Preface

A modern electrical-engineering textbook is formidable. One thousand pages of matrices and theorems and problems sap enthusiasm from the hardiest students. Even after wading through this massive amount of material, students may be no closer to designing or building electronic circuits. A delightful contrast to these books is Paul Nahin's *The Science of Radio*. Nahin, who is also a historian of great skill, approaches the mathematics of communications engineering in top-down fashion, by telling a history of early radio and introducing the mathematics only when ("just in time") he needs it for his story. However, in one sense, Professor Nahin only tells half the story, and we would like to tell the rest of it. The mathematics of communications, although beautiful, is limited – engineering products must be built. Today's electrical-engineering students have usually not built stereos or tinkered with cars, and this means that they do not know the smoke and smell of construction or the excitement of electronic circuits coming to life. Many universities encourage this trend, with exercises where students switch components in and out of a circuit, never even heating up the soldering iron.

This is an introduction to electronics based on the progressive construction of a radio transceiver, the NorCal 40A, through thirty-nine exercises. At Caltech, beginning electrical-engineering students complete one problem as homework for each lecture. These exercises may also be useful for students in radio engineering classes. Radio amateurs who want to learn more about the transceivers they build have also found the material helpful.

The approach is not traditional. The reader will not find Laplace transforms or matrix-circuit solutions. On the other hand, Philips's SA602AN double-balanced mixer and oscillator looms large in our story. In addition, as the students progress through the material, they will become adept at working with complex numbers and learn about Fourier series. Our experience is that it is valuable for students to learn to put knobs on without destroying the screw heads and to learn to completely strip the enamel from magnet wire before soldering it into the circuit. One benefit of this approach is that when the transceivers are finished, students can do quite sophisticated tests on complete systems with only modest equipment.

The first chapter introduces the fundamental ideas in radio, and the second discusses basic components in circuits. We tackle phasors in the third chapter and begin the construction of the transceiver, which proceeds through much of the rest of the book. I have included a chapter on transmission lines because of the connections to filters and acoustics. The focus is on material and measurements that show how the transceiver works. The discussions of power amplifiers and oscillators as nonlinear circuits are more serious than those usually found in introductory electronics textbooks. I conclude with a chapter on antennas and propagation.

There are problems at the end of each chapter. After introductory exercises, the problems take a student through the transceiver construction. They include background and construction notes. The parts with numerical answers and plots that students do for homework are distinguished by boldface letters, **A**, **B**, and so on. Appendix A by Kent Potter gives a list of the supplies and equipment we use in the measurements. Appendix B explains Fourier series. Appendix C has the instructions for the circuit-simulator program *Puff* that is included and is used in the problems. Appendix D has a set of data sheets for the parts in the transceiver.

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