.1 Introduction	12
2.2 MOS Models	13
2.3 The Current Division Technique	21
2.4 The Basic Gain Stage	25
2.5 Limitations of the Basic Gain Stage	32
2.6 The Gain-Boosting Technique	37
2.7 The Super MOS Transistor	43
2.8 Conclusion	48
Problems	49
References	55
3 Continuous-Time Signal Processing Mohammed Ismail, Shu-Chuan Huang, and Satochi Sakurai	57
3.1 Introduction	57
3.2 Primitive Analog Cells	58

3.3	Linear Voltage-Current Converters	63
3.4	MOS Multipliers	72
3.5	MOS Resistors	83
3.6	Winner- Take-All Circuits	98
3.7	Amplifier-Based Signal Processing	101
3.8	Summary	115
	Problems	116
	References	130
4	Low- Voltage Signal Processing	135
	Johan Huijsing, Ron Hogervord, Jeroen Fonderie, Bernard Van den Dool, Klaas - Jan de Langen, and Gert Groenevold	
4.1	Introduction	135
4.2	CMOS Operational Amplifier Design	136
4.3	Bipolar Operational Amplifier Design	143
4.4	Low- Voltage BiCMOS Op Amp Design	152
4.5	Instrumentation Amplifier Design	158
4.6	Low- Voltage Filters	164
	Problems	177
	References	181
5	Basic BiCMOS Circuit Techniques	184
	Sayed Zarabadi, Mohammed Ismail, and Frode Larsen	
5.1	Introduction	184
5.2	Devices and Technology	186
5.3	Basic Analog Subcircuits	206
5.4	Closing Remarks	237
	Problems	237
	References	246
6	Current- Mode Signal Processing	248
	Terri Fiez, Ruuell Croman, Edmund Schneider, and Marius Goldenberg	
6.1	Introduction	248
6.2	Continuous- Time Signal Processing	249
6.3	Sampled-Data Signal Processing	260
6.4	Switched-Current Data Converters	267
6.5	Practical Considerations in SI Circuits	268
6.6	Design Example : SI DTMF Decoder	284
6.7	Conclusion	295
	Problems	296
	References	307
7	Neural Information Processing I	311
	Joongho Choi and Bing J. Sheu	
7.1	Introduction	311
7.2	Biologically-Inspired Neural Networks	313
7.3	Analog Strong-Inversion Networks	328
7.4	Floating-Gate, Low-Power Neural Networks	339
	Problems	347
	References	353
8	Neural Information Processing II	358
	Andreas G. Andreou and Kwabena A. Boahen	
8.1	Introduction	358
8.2	CMOS Technology and Models	361
8.3	Design Methodology	382
8.4	Networks	393
8.5	A Contrast Sensitive Silicon Retina	403
8.6	Concluding Remarks	407
	Problems	408
	References	409
9	Sampled-Data Analog Filters	414
	Adel Sedra and Gordon Roberts	
9.1	Introduction	414
9.2	First-Order SC Circuits	415

9.3	Bilinear Transformation	421
9.4	Second-Order SC Circuits and Cascade Design	428
9.5	Switched-Capacitor Ladder Filters	437
9.6	Synthesis of Switched-Current Filters	446
9.7	Conclusion	458
	Problems	460
	References	465
10	Oversampled A / D Converters	467
	Bosco Leung	
10.1	Introduction	467
10.2	Nyquist Rate A / D Converters	468
10.3	Modulators for Oversampled A / D Conversion	471
10.4	First- and Second-Order Sigma-Delta Modulators	475
10.5	Interpolative Modulators	480
10.6	Cascaded Architecture	481
10.7	Multi-Bit Sigma-Delta Modulators	483
10.8	Decimation Filters	484
10.9	Design Example : A Multi-Channel Voiceband Coder	489
	Problems	499
	References	502
11	Analog Integrated Sensors	506
	gor Filanovsky and Henry Balte	
1.1	Introduction	506
1.2	Mechanical Sensors	507
1.3	Thermal Sensors	509
1.4	Humidity Sensors	513
1.5	Magnetic Sensors	514
1.6	Sensor Interfaces	519
1.7	Stabilization of Power Dissipation	540
	Problems	543
	References	545
12	Design for Testability	547
	Han, Kerkhoff	
2.1	Introduction	547
2.2	Fault Modeling and Simulation	550
2.3	Testability-Analysis Techniques	553
2.4	Ad Hoc Methods and General Guidelines	557
2.5	Scan Techniques	560
2.6	Boundary-Scan	564
2.7	Built-in Self Test	567
2.8	Analog Test Busses	571
2.9	Design for Electron-Bearn Testability	574
2.10	Conclusion	576
	Problems	578
	References	581
13	Analog VLSI Interconnects	585
	Massimo Sivilotti	
3.1	Introduction	585
3.2	Physics of Interconnects in VLSI	586
3.3	Scaling of Interconnects	594
3.4	A Model for Estimating Circuit Wiring Density	595
3.5	A Configurable Architecture for Prototyping Analog Circuits	603
	Problems	612
	References	614
14	Statistical Modeling and Simulation	615
	Christopher Michael, Christopher Abel, and Mohammed Ismail	
4.1	Introduction	615
4.2	Review of Statistical Concepts	616
4.3	Correlations and Principal Component Analysis	621
4.4	Statistical Deviee Modeling	625
4.5	Statistical Circuit Simulation	631
4.6	Examples of Statistical Circuit Simulations	640
4.7	Conclusion	650
	Problems	650

REFERENCES	655
References	655

15	Analog Computer-Aided Design	657
	L.Richard Carley	
	5.1 Introduction	657
	5.2 Automating Analog Circuit Design	659
	5.3 Automating Analog Layout	676
	5.4 Conclusion	696
	References	696
16	Analog and Mixed Analog-Digital Layout	699
	Umberto Gatti and Franco Maloberti	
	6.1 Introduction	699
	6.2 CMOS Transistor Layout	700
	6.3 Resistor Layout	703
	6.4 Capacitor Layout	707
	6.5 Analog Cell Layout	710
	6.6 Mixed Analog-Digital Layout	720
	6.7 Conclusion	725
	References	725
A	SPICE Model Parameters	727
TOP		