

Contents

1	Introduction	1
1.1	Background and Motivation	1
1.2	Main Contributions	2
1.3	Book Organization	2
2	Class D Audio Amplifiers and Data Conversion Fundamentals	5
2.1	Class D Audio Amplifiers	5
2.2	Signal Conversion Fundamentals	8
2.3	Quantization Noise	12
2.4	Oversampling	13
2.5	Continuous-Time (CT) Sigma-Delta Modulators ($\Sigma\Delta$)	14
2.6	Analysis of the $\Sigma\Delta$ Architecture	18
2.6.1	Feedforward Summation	18
2.6.2	Feedforward Summation and Local Resonator Feedback	19
2.6.3	Distributed Feedback	20
2.6.4	Distributed Feedback and Local Resonator Feedback	22
2.6.5	Comparison Between Feedforward and Feedback Compensation	22
2.6.6	1.5-bit Quantization	23
3	Implementation of the $\Sigma\Delta$	25
3.1	Integrator Stages	25
3.1.1	Integrator Stages Using Active RC-Integrators	25
3.1.2	Integrator Stages Using Differential Pairs	27
3.2	1.5-bit ADC for a Fully Differential Integrator Stage	33
3.3	Encoding Logic for the 1.5-bit Quantizer	35
3.4	Feedback Circuitry for a Fully Differential Architecture	38
3.5	Simulation Results of the $\Sigma\Delta$ with Differential Pairs	39
3.5.1	Simulation Results for a 3rd Order 1.5-bit CT- $\Sigma\Delta$ in a CRFB structure using Active-RC Integrators	40
3.5.2	3rd Order 1-bit CT- $\Sigma\Delta$ in a CIFB Structure Using Differential Pairs	42

3.5.3 3rd Order 1-bit CT- $\Sigma\Delta$ M in a CRFB Structure Using Differential Pairs	44
3.5.4 3rd Order 1.5-bit CT- $\Sigma\Delta$ M in a CIFB Structure Using Differential Pairs	46
3.5.5 3rd Order 1.5-bit CT- $\Sigma\Delta$ M in a CRFB structure Using Differential Pairs	48
4 Measured Prototypes and Experimental Results	51
4.1 3rd Order 1-bit CT- $\Sigma\Delta$ M in a CIFB Structure	51
4.2 3rd Order 1-bit CT- $\Sigma\Delta$ M in a CRFB Structure	55
4.3 3rd Order 1.5-bit CT- $\Sigma\Delta$ M in a CRFB Structure	58
4.4 Comparison Between Theoretical and Experimental Results	61
5 Conclusions	63
5.1 Final Remarks	63
Appendix 1: Analytical Sizing of the CT-$\Sigma\Delta$M Implemented with Differential Pairs	67
Appendix 2: Feedback Circuitry for Single-Ended Architectures	71
References	75

Design and Implementation of Sigma Delta Modulators
($\Sigma\Delta$ M) for Class D Audio Amplifiers using Differential
Pairs

Pereira, N.; Paulino, N.

2015, XIII, 76 p. 65 illus., 18 illus. in color., Softcover

ISBN: 978-3-319-11637-2