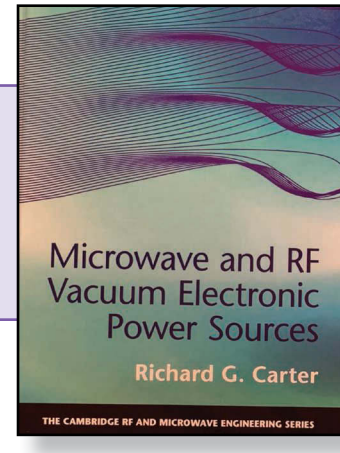
Book/Software Reviews

Tubes Are Good for You

■ **Alfy Riddle**

In this age of cell phones and Bluetooth, we may be tempted to overlook the fact that almost all of us have at least one high-power microwave tube in our house, and the magnetron in our microwave oven is only one of them. The notion that tubes are outdated and will be replaced by gallium nitride transistors might be alluring, but I think there will always be places where they rule, not to mention that the physics of tubes provides a fascinating study of electromagnetics, materials, and relativity.

Richard G. Carter's book, *Microwave and RF Vacuum Electronic Power Sources*, offers an extensive study of different tubes and the physics behind them. The ingenuity applied to creating all the types he describes is fascinating in itself. Dr. Carter's 50 years of experience inform his writing, and he includes Mathcad worksheets and real-world examples in this book of more than 800 pages in 20 chapters. It is well written and, for the mathematically adept, easy to read. It is also practical in that it can be consumed at a casual level to learn the ideas behind and operation of various tubes and at a detailed mathematical level for in-depth understanding.



Microwave and RF Vacuum Electronic Power Sources
By Richard G. Carter
Cambridge University Press, 2018
ISBN: 978-0-511-97923-1
838 pages, US$195.

Microwave and RF Vacuum Electronic Power Sources has four sections covering an electromagnetics review, the elements of tubes (such as slow-wave structures, linear electron beams, thermionic diodes, electron guns, and magnets), the types of tubes (such as triodes, klystrons, magnetrons, traveling-wave tubes, and crossed-field amplifiers), and system integration. While some aspects of tubes, such as space-charge-limited flow, are present in semiconductor devices, many others are unique to electrons flowing in a vacuum. Chapters 9–11 cover electron guns, electron collectors, and beam–wave interaction.

Although triode and tetrode tubes are similar to semiconductor devices, some, such as traveling-wave tubes, are inherently distributed, and others, including magnetrons, are intrinsically resonant. The use of electron beams gives tubes optical aspects, including beam focusing. Tubes are fascinating because they separate high-frequency operation from physical size. Transistors get smaller and smaller as operating frequency climbs higher because transit time rules. This limits voltages and power dissipation. Tubes can decouple the link between frequency and size and so allow more power dissipation (which does depend on size) and higher-frequency operation.

Even if you are not involved with tube electronics, this is a good book to have on your shelf. Reading it will provide you with a broader understanding of electromagnetics and devices. Plus, I am sure you will enjoy it.

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