Optoelectronics for Data Communication"

Edited by R. C. Lasky, U. L. Oesterberg, and D. P. Stigliani, Academic Press, 1995, 338 pages, ISBN 0-12-437160-4

REVIEWER: STUART BRORSON

Prior to its period of retrenchment in 1992–93, IBM invested both money and manpower into optoelectronics, perceived to be a key technology for intercomputer communications. Among the fruits of that creative period is the laser-based long distance ESCON optical interconnect for mainframe computers, in wide use today. Unfortunately, IBM's financial woes at the beginning of this decade put an end to many of its activities in optoelectronics. However, a new product of that fecund period has recently appeared on technical bookshelves: *Optoelectronics for Data Communications*, edited by Lasky, Oesterberg, and Stigliani, presents eight original chapters reviewing fiber optics and optical data communications. The IBM heritage is evident throughout the book: of the 13 authors of the chapters in this book, eight of them maintain an institutional address within IBM, and several others are former IBMers. As a counterbalance to Big Blue's prominence on the author list, several other authors hail from Dartmouth College's Thayer School of Engineering.

Consistent with its corporate parentage, this book's primary focus is on optoelectronics technology for data communications as distinct from telecommunications. The emphasis is on computer-to-computer communication over shorter distances and at lower bit rates than are common in long distance telephony. Multimode fiber is considered alongside single-mode, and considerations of component cost by necessity coexist with the requirements of link quality and reliability. The book starts with basic fiber optics, progresses through semiconductor device physics and communications link engineering, briefly covers the business aspects of marketing optoelectronic products, and concludes by trying to divine the future of optoelectronics in the wider world of data communications and computer networking. Among the unique and welcome features of this book is its hard-core "nuts and bolts" perspective. The topics covered reflect the priorities of industrial scientists involved with the details of practical optical communication links. For example, two chapters deal with the minutiae of fiber optic cable and connector technology. In Chapter 2, the usual treatment of modes and propagation in fiber is followed by an in-depth discussion of fiber's mechanical strength and methods to improve fiber optic cable's robustness. Afterwards, connector design and engineering are stressed, and precision ceramic ferrule technology for fiber alignment is treated. Chapter 5 treats the effect of fiber coupler quality on transmission link performance, and describes in great detail the 12 coupled fiber parameters which may be measured during the cable qualification process.

Further evidence of this book's nuts and bolts approach is Chapter 4, entitled "Integrated Circuits, Transceiver Modules, and Packaging," which discusses the various types of devices in common use as transmitters and receivers (e.g., LEDs, lasers, PIN photodiodes, and avalanche photodiodes), and provides hints about, for example, why one might use a laser instead of an LED for a high-speed link, but would prefer to use an LED for short distances over plastic fiber. This sort of practical information is usually lacking in standard optoelectronics textbooks. Later in the chapter, the authors consider a typical high-speed receiver circuit, and dwell on the intricacies of PLL circuits for clock recovery.

In contrast to the multiple chapters devoted to such subjects as packaging and connector technology, only one chapter deals with the physics of optical transmitters and receivers: Chapter Three, "Light Sources, Detectors, and Basic Optics." I see this as a laudable development: There are tens of books already in print which purport to treat "practical" optoelectronics for communications, but are really elementary treatises on semiconductor physics and electromagnetic wave propagation, with a few chapters dealing with the transmission of bits tacked on at the end. *Optoelectronics for Data Communication* represents the antithesis of this approach, since the one "device physics" chapter is — due to its brevity — somewhat superficial. For example, the response of electrons in a semiconductor to an applied electric field is explained using an analogy to a crowded party at a two-story house. Those readers who

(Continued on page 14)

(Continued from page 12)

already understand how electrons and holes work will appreciate the cleverness of the analogy, but those whose exposure to band-gaps and Fermi-Dirac statistics is cursory may be left scratching their heads. On the other hand, this "device" chapter is complete, managing to go from Fresnel's reflection law for plane waves to DFB lasers within 48 pages of normal size text (and figures).

Among the best parts of the book is Chapter Six, "Data Processing Systems and Optoelectronics." I found the section on optical link design to be one of the best summaries of the subject I have ever read. The author presents a typical link budget calculation and discusses the various power penalties which impact the performance of a link in a simultaneously mathematical and easily understandable way.

If I were to offer a criticism of this book, it is that it suffers from the same verbosity which plagues many reviews of technical subjects. Because of the vastness of their subject matter and the desire to cover it all, the authors occasionally lapse into "catalog writing": simply writing lists of subjects followed by unessential commentary. For example, in Chapter Seven, "Bringing a Product to Market," the author feels compelled to describe the organization of a typical engineering company down to the test engineer, and includes a subchapter which begins "Test Engineering: The test engineer tests the product in accordance with the development engineer's specifications...." Is there anyone who has made it to page 291 in this rather technical book who is uncertain about the role of the test engineer in a large engineering firm?

A related problem with this book — indeed, a generic problem of technical reviews — is that it is often tempting to write at great length about things which really demand a single figure. I recall that the most informative electronics books I read as a teenager were those large volumes showing nothing other than collections of circuit schematics grouped under headings such as "Audio Oscillators" or "Power Supplies." Although the figures in this book are generally adequate, I found myself occasionally wishing for my old textless book of schematics (e.g.,, towards the end of the chapter treating receiver circuits and clock recovery).

Is this a worthwhile book? If so, for which audience? Because of its heavy emphasis on the practical issues faced by industrial scientists, *Optoelectronics for Data Communication* is a useful introduction to fiber optic communications for technically knowledgeable outsiders interested in learning about the subject, or for newly hired engineers who will be working with optical networks. It would also serve well as secondary reading material in a graduate course on optoelectronics. It is very practically oriented, but employs mathematics when necessary. No advanced knowledge of physics or electronics is assumed, though former aquaintance with either or both is certainly helpful. Finally, though the last two chapters, "Bringing a Product to Market" and "The Future of Information Technology," were not completely successful, I admire the attempt to introduce these important topics into an engineering book. Hopefully, we will see more marriages of engineering and business in print as the field of optoelectronics continues to ripen and bloom.