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# Phaselock Techniques



## Synopsis

A greatly revised and expanded account of phaselock technology. The Third Edition of this landmark book presents new developments in the field of phaselock loops, some of which have never been published until now. Established concepts are reviewed critically and recommendations are offered for improved formulations. The work reflects the author's own research and many years of hands-on experience with phaselock loops. Reflecting the myriad of phaselock loops that are now found in electronic devices such as televisions, computers, radios, and cell phones, the book offers readers much new material, including:

- \* Revised and expanded coverage of transfer functions
- \* Two chapters on phase noise
- \* Two chapters examining digital phaselock loops
- \* A chapter on charge-pump phaselock loops
- \* Expanded discussion of phase detectors and of oscillators
- \* A chapter on anomalous phaselocking
- \* A chapter on graphical aids, including Bode plots, root locus plots, and Nichols charts

As in the previous editions, the focus of the book is on underlying principles, which remain valid despite technological advances. Extensive references guide readers to additional information to help them explore particular topics in greater depth. *Phaselock Techniques, Third Edition* is intended for practicing engineers, researchers, and graduate students. This critically acclaimed book has been thoroughly updated with new information and expanded for greater depth.

## Book Information

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## Customer Reviews

The first PLL I know of was developed by JPL for the receiver used to track the first US satellite,

Explorer 1, circa 1958. The basic idea was pretty straightforward, to close a very narrow loop around the phase of a carrier signal embedded in noise, perhaps with a SNR as low as a negative 20 dB in the receiver IF. This loop was used to adjust a voltage controlled oscillator [VCO] in the receiver to match the frequency and phase of the satellite signal. The error [and phase modulated telemetry] was detected by a phase detector and when the loop was locked, the error signal was essentially a varying dc voltage used to control the oscillator. An easy-to-implement low-pass filter [with a lead term] determined the SNR of the control signal and the noise bandwidth of the receiver. Thus was generated a Type 2 servo. This loop implementation, that made tracking the received satellite signals as low as -154 dBm, practical, was attributed to Dr Eberhardt Rechtin of JPL. There are a lot of tradeoffs needed to optimize the PLL, stabilizing the second order feedback loop was only one of these. Requirements were also placed on the satellite's signal source stability and telemetry modulation index, etc. Dr Gardner was the first mathematical engineers to unveil all the secrets of this technology and the requirements of the hardware needed to implement it successfully. Before his excellent text, you had to be in tight with the JPL guys, a generally outstanding bunch of fellows it was my pleasure to know as a young engineer. Just dumb luck. Dr Gardner was much more than a PLL guru, he was one of the best communications systems engineers on the planet and some more dumb luck found me working with Dr Gardner on many diverse projects during the next 40 years.

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