IDEC Chip Design Contest

A Zero-Crossing-Based Delta-Sigma Modulator Using Ring-Amplifiers

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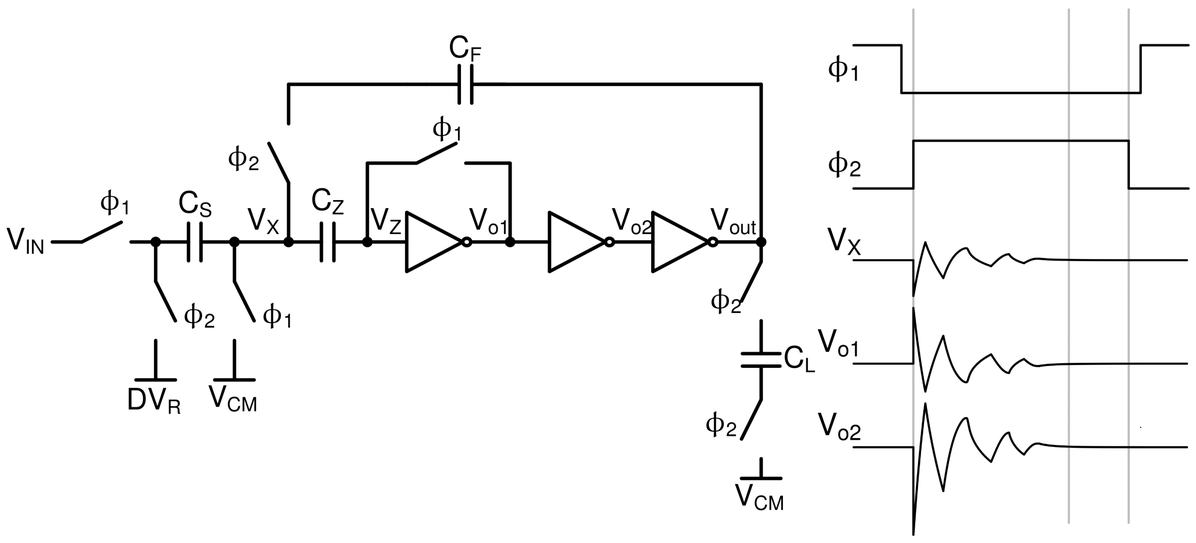
Introduction

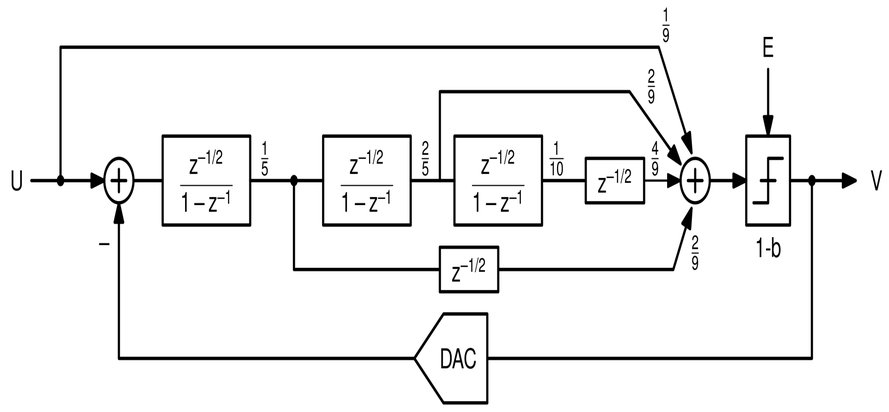
- The energy efficiency of an OTA in conventional switched-capacitor circuits is low.
- Ring-amplifier-based integrators provide better energy efficiency.
- A 3rd-order Delta-Sigma ADC employing ring-amplifier-based integrators was fabricated.

Circuit Design



- Ring-amplifier-based integrator circuit is designed.
- The inverter chain replaces the OTA.

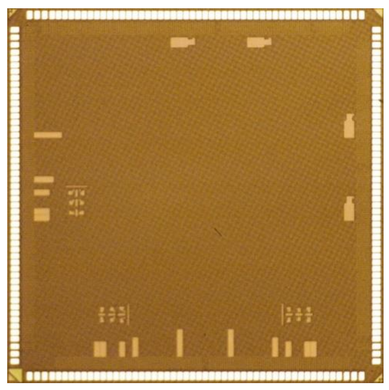
Architecture



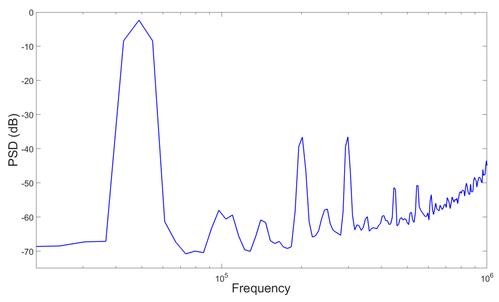
- Third-order Delta-Sigma modulator
  :Low-distortion feedforward structure
- Half-delay and pseudo-differential ring-amplifier-based integrators
- 1-bit quantizer & passive adder

Implementation

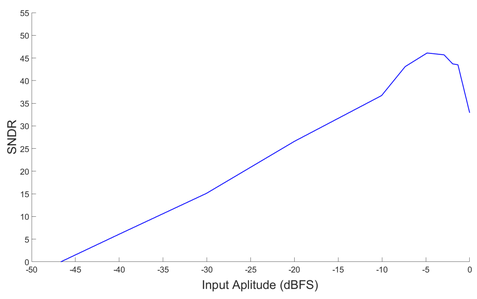
- Process
  : 65-nm Samsung
  : Core Area : 0.4 mm x 0.34 mm
  (0.136mm^2)



- Measurement Result



Power Spectral Density (PSD)



Input Amplitude vs. SNDR

Performance Summary

	Post-Sim.	Meas.
Technology(nm)	65	65
Supply voltage(V)	1.2	1.2
Signal Bandwidth(kHz)	390	390
Clock Frequency(MHz)	50	50
Oversampling Ratio (OSR)	64	64
Power Consumption(uW)	835	770
Peak SNR (dB)	74.2	46.1
Peak SNDR (dB)	67.5	41.8
Dynamic Rage (dB)		46

Conclusion

- The proposed modulator uses ring-amplifier-based integrators, which are better than zero-crossing-based or OTA-based integrators in terms of accuracy or energy efficiency.
- The measurement shows poor linearity, because there are some mistakes in the chip design.
- To improve the linearity performance, a revised ring-amplifier-based DSM will be designed.

Acknowledge

- The chip fabrication and EDA tools were supported by the IC Design Education Center (IDEC), Korea.

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