



# Phase-Locked Loops for Wireless Communications: Digital, Analog and Optical Implementations

*Donald R. Stephens*

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## Phase-Locked Loops for Wireless Communications: Digital, Analog and Optical Implementations

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*Phase-Locked Loops for Wireless Communications: Digital, Analog and Optical Implementations, Second Edition* presents a complete tutorial of phase-locked loops from analog implementations to digital and optical designs. The text establishes a thorough foundation of continuous-time analysis techniques and maintains a consistent notation as discrete-time and non-uniform sampling are presented. New to this edition is a complete treatment of charge pumps and the complementary sequential phase detector. Another important change is the increased use of MATLAB®, implemented to provide more familiar graphics and reader-derived phase-locked loop simulation. Frequency synthesizers and digital divider analysis/techniques have been added to this second edition. Perhaps most distinctive is the chapter on optical phase-locked loops that begins with sections discussing components such as lasers and photodetectors and finishing with homodyne and heterodyne loops. Starting with a historical overview, presenting analog, digital, and optical PLLs, discussing phase noise analysis, and including circuits/algorithms for data synchronization, this volume contains new techniques being used in this field. Highlights of the *Second Edition*:

- Development of phase-locked loops from analog to digital and optical, with consistent notation throughout;
- Expanded coverage of the loop filters used to design second and third order PLLs;
- Design examples on delay-locked loops used to synchronize circuits on CPUs and ASICs;
- New material on digital dividers that dominate a frequency synthesizer's noise floor. Techniques to analytically estimate the phase noise of a divider;
- Presentation of optical phase-locked loops with primers on the optical components and fundamentals of optical mixing;
- Section on automatic frequency control to provide frequency-locking of the lasers instead of phase-locking;
- Presentation of charge pumps, counters, and delay-locked loops.

The *Second Edition* includes the essential topics needed by wireless, optics, and the traditional phase-locked loop specialists to design circuits and software algorithms. All of the material has been updated throughout the book.

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