PREFACE

The concerns that motivated this book are superbly captured by the Foreword graciously contributed by Dr. Baruch Levush, Head of the Vacuum Electronics Branch of the U.S. Naval Research Laboratory. The designers of present and future microwave and millimeter-wave power electronics systems *need* to be aware of the unique and rich characteristics of microwave vacuum electronic devices (MVEDs; pronounced, "emm-veds"). Unfortunately, there exists a glaring lack of vacuum electronics courses in most university curricula. This book seeks to help fill that gap and can be used by conscientious educators to give their graduate students a clearer grasp of the full range of possibilities.

Needless to say, no single text can adequately cover an entire field of research. For that reason, most chapters herein boast extremely rich lists of references. The reader is encouraged to seek out the books that are linked to the sub-areas that are of primary interest to them. The reference lists also make it clear which technical journals are most frequently used by MVED researchers, namely the *IEEE Transactions on Plasma Science*, the *IEEE Transactions on Electron Devices*, *Physics Review Letters*, *Physical Review E*, *Physics of Plasmas*, and the *IEEE Transactions on Microwave Theory and Techniques*. In addition, the reader interested in seeking out the most current status of any MVED-related topic is strongly encouraged to participate in the premier annual MVED technical conference, namely the IEEE International Vacuum Electronics Conference (IVEC). Each annual IVEC hosts an Internet page to facilitate participation. Several other regular conferences normally boast a significant number of MVED-related papers including the International Conference on Infrared and Millimeter Waves, the IEEE International Conference on Plasma Science, the American Physical Society Division of Plasma Physics Meeting, and various international conferences on vacuum microelectronics.

The preparation of this text was originally launched as a method to document the rich fruits of more than 15 years of ongoing MVED basic research that has been sponsored by the U.S. Air Force Office of Scientific Research (AFOSR). Up until Spring of 2004, AFOSR proudly managed the U.S. DOD's "Innovative Microwave Vacuum Electronics" MURI ("Multidisciplinary University Research Initiative"). Led by Neville C. Luhmann, Jr., of the University of California (Davis), that program began in August of 1999 and continued for almost five years at a funding rate of U.S.$1.24 M/yr. That MURI combined UC–Davis' expertise together with five other MVED research teams under John Booske at the University of Wisconsin (Madison), Victor Granatstein at the University of Maryland (College Park), Richard Temkin at the Massachusetts Institute of Technology (Cambridge),

George Caryotakis at Stanford University (Stanford Linear Accelerator Center), and Ronald Gilgenbach at the University of Michigan (Ann Arbor) into a single consortium. In addition to that MURI, AFOSR also sponsored and continues to support significant MVED basic research efforts conducted by Lars Ludeking and David Smithe of Mission Research Corporation (Washington), by Peter Lindsay and Xiaodong Chen of Queen Mary College (London), and by Anthony Lin of the University of California (Los Angeles). All of the above teams have contributed to the writing and preparation of this book.

As this book evolved, however, the scope of the material grew to capture much more than merely the MURI research aspects of the vacuum electronics field. Our authors quickly realized that this was an opportunity to "take a snapshot" of the entire MVED state-of-the-art. In its final form, it also encompasses the field's rich history and its potent current capabilities—all the elements necessary for adequate consideration of a technology's strengths. To accomplish this broader objective, many authors and chapter masters were specifically chosen from *outside* the university research community. Technical experts from industry as well as from government labs were recruited to add their own richness of experience to the text. We were aided in this process by the fact that strong ties have already evolved between the industrial, academic, and government lab components of the MVED R&D field. This is a tightly knit and dynamic technical community; any participant in the annual IVEC meetings will see this instantly.

As you prepare to read this book, there is an interesting (and somewhat amusing) issue of nomenclature that pervades this text. Back in the early days of MVEDs in the 1930s and 1940s, they were referred to as "valves" in Great Britain and as "tubes" in the United States. When MVED engineers gather to discuss their field, they still use the term "tube" to describe anything from the tiniest mini-traveling-wave-tube to a huge 75-MW klystron. The managing editor for this book (RJB) felt it was misleading to refer to a 75-MW device as a "tube," a very diminutive term that many engineers would mentally link to the small, glass-enveloped components that once populated television sets. For that reason, the acronym "MVED" was substituted for the original word, "tube," often proposed by individual contributing authors. One cannot imagine the uproar this caused. Old habits die hard. Nevertheless, "MVED" was retained as the name of choice for this book out of consideration to the reader. When the reader goes to an IVEC meeting, however, he/she should be prepared to still hear the word "tube" used to describe an MVED. Presumably in the United Kingdom, this would be "valve" instead.

Turning to more serious matters, we are pleased to be able to refer the reader to the collection of digital appendices provided with this book. These include some detailed theoretical derivations, some classic reference works, and some samples of MVED design tools. Most noteworthy are the seven appendices of Chapter 3 (Klystrons) which allow for actual "hands-on" klystron design work. All of the available appendices are listed at the end of the Contents for this book. To access this material, simply go to the following Internet address and download the files provided there: ftp://ftp.wiley.com/public/sci_tech_med/modern_microwave/

Arlington, Virginia
Madison, Wisconsin
Davis, California
College Park, Maryland
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ROBERT J. BARKER
JOHN H. BOOSKE
NEVILLE C. LUHMANN, JR.
GREGORY S. NUSINOVICH