

# **THEORY, ANALYSIS AND DESIGN OF A DISCRETE TIME PARAMETRIC AMPLIFIER AND ITS VARIANTS**

by

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# Certificate

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This is to certify that the thesis entitled “*Theory, analysis and design of a discrete time parametric amplifier and its variants*”, being submitted by **Shrimali Hiteshbhai Kantilal** to the Indian Institute of Technology Delhi, is worthy of consideration for the award of the degree of **Doctor of Philosophy** and is a record of the original bonafide research work carried out by him under my guidance and supervision. The results contained in the thesis have not been submitted in part or full, to any other University or Institute for the award of any degree or diploma.

I certify that he has pursued the prescribed course of research.

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# Abstract

A discrete-time Parametric amplifier is a low power, low noise and a low gain amplifier. However, the discrete-time parametric amplifier suffers from a poor driving capability, high harmonic distortion at the output and a large output common-mode voltage shift. The thesis presents the modified clocking scheme and a feed-forward compensation circuit as a technique to reduce harmonic distortion in a discrete-time parametric amplifier. The same techniques may be applied to other variants of the discrete-time parametric amplifier (DTPA), such as, the complementary discrete-time parametric amplifier (CDTPA), the reverse discrete-time parametric amplifier (RDTPA), and the double-complementary discrete-time parametric amplifier (DCDTPA), to achieve similar reductions in harmonic distortion. In literature, distortion analyses for weakly non-linear systems has been reported. This research work presents systematic distortion analyses using Volterra series for the discrete-time parametric amplifier. As an application of the discrete-time parametric amplifier, the DCDTPA based comparator has been used to design a 10 bit, 1 Gsamples/sec, 128 over sampling ratio continuous-time  $\Sigma\Delta$  analog to digital converter in a standard  $0.13 \mu\text{m}$  CMOS technology. In order to achieve such a high speed, the high-bandwidth operational transconductance amplifier and a DCDTPA based quantizer have been designed as an integral part of a continuous-time  $\Sigma\Delta$  analog-to-digital converter.

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