

an extended period, the booster stayed cool with a small heat sink on it (see the title photo). One nice feature of this IC is that it has a "soft start" feature, which limits the initial current inrush that is common with older regulators.

### Finding the Parts

Most of the parts for this project are not hard to find. Digi-Key and other large suppliers have most of them. My greatest difficulty was locating the proper inductor. Inductors and transformers for circuits such as these are often available only directly from their manufacturer and sold only in quantities of hundreds or thousands. That's one reason I selected the LM2587 for my booster: The software indicated that I could wind the inductor on a toroidal core. I had learned how to do this while building QRP rigs and knew where to get toroids.

### Summary

It may take you a little while to get used to thinking in terms of *boosting* rather than *dropping* voltage, but once you do, you will realize this switching regulator has many uses. At home with an inexpensive 5-V computer power supply at its input, you'll have a power supply variable up to 17 V (or more, with minor changes). Think about using the booster as a lamp dimmer for a 12-V lamp, or as a motor-speed controller. In the field, you can use NiCds or other low-voltage batteries as a power source. If you want to design a different regulator, all the data you need is available at the referenced locations. Keep in mind that switching regulator technology is improving very rapidly, so you may find faster, smaller, more-efficient modules available. I am interested in hearing the thoughts, ideas and experiences of anyone who does explore this area.

### Notes

<sup>1</sup>A PC board, all board-mounted parts and detailed instructions for this project are available from the author for \$21, plus \$2 for shipping in the US and Canada, \$4 elsewhere. Foreign orders please include an international money order or a check in US currency payable at a US bank. Charge cards are not accepted. Foreign orders are shipped by air, small packet. Florida residents please add sales tax. A template package is not available.

<sup>2</sup>Electronic Business News, Oct 28, 1996, p24.

<sup>3</sup>Linear Technologies App Note 25, Sep 1987; <http://www.linear-tech.com>

<sup>4</sup>Electronic Engineering Times, Sep 30, 1996, p 28.

<sup>5</sup>To obtain the free software and get more information on the LM2587 and other Simple Switcher modules, visit the following National Semiconductor Web page: <http://www.national.com/sw/SimpleSwitcher/0,1043,0,00.html>; you can download the individual software versions from <http://www.national.com/sw/switch/sms421.exe> and <http://www.national.com/sw/switch/sms33.exe>. Also see <http://www.national.com> and <http://www.nsc.com>, or contact them via e-mail [support@tevm2.nsc.com](mailto:support@tevm2.nsc.com). —Ed.

<sup>6</sup>Sam Ulbing, N4UUAU, "An Active Audio CW Filter You Can Build," *QST*, Oct 1992, pp 27-29.

<sup>7</sup>Sam Ulbing, N4UUAU, "Uncle Albert's Keyer,"

*QST*, Jan 1994, pp 42-44.

Sam Ulbing, N4UUAU, has contributed a number of project articles to *QST*, *QEX* and *73 Amateur Radio Today Magazine*. Most of these articles have been low-power, 12-V-based projects. This is because Sam is one of the growing number of sailors who like to take their ham gear along when they sail.

Sam became a ham after spending a winter on his sailboat in the Bahamas and meeting other boaters who are hams. The advantages of having a ham radio on board were immediately apparent: Hams are able to get vital information such as weather reports daily on nets like the Waterway Net. \* In addition, Sam found



### RADIO-FREQUENCY ELECTRONICS CIRCUITS AND APPLICATIONS

By Jon B. Hagen, KP4I

Published by Cambridge University Press, North American Branch 40 West 20th St, New York, NY 10011-4211. Order direct at 800-872-7423. First edition, 1996, hard cover, 8x10 1/4 inches, 358 pages B&W illus, with many equations, ISBN 0-521-55356-3, \$49.95.

Reviewed by Paul Danzer, N111  
Assistant Technical Editor

Jon Hagen, a former Raytheon engineer, is currently the director of laboratory operations at the National Astronomy and Ionosphere Center at Cornell University. He is also a ham, and his long-term amateur experience shows through in this book.

Hagen wrote this as a textbook, and I am rather glad that I did not have to take this course. I suspect it would be rather like covering world history from Adam to atom, all in just one semester. However, the large number of topics covered in very little space is just what might make it an attractive addition to your book shelf.

The book takes a very interesting approach—in most areas it first explains a topic and then gives the basic mathematics that apply. The chapter on phase locked loops is typical, taking five pages to paint a word picture—including a mechanical analog—before the first schematic and equations. You can stop right there, and probably understand the operation of most common PLLs. But if you want, you can continue to tour the next pages of design equations and additional information. For perpetual students, or those very interested in a topic, each chapter ends with a small set of problems and exercises.

The book's organization is particularly interesting. After introducing and defining RF and narrowband signal ideas (Chapter 1), it jumps to impedance matching (Chapter 2) and then to linear amplifiers (Chapter 3). At this point you are ready for processing signals in filters and various RF circuits.

The book then proceeds through the parts of radio receiver, including the circuits and the modulation concepts needed to understand radio communication. Even switching converter

that boaters who have their ham stations on board tend to become much closer friends because they can keep track of each others' location and are thus able to meet often. Sam reluctantly uses SSB. His favorite mode is CW, which—with its low power consumption—is ideal for use on a boat. When he's not on his boat, you can contact Sam at 5200 NW 43rd St, Suite 102-177, Gainesville, FL 32606; e-mail [n4uau@afn.org](mailto:n4uau@afn.org).

Photos by the author.

\*The Waterway Radio and Cruising Club meets daily on 7268 kHz at 0745 Eastern. **QST-**

power supplies are covered. A really nice inclusion in the switching converter chapter is the operation of those pesky feedback power supplies commonly found in today's TVs. Now if someone could only publish a book on how to troubleshoot and fix those beasts!

The small-signal RF amplifier chapter is particularly interesting. Would you believe there are only two equations in the entire chapter? But somehow the concepts of small signal amplifiers, including dynamic range (one nicely done figure), come through clearly.

Another highlight of the book is Chapter 22, Transformers and Baluns. It has more equations than found in most chapters, but it remains comprehensible, and even if you skip some of the math you will probably still get a clear understanding of the topics. There is also a paragraph and drawing of the mechanical analog of a perfectly coupled transformer—rather unusual way to explain this idea.

A set of very clear drawings highlight the waveguide circuits chapter. The equations here are brief, and you can either study them or just look at their form, which will often explain what is going on.

Hagen introduces his chapter on TV with an interesting drawing of a Nipkow rotating disk TV system, which he uses to lead into the sequential signal idea of all analog TV transmissions. Included here are several drawings of the video interlace time sequences and the commercial channel subcarrier standard—excellent reference material for TV repair and TVI troubleshooting.

One chapter is devoted to radar pulse modulators. Even if you have no interest in radar, the chapter will give you some good ideas on how to generate very short pulses.

Each of the 34 chapters run between 5 to 12 pages each, so the book is really the basis of a survey of its title, *Radio-Frequency Electronics*. For a ham, it has concise word explanations of most of the common items you might want to know more about. Although you'd be hard put to design circuits from the equations given, they do act as a solid introductory step to the ideas behind topics you might not be familiar with.

As a reference book, it may serve you very well. The publisher suggests it would be "an ideal textbook for junior and senior courses in electrical engineering." Unfortunately, if you are interested in using it as a textbook, the publisher also tells us there is no instructor's guide or manual that contains the answers to the book's various learning exercises. **QST-**