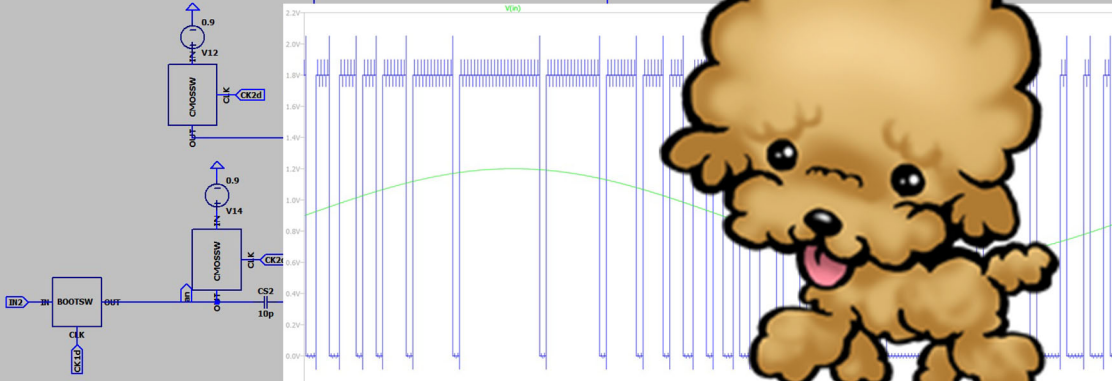
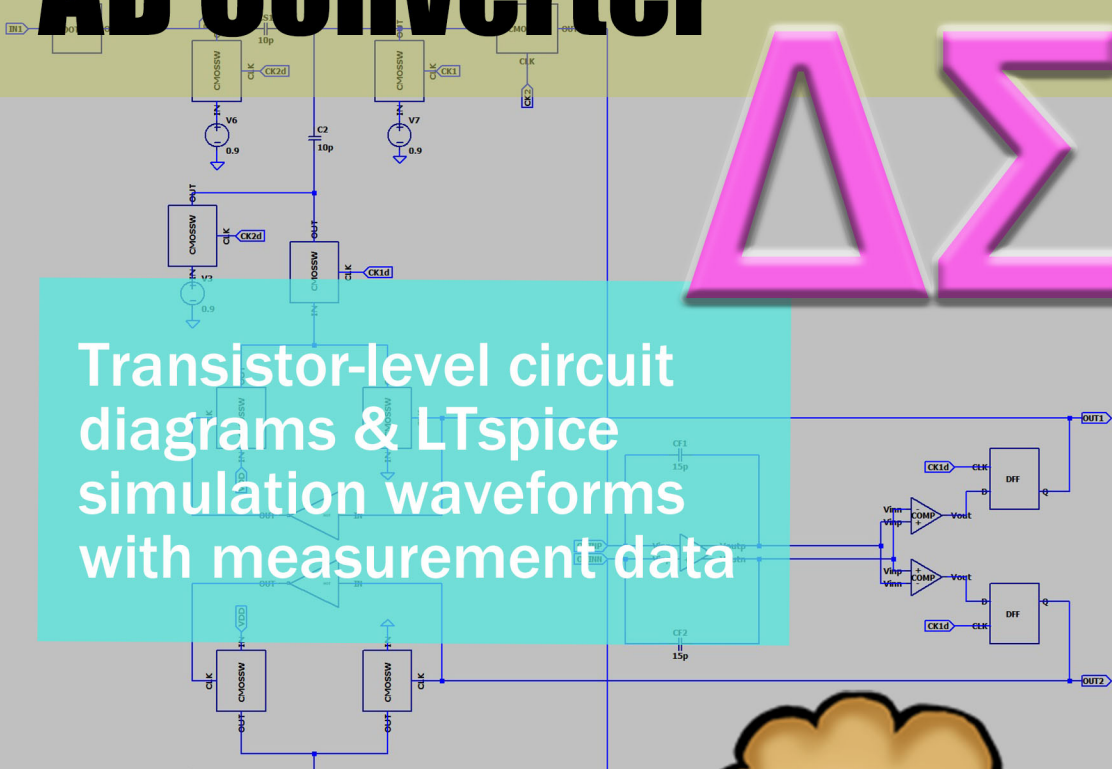


Designing a Delta-Sigma AD Converter



Transistor-level circuit diagrams & LTspice simulation waveforms with measurement data



T.KAWANA

Designing a Delta-Sigma AD Converter

Author: TORU KAWANA

Contents

Preface

Chapter 1 — Element Circuits of the Delta-Sigma ADC

1. Single-Ended Delta-Sigma ADC
2. CMOS Switch
3. Sample-and-Hold
4. Inverter
5. Bootstrap Switch
6. Flip-Flop
7. Operational Amplifier
8. Comparator
9. Clock Signals

Chapter 2 — Functional Blocks of the Delta-Sigma ADC

1. Functional-Block Overview
2. Sample-and-Hold Circuit
3. Switched-Capacitor Integrator
4. Comparator
5. DFF
6. DAC

Chapter 3 — Performance Evaluation: Single-Ended Configuration

1. PWL Signal Simulation
2. Output Linearity
3. INL
4. DNL
5. Sine-Wave Simulation
6. FFT Analysis
7. Noise Shaping
8. SNR
9. ENOB

Chapter 4 — Performance Evaluation: Differential-Output Configuration

1. PWL Signal Simulation
2. Output Linearity
3. INL
4. DNL
5. Sine-Wave Simulation

6. FFT Analysis
7. Noise Shaping
8. SNR
9. ENOB
10. Single-Ended vs. Differential Comparison

Afterword

Preface

Features of this book

- The circuit configuration of the delta-sigma AD converter is presented at the transistor level.
- Each element circuit and functional block is shown together with its schematic and a stand-alone simulation waveform, making the operation easy to follow.
- The method for simulating the whole system is shown concretely on the LTspice screen.
- The overall output waveforms and signal values are given concretely, so you can see which metric appears in which result.
- For metrics that require calculation, worked examples derived from the measured values are provided.

Specialist textbooks that present the system level and the rough circuit configuration are commercially available, and you can learn the principles and the way of thinking from them. Realizing the converter at the transistor level, however, is not easy. The purpose of this book is to deepen your understanding of the specifications and verification items while looking at the results of circuit-simulating a transistor-level design in the free software LTspice. It is also intended to give the reader a starting point for actually designing and simulating a delta-sigma AD converter, using the circuit configuration shown here as a reference.

