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S. Henzler

## **Time-to-Digital Converters**

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With ongoing technology scaling high resolution in the voltage domain becomes increasingly troublesome. Time domain resolution, however, is continuously improving as digital circuits become faster in each new technology generation. *Time-to-Digital Converters* describes the fundamentals of time-to-digital converters (TDC) based on analog and digital conversion principles. An in depth theoretical investigation is provided with respect to quantization, linearity, noise, and variability. Advanced TDC architectures are described that address the challenges of signed time interval measurement, long measurement time, high resolution, high linearity, low-power, variability and calibration, low mismatch among multiple measurements, and suitability for design automation. Resolution enhancement techniques such as pulse-shrinking, Vernier delay-line, local passive interpolation, gated delay-lines, and time amplification are introduced and discussed with respect to operating principle, resolution, power, area, conversion time, susceptibility to variations, and suitability for implementation and mass production. Finally, an overview on TDC applications in phase-locked-loops and analog-to-digital converters is given. *Time-to-Digital Converters* provides a strong theoretical basis and comprises a unique in depth overview on TDC architectures and conversion principles.



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