Wideband Amplifiers

By Peter Staric and Erik Margan

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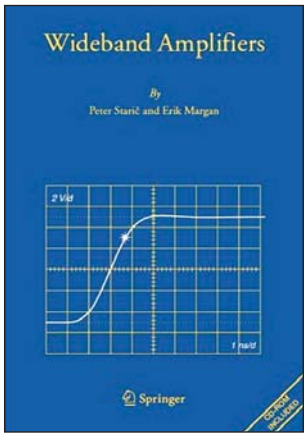

This is an excellent book in the field of analog electronics. Analog, linear and wideband amplifiers are now, as they always were, important building blocks of any electronics systems that interface with real world sensors. This book is a welcome addition to the field of linear and wideband amplifier analysis and design.

In Part 1, Staric and Margan cover the basic mathematical functions needed for analysis in many parts of the book. The Laplace transformations are treated extremely well. This chapter is so well written that one could use it for at least one semester of review of linear analysis. I particularly like the graphical representation of the transfer function in the *S*-domain, such as Fig.1.14.2 on page 1.75 and another on page 1.79. The convolution is very well covered and extremely well explained. It is also graphically aided by using the block representations as shown on page 1.83. One could do that only after thoroughly understanding the subject matter.

In Part 2, of the book, the authors discuss and present various inductive peaking circuits. They devoted 114 pages to these extremely important subjects. I particularly like this chapter since I know that the front end of amplifiers, such as those found in the oscilloscope, must be accurately designed and also must behave consistently at all temperatures. I am very glad that the authors cover the inductance calculations and show the inductance of a coil to be essentially the geometric property. Young readers may find this section particularly important since such subjects are not typically covered in general network courses. The bandwidth requirements for analog circuits are continually increasing and demand is getting higher and higher. Therefore we require that the inductors and transformers in peaking circuits, be used in an effective way.

Also very welcome are simple and rather basic two- to four-component circuits. They are thoroughly analyzed: authors show a plot of frequency response, phase response and, of course, the derivative of the phase response which gives the solution for the envelope delays. The emphasis is on thorough analysis of transient response, where the reader may use the knowledge and the methods of the first chapter to full extent.

Again, the circuits with inductive peaking are well selected. The graphs showing amplitude versus frequency are extremely well presented and immediately useful to the practicing engineer. I particularly like the graphs presented on pages 2.60 and 2.61 which show the circuit and its response, both in frequency and time domain, for the step function, while at the same time displaying the corresponding pole placement in the corner of the same graph, as well as the circuit diagram with all the relevant data and the essential formulae. In this way a young practicing engineer gets all the basic data in any of the diagrams clearly displayed and ready for use.

The frequency response, phase response and envelope delay versus frequency, and transient response are well exemplified and beautifully shown in the graphs on pages 2.76 to 2.81. Practicing engineers will undoubtedly find these worked out circuits useful for their work. On page 2.104 the diagrams of frequency responses of all inductive peaking circuits discussed previously and their transient responses are compared in order to allow the design engineer do select the optimal circuit. Such overview and details are very hard to find in textbooks in general. This work was possible only because the authors have worked in the electronics industry, which required the utmost detailed performance analysis of the commercial circuits used in electronic instrumentation. Books written by professors generally do not show such detailed analysis of practical circuit topologies.

The equations of practical solenoid inductance on page 2.108 are welcome since such information is difficult to find in a typical textbook. The planar inductance could have been more emphasized as shown on page 2.109; since there are many uses of the planar inductance design in RF power amplifier designs as well as on ICs.

Every section of the book has a rich collection of literature that could help the reader to look even further into the design of analog circuits.

In Part 3, we see the development of active circuits used as amplifiers with semiconductor devices. Similar topics of wide band design are shown in this chapter by applying the previous design techniques using active parts. Transistors are used in almost all cases. Sometimes Staric and Margan refer to a FET. This is all right since all the devices are similar.

Calculations were done mostly using the commercial software ICAP IV. Transistor modeling is done well, using recently updated transistor models. The configurations of the basic cell, such as CE, CB and CC are very well covered and, more important, the internal modeling parameters are well-described for the first time reader. The authors did not discuss the MOSFET devices that are now heavily used in opamp designs on silicon. They do, however, cover discrete junction FET transistors quite well. In low noise applications the jFET transistors are extremely valuable as front end devices.

In Part 4, the authors cover the cascading of amplifier stages. This section is excellently written. Many concepts worked out here will be instantly useful to a circuit designer. Also, many other circuit design concepts are elaborated. This will help the designer to choose appropriate topologies for optimum designs. A proper pole pattern selection is very important for good amplifier performance. It is shown that for a smooth, low overshoot tran-

sient response of the envelope delay the pole pattern is followed by the use Bessel functions. It is also shown how important is to choose the staggered poles in multistage amplifiers instead of repeated poles, particularly when the gain × bandwidth efficiency is of utmost concern.

In Part 5, the system synthesis and the integration of components is discussed. This is a well-written self-standing chapter with good graphics.

In Part 6 are presented the computer algorithms for analysis and synthesis of amplifier/filters and systems.

In Part 7 are given algorithms and application examples. The authors are using well known software by MatLab. A compact disc is included with the book; examples are worked out in the software.

This book is definitely the best work I have seen in this particular category. The book is excellent for practicing engineers, and could also be used as a textbook in post graduate electrical engineering courses. The professor who uses it as a text will have to assign his own homework problems since the book does not include them.

Design of circuits in wireless world, communications, and the analog design on silicon has become much richer with the publication of this book. I strongly recommend that every electronics designer have this book in his or her personal library.

Reviewed by Anton Mavretic, Ph.D.
Center for Space Physics
Boston University
E-mail: mavretic@bu.edu

Classic Works in RF Engineering
Combiners, Couplers, Transformers and Magnetic Materials

By John L.B. Walker, Daniel P. Myer, Frederick H. Raab and Chris Trask

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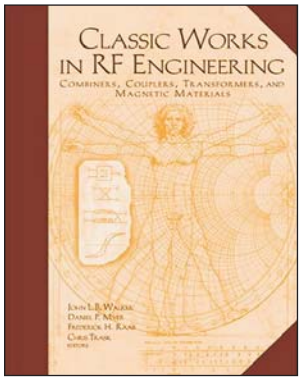

How often do you wish it was easier to find a classic reference, particularly a technical paper that may be more than 40 years old? This problem is especially frustrating for topics that are not well-covered in textbooks, where the collected papers on the subject are the primary source of background information. Here is a book that solves this problem for one specific topic—RF transformers, particularly those using ferrite and powdered-iron magnetic materials, typically used from low frequencies to UHF.

Fifty-three classic papers are reprinted in this book, grouped by subtopic. Each chapter includes substantial introductory material by the authors, followed by the reprints of pertinent papers. I should note that these introductions include a list of references beyond those that are reprinted. The six chapters are:

Chapter 1: Introduction

Chapter 2: Magnetic Materials

This chapter collects hard-to-find data on the characteristics of ferrite and iron powder magnetic cores, including composition, permeability, losses, temperature variations and other parameters. Most of the references are not well known, except to specialists in this area.

Chapter 3: Baluns/Hybrids/Anti-Phase Power Splitters

Antennas and push-pull amplifiers are good examples where conversion of a signal between unbalanced (ground-referenced) and balanced (ground-independent) sources and loads is required. L-C, transmission line and transformer-based designs are among the types considered.

Chapter 4: Transmission Line Transformers

This chapter covers broadband impedance matching using transmission line transformers. In particular, this chapter addresses topologies, design methods and construction techniques required to obtain a transformer with the desired impedance transformation ratio, bandwidth, loss and power handling capabilities.

Chapter 5: Hybrid Power Combiners and Splitters

The principles of transmission line transformers are extended to power combining/dividing circuits in this chapter. The emphasis is on high-power applications, although the circuits are certainly scalable for small-signal implementation.

Chapter 6: Quadrature Combiners and Splitters

This more specialized circuit is difficult to implement in wide bandwidths, but its value in areas such as odd-order harmonic cancellation in combined power amplifier systems makes it an interesting topic for many designers.

Some of the reprinted papers are widely-referenced seminal papers by such authors as Guanella, Ruthroff, Wilkinson, Pitzalis and Granberg. Others are papers and journal articles by a variety of authors, many of whom addressed one specific aspect of the subject. Some of these papers may be the only published material on their respective topics.

The subject of this book is one of personal interest, and I have used many of these circuits in radio and antenna systems over the past 30 years. I am also gratified to see that eleven of the papers selected by the authors were originally published under my direction in technical magazines and at engineering conferences.

Reviewed by Gary Breed
Editorial Director
High Frequency Electronics