

Volume III

# Power Devices and Their Applications

Edited by  
Dr. Fred C. Lee  
&  
Dr. Dan Y. Chen  
Virginia Power Electronics Center

# TABLE OF CONTENTS

Forward.....	v
About the Book.....	vii
Introduction: "Power Semiconductors: Fast, Tough, and Compact," <i>D.Y. Chen</i> ( <i>IEEE Spectrum</i> , September 1987).....	1
<b>Part 1: Power Semiconductor Devices</b>	
"Characterization of High Power Darlington Transistors," <i>F.C. Lee, D.Y. Chen,</i> <i>M. Smith, and G. Carpenter, (PowerCon International, March 1982)</i> .....	7
"Reverse-Bias Second Breakdown of High Power Darlington Transistors," <i>D.Y. Chen, F.C. Lee, D.L. Blackburn, and D.W. Berning,</i> ( <i>IEEE Transactions on Aerospace and Electronic Systems</i> , November 1983).....	21
"Characterization of High-Power BJTs for Motor-Drive Applications," <i>M.M Jovanovic</i> <i>F.C. Lee and D.Y. Chen, (Industry Applications Society Annual Meeting, September 1986)</i> .....	29
"Characterization of RBSOA of High Power Bipolar Transistors Using a Nondestructive Tester," <i>M.M. Jovanovic, F.C. Lee, and D.Y. Chen</i> ( <i>IEEE Transactions on Industrial Electronics and Control Instrumentations</i> , May 1979).....	37
"Design Considerations for Paralleling Bipolar Transistors," <i>M.M. Jovanovic, and F.C. Lee,</i> ( <i>IEEE Transactions on Power Electronics</i> , October 1987).....	45
"A Practical SCR Model for Computer-Aided Analysis of AC Resonant Charging Circuits," <i>R.L. Avant, F.C. Lee, and D.Y. Chen,</i> ( <i>IEEE Transactions on Industrial Electronics</i> , November 1982).....	55
"A Unified SCR Model for Continuous Topology CADA," <i>R.L. Avant, and F.C. Lee,</i> ( <i>IEEE Transactions on Industrial Electronics</i> , November 1984).....	67
"The J3 SCR Model Applied to Resonant Converter Simulation," <i>R.L. Avant and F.C. Lee (IEEE Transactions on Industrial Electronics, February 1985)</i> .....	79
"Turn-Off Characteristics of Power Transistors Using Emitter-Open Turn-Off," <i>D.Y. Chen, and B. Jackson, (IEEE Transactions on Aerospace and Electronic</i> <i>Systems, May 1981)</i> .....	87
"Bipolar – FET Combination Power Transistors for Power Conversion Application," <i>D.Y. Chen, and S.A. Chin, (IEEE Transactions on Aerospace and Electronic</i> <i>Systems, September 1984)</i> .....	93
"A New FET-Bipolar Combinational Power Semiconductor Switch," <i>D.Y. Chen,</i> <i>S. Chandrasekaren, and S.A. Chin, (IEEE Transactions on Aerospace and</i> <i>Electronic Systems, March 1984)</i> .....	99
"Design Considerations for FET-Gated Power Transistors," <i>D.Y. Chen, and S.A. Chin,</i> ( <i>IEEE Transactions on Electronic Device Systems</i> , December 1984).....	107

“A GTO Circuit Using IGT and MOSFET as Gate Drivers,” S. Chin and D.Y. Chen, (IEEE Industrial Applications Society Annual Meeting, October 1987).....	111
“An 1800 V, 300 A Nondestructive RBSOA for Bipolar Transistors,” G. Carpenter, F.C. Lee, and D.Y. Chen, (Power Electronics Specialists Conference and Exposition, April 1988) .....	115
“RBSOA Characterization of GTO Devices,” G. Carpenter, D.Y. Chen, and F.C. Lee, (VPEC Seminar, September 1989) .....	125
“A New Way to Speed Transistor Switching,” D.Y. Chen, (Machine Design Magazine, April 1982) .....	135
“A Transistor Model for Numerical Computation of Forward-Bias Second-Breakdown Boundary,” M.M. Jovanovic, (Power Electronics Specialists Conference, June 1990) .....	141

## Part 2: Magnetics

“Electronic Transformer Using Amorphous Material,” M. Milkovic, F. Lubosky, D.Y. Chen, and R. Tompkins, (IEEE Transactions on Magnetics, September 1977).....	149
“High Frequency Core Loss Characteristics of Amorphous Magnetic Materials,” D.Y. Chen, (Proceedings of the IEEE, July 1981).....	155
“Magnetic Properties of the Amorphous Magnetic Metals Between 50 kHz and 225 kHz,” D.Y. Chen, (International Power Conversion Conference, September 1980).....	159
“Comparison of High Frequency Magnetic Core Losses Under Two Different Driving Conditions: A Sinusoidal Voltage and A Square-Wave Voltage,” D.Y. Chen, (Power Electronics Specialists Conference, June 1978).....	167
“Power Tests of Ferrite Materials in 1 to 20 MHz Frequency Range,” P.M. Gradzki and and F.C. Lee, (VPEC Seminar, September 1989) .....	173
“Minimum Weight EI Core and Pot Core Inductor and Transformer Designs,” C.J. Wu and F.C. Lee, (IEEE Transactions on Magnetics, September 1987) .....	179
“Design Graphs for Optimizing the Energy-Storage Inductor for DC-DC Power Converters,” S.A. Chin, D.Y. Chen, and F.C. Lee, (IEEE Transactions on Aerospace and Electronic Systems, March 1983).....	183
“Computer-Aided Graphic Design Optimization of Inductors for DC-DC Power Converters,” R.Ramkumar, R. B. Ridley, and F.C. Lee, (VPEC Seminar, September 1987).....	195
“Input Filter Design for Switching Regulators,” F.C. Lee, and Y. Yu, (IEEE Transactions on Aerospace and Electronics Systems, September 1979).....	213
“Computer-Aided Design for High-Frequency Power Transformers,” P.M. Gradzki, M.M. Jovanovic, and F.C. Lee, (Applied Power Electronics Conference, March 1990) .....	221
“Practical Design Considerations for High-Frequency Transformers and Resonant Inductors,” W.A. Tabisz, and M.M Jovanovic,(VPEC Seminar, September 1990) .....	229

## Part 3: Applications

“A Transistorized Chopper – Inverter Controller for Electric Vehicle Propulsion,” D.J. Shortt, R.A. Carter, and F.C. Lee, (IEEE Transactions on Industrial Electronics, November 1985) .....	241
---	-----

“Transistorized Power Module for High Power DC-Sinusoidal Inverter for Very Low Frequency Transmitter Application,” <i>C.H. Peng, D.Y. Chen, and F.C. Lee, (Industrial Applications Society Annual Meeting, October 1981)</i> .....	249
“Application of Transistor Emitter-Open Turn-Of Scheme to High-Voltage Power Inverters,” <i>D.Y. Chen and J.P. Walden, (IEEE Transactions on Industry Applications, July/August 1982)</i> .....	255
“Designing a High-Frequency Snubberless FET Power Inverter,” <i>Z.D. Fang, D.Y. Chen, and F.C. Lee, (PowerCon II, April 1984)</i> .....	261
“IGT/COMFET Latching Characteristics and Application to Brushless DC Motor Drive,” <i>V. Sukumar and D.Y. Chen, (IEEE Transactions on Aerospace and Electronic Systems, September 1986)</i> .....	273
“Application of IGT/COMFET to Zero-Current Switching Resonant Converters,” <i>R. Rangan, D.Y. Chen, J. Yang, and J. Lee, (IEEE Transactions on Power Electronics, January 1989)</i> .....	279
<b>Author Index</b> .....	285
<b>Editors’ Biographies</b> .....	287