Semiconductor Devices

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Semiconductor Devices

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Contents

<i>Foreword</i>	ix
<i>Preface</i>	xi
1 Semiconductors	1
1.1 Introduction	1
1.2 Atomic structure	1
1.3 Energy bands	3
1.4 The Fermi energy level, W_F	6
1.5 Holes and electrons	6
1.6 Mobility	7
1.7 Recombination and lifetime	8
1.8 Drift current and diffusion current	9
1.9 Impurity doping in semiconductors	10
1.10 Impurity levels on the energy-band diagram	11
1.11 Trapping levels and recombination centres in semiconductors	12
1.12 Majority and minority charge carriers	13
1.13 Energy-band diagrams for insulators and conductors	14
1.14 Work function and contact potential	14
1.15 Metal-to-semiconductor junctions	15
1.16 Some applications of semiconductor materials	17
2 Basic Semiconductor Devices	18
2.1 Thermistors	18
2.2 Voltage-dependent resistors	21
2.3 Hall-effect devices	22
2.4 Magnetoresistors	24
2.5 Semiconductor strain gauges and piezoresistors	25
2.6 Thermoelectric effect	25
2.7 The Gunn effect	28
2.8 Photoconductors	28

3 Semiconductor Diodes and the Unijunction Transistor	33
3.1 Basic features of diodes	33
3.2 The $p-n$ junction diode	33
3.3 Characteristics of a practical $p-n$ junction diode	36
3.4 Diode resistance	38
3.5 Reverse breakdown and Zener diodes	39
3.6 Tunnel diodes	46
3.7 Variable-capacitance diodes	49
3.8 $p-i-n$ diodes	50
3.9 Diffusion capacitance or storage capacitance of diodes	51
3.10 Schottky barrier diodes	52
3.11 Unijunction transistors (UJT)	53
4 Bipolar Junction Transistors, Amplifiers and Logic Gates	57
4.1 Introduction to bipolar junction transistors (BJTs)	57
4.2 Transistor circuit configurations	58
4.3 Operation of an $n-p-n$ transistor	59
4.4 Common-emitter characteristics	62
4.5 Common-base characteristics	64
4.6 Thermal effects on transistor characteristics	66
4.7 Maximum power dissipation	68
4.8 Transistor derating curves	68
4.9 h -parameters	70
4.10 Relationships between the common-emitter, the common-base and the common-collector parameters	74
4.11 A basic small-signal linear amplifier	75
4.12 Thermal stability	79
4.13 Stability factors	84
4.14 h -parameter analysis of a linear amplifier	84
4.15 The transistor as a switch – the NOT gate	85
4.16 OR and AND logic functions	88
4.17 NOR and NAND gates	88
5 Field-effect Transistors, Amplifiers and Logic Gates	91
5.1 Types of field-effect transistor	91
5.2 The junction-gate field-effect transistor	91
5.3 Characteristics of an n -channel JUGFET	93
5.4 Common-source small-signal equivalent circuit of the FET	97
5.5 Thermal effects on JUGFET characteristics and parameters	99
5.6 A simple common-source amplifier	100
5.7 A practical form of JUGFET amplifier	103
5.8 Analysis of FET amplifiers	103

5.9	Insulated-gate field-effect transistors (IGFETs)	106
5.10	Depletion-mode MOSFETs	109
5.11	Equivalent circuits of the MOSFET	109
5.12	The FET as a voltage-dependent resistor (VDR)	109
5.13	Comparison of p -channel and n -channel MOSFETs	109
5.14	MOS linear amplifier	110
5.15	MOS logic circuits	111
5.16	MOS gate insulation protection	113
5.17	Silicon-on-sapphire (SOS) structure	115
5.18	The silicon-gate structure	116
5.19	Fetrons	116
5.20	Summary of FETs and FET characteristics	118
6	Monolithic Integrated Circuits	119
6.1	Silicon crystal production	119
6.2	Manufacture of a simple bipolar IC	121
6.3	Encapsulation of ICs	125
6.4	Parasitic components in ICs	126
6.5	Monolithic diodes	126
6.6	Schottky diodes and Schottky transistors	126
6.7	Monolithic capacitors	128
6.8	Inductors	129
6.9	MOS transistors	129
6.10	Medium-scale and large-scale integration	130
7	Charge-coupled Devices	131
7.1	Basic principles of CCDs	131
7.2	A three-phase CCD	132
7.3	Charge transfer efficiency	134
7.4	Digital shift register	134
7.5	Analog shift register or delay line	134
7.6	Optical imaging	135
7.7	Two-phase and four-phase devices	136
7.8	CCD logic gates	136
8	Semiconductor Memories	137
8.1	Types of memory	137
8.2	The S–R flip–flop	138
8.3	Master–slave flip–flops	140
8.4	Static RAMs	142
8.5	Dynamic RAMs	143
8.6	Review of RAMs	145

8.7	Content addressable memories (CAMs)	145
8.8	Read-only memories (ROMs)	145
8.9	Programmable logic arrays (PLAs)	147
8.10	Amorphous memories	148
9	Thyristors and Other Multilayer Devices	149
9.1	The reverse blocking thyristor	149
9.2	Thyristor turn-on methods	152
9.3	Thyristor turn-off methods	154
9.4	The 'shorted-emitter' construction	154
9.5	Turn-on behaviour of thyristors	155
9.6	The triac or bidirectional thyristor	156
9.7	The diac or bidirectional breakdown diode	161
9.8	The silicon controlled switch (SCS)	162
9.9	The programmable unijunction transistor (PUT)	163
10	Optoelectronics	164
10.1	Photodiodes	164
10.2	Photovoltaic cells or solar cells	166
10.3	Phototransistors	166
10.4	Photothyristors	168
10.5	The light-emitting diode (LED) or electroluminescent diode	168
10.6	LED displays	170
10.7	Optically coupled isolators	172
10.8	Semiconductor lasers	173
10.9	Liquid crystal displays (LCDs)	173
<i>Index</i>		176

Foreword

Technological progress has nowhere been more rapid than in the fields of electronics, electrical, and control engineering. The *Macmillan Basis Books in Electronics Series* of books have been written by authors who are specialists in these fields, and whose work enables them to bring technological developments sharply into focus.

Each book in the series deals with a single subject so that undergraduates, technicians and mechanics alike will find information within the scope of their courses. The books have been carefully written and edited to allow each to be used for self-study; this feature makes them particularly attractive not only to readers approaching the subject for the first time, but also to mature readers wishing to update and revise their knowledge.

Noel M. Morris

Preface

The boundaries of electronics are continually expanding, and are subject only to the limitations imposed by production technology and our knowledge of device principles. The aim of this book, which is one in the *Macmillan Basis Series*, is to introduce the principles of electronic devices to students in the widest sense of the word. An attempt has been made in this book to avoid leaning too heavily on the physics of devices. As soon as the operation of a particular device has been explained, circuits and applications are introduced to illustrate its use.

The physical basis of semiconductor elements is given in a non-mathematical manner in the first chapter, and provides readers with a broad and progressive approach to the topic. The second chapter deals with basic non-active semiconductor devices such as thermistors, voltage-dependent resistors, Hall-effect devices, and many others that are used as transducing or sensing elements. An important element, the $p-n$ junction diode, is discussed in chapter 3, together with many variants such as Zener diodes, varactor diodes, $p-i-n$ diodes and others. The book logically proceeds to deal with bipolar junction transistors in chapter 4; in this chapter the use of the BJT as an amplifying element and as a switch is explained, the discussions being supported by appropriate circuits. A similar coverage is given to field-effect transistors in chapter 5; both junction-gate and metal-oxide-semiconductor types are described.

The principles of the manufacture of integrated circuits are outlined in chapter 6, including techniques used in BJT and FET circuits. The work in chapter 7 on charge-coupled devices follows logically the coverage of field-effect devices; these devices are of considerable interest in the fields of digital storage, analog shift registers and optical imaging. The rapid development of digital electronics, as exemplified by the ubiquitous pocket calculator, is illustrated in chapter 8 in which a variety of semiconductor memories and memory systems are discussed. Aspects of power electronics are not ignored, and in chapter 9 multilayer devices such as the thyristor, the triac, the diac, the silicon controlled switch and the programmable unijunction transistor are described. The triac is a complex device, and its operation is fully described in chapter 9. Finally chapter 10 deals with a wide range of optoelectronic devices such as photodiodes, solar cells, phototransistors, light-emitting diodes and optically coupled isolators. Liquid crystal displays, although not semiconductor devices, are employed in increasing numbers, and are discussed in the final chapter.

I would like to thank the electronics industry at large for supplying information not only about devices currently in use, but also about devices in the development stage. I am also indebted to my wife for her not inconsiderable efforts in the preparation of the manuscript, and for her patience with my preoccupation while it was being written.

Meir Heath

Noel M. Morris