Preface

Electrical consumption, especially direct or variable frequency currents, has strongly increased over 50 years in industry. This situation explains the growth of power electronics.

At the beginning, when rectifiers replaced DC machines, only diodes and thyristors were used. Then power transistors appeared and enabled the extension of smaller power applications for domestic use. New research topics were developed around converters and power devices. For all these years, circuit specialists used available components but did not try to improve them; a lot of progress in device manufacturing proceeded from microelectronic tecnology.

At the beginning of the 21st century it appeared necessary to bring component researchers and circuit specialists closer together to create a global conception approach.

For over 15 years, French industrialists and academics have combined their efforts in the GIRCEP (Groupement Industriel et de Recherche sur les Composants Electrniques de Puissance) to develop, with the help of CNRS (Centre National de Recherche Scientifique – France), research programs in power electronics. Power Electronics Semiconductor Devices is a product of this work.

The first and second chapters are devoted to up-to-date switches (MOSFET and IGBT). Their properties and limitations are presented by P. Aloisi.

In Chapter 3, D. Chatroux and J.L. Schanen explain how to increase current or voltage with serial or parallel associations of elementary components.

M.L. Locatelli and D. Planson present a prospective study on new silicone carbide devices in Chapter 4. Possible performance improvements are shown as well as the technological difficulties linked to the production and process of the material.

Chapter 5 is devoted to a passive component essential for static converters; power capacitors working at high frequency. The authors are A. Béroual, S. Guillemet and Th. Lebey.

Power electronics must use conductors that allow the movement of large currents with a parasitic inductance as low as possible. A model for a good design of these conductors is described by E. Clavel, F. Costa, C. Gauthier, A. Guéna, J. Roudet and JL. Schanen in Chapter 6.

The operation of converters is often explained by the swiching cell concept defined by H. Foch [FOC88] in the 1980s. The right understanding of its operation and fine modeling are shown in Chapter 7, written by J. Roudet and JL. Schanen.

In Chapter 8, thermal aspects relating to the use of power electronic devices are developed by C. Perret and R. Perret with the help of J.M. Dorkel. The main problems related to cooling and examples of modeling are described.

Finally, in Chapter 9, P. Austin, M. Breil and JL. Sanchez show the value of integration on silicon for power electronic modules. From industrial achievements and laboratory prototypes they provide progressive ideas that can lead to a profound evolution of power electronics.

The book lacks at least one chapter: one which deals with magnetic components for power electronics. Several recent studies have been developed in laboratories; interested readers may consult [KER03] and [LAO04] for further information on current developments.

This book on power electronic devices represents a summary of research carried out in French and international laboratories in the early years of the 21st century.

Robert Perret

References

[FOC88] FOCH H. and al, "Electronique de puissance", *Les Techniques de l'Ingénieur*, D3150 to D3163.

[KER03] KERADEC J.-P., FOUASSIER P., COGITORE B., BLACHE F., "Accounting for resistivity and permeability measurements. Application to MnZn ferrites", *IEEE Instrumentation Measurements and Technology Conference*, vol 2 no. 23-27, p.1252-1256, Vail, USA, 2003.

[LAO04] LAOUAMRI K., KERADEC J.-P., FERRIEUX J.-P., BARBAROUX J., "Design and identification of an equivalent circuit for a LCT component. Inventory and representation of losses", *IEEE Transactions on Instrumentation and Measurements,* vol 53 no. 5, p.1409-1417, 2004.