

Electronics for Guitarists

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 Springer

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Preface

From an electrical engineering standpoint, the guitar is simply a signal source. Of course, the guitarist knows that it's really so much more than that. The guitar is a conduit to the soul of the guitar player. On the other hand most guitarists know that the electronic circuits used to process and amplify this signal are more than just a collection of transistors and tubes. These circuits and the guitar signal are related in complex and fascinating ways. There are few areas of art and engineering that combine with such dynamic synergy.

If you know absolutely nothing about electronics, starting into this book might be somewhat like showing up for swimming lessons and being thrown into the deep end of the pool. You may panic and struggle to tread water at first, but in the end I'm certain you will come out with some significant knowledge, and maybe even a sweet tube amplifier or effects box you built yourself- and actually understanding how it works!

If you already understand basic circuit analysis, and transistor/linear IC circuit analysis, then this book may serve to give you some insight into the basic principles of various effects and signal processing circuits. If you understand electronics but have never studied vacuum tube circuits, which probably includes most of you that were born in the 1950s or later, I think you will find Chapter 6 most interesting.

If you are already an old pro at tube circuit design/analysis/troubleshooting, then you may find my approach to tube circuit design to be somewhat unconventional. I learned tube theory a long time after I learned transistor theory, and I tend to approach tube circuit design and analysis in a way that is quite different from the typical tube-era texts that you might have seen. I'm not saying that my approach is better or worse, just different.

Who This Book Is Written For

The primary audience for this book is the guitarist that would like to know how transistor and vacuum tube-based amplifiers, and how various effects circuits work. In many ways, this book should be of interest to any musician that is

interested in analog signal processing. This book should also be useful to electronics hobbyists, technologists and engineers that are interested in guitar related applications.

Analog Rules!

The main thrust of this book is old school analog circuitry- lots of coverage of discrete transistors and diodes, classical filter circuits, and of course vacuum tube-based amplifiers. There is not much in the way of digital electronics used here, and no microcontroller or microprocessor related circuitry at all. We are going old-school all the way here.

About the Math

The main obstacle most often associated with understanding electronics is math. It is not necessary to understand the differential equations describing the dynamics of the guitar in order to become a virtuoso. In fact, it is not really necessary to know any mathematics at all to be a great guitar player. However, it is necessary to understand some basic mathematical concepts, such as proportionality for example, to gain even an elementary understanding of electronics. At first glance you might think there is a lot of math in this book. While in the strictest sense this is true, most of the math in the body of the text is simply analysis formulas that I present without derivation. Whenever possible I have tried to explain the principles behind the equations and circuits as briefly and succinctly as possible.

Building the Circuits

Math is very important – in fact absolutely essential – if you want to learn to design your own circuits. But if you only want to build and experiment, you can skip much of the math and still learn a lot. All of the circuits presented here have at least been prototyped, and are great starting points for further experimentation. With the exception of the vacuum tube-based circuits, all of the circuits presented operate at relatively safe, low voltages. The battery powered circuits are especially suitable for beginners.

Most of the transistor and op amp based circuits in the book can be built for under \$20.00. Often, the most expensive parts of the effects box type projects will be the case, or perhaps the switches. Should you decide use an online printed circuit board service, you can expect to pay about \$50.00 and up, but then it's easy to make multiple copies which would make nice gifts for your friends and family.

Vacuum Tubes

Chances are good that one of the main reasons you are reading this book is to learn something about vacuum tube amplifiers. I don't think you will be disappointed. Unless you have studied electronics or it has been your hobby for a while, I recommend that you work through the chapters leading up to vacuum tube amplifiers. It's a good idea to learn to build safe, low-voltage circuits before tackling a scratch-built tube amp. You also won't feel too bad if you burn up a few 25-cent transistors as you climb the electronics learning curve.

There is no way around the fact that vacuum tube amplifiers are very expensive to build. Even the smallest tube amplifier will probably cost about \$200.00 to build if you order all new parts. A moderately powerful, scratch-built tube amplifier will probably cost \$400.00 or more. Even so, there is something that is very cool about seeing the warm glow of those tubes as you play through this amp that you built from the ground up. You might also end up being the amp guru of your neighborhood some day, which is not a bad thing either.

Safety

Any circuit that derives power from the 120 V AC line can be dangerous and common-sense precautions should be taken to prevent shock hazards. This is especially true of vacuum tube circuits which use power supplies of over 500 V in some cases. These voltages can be lethal and extra caution should be exercised if you decide to build any type of vacuum tube circuit. It is recommended that you consult with a knowledgeable technician or hobbyist if you are inexperienced with high voltage circuitry.

Disclaimer

The information and the circuits in this book are provided as is without any express or implied warranties. While every effort has been taken to ensure the accuracy of the information contained in this text, the author assumes no responsibility for errors or omissions, or for damages resulting from the use of the information contained herein.

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Denton J. Dailey

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