

# CONTENTS

How This Book Will Help You .....	iii
<b>1. Using Number Systems .....</b>	<b>1</b>
Understanding the Decimal System	1
Examples of Other Base Systems	3
How to Convert Between Systems	6
Converting from Base X to Base 10	· From Base 10 to Base X
Doing Arithmetic in any Base System	11
Examples of Coded Numbers	14
B.C.D.—Binary Coded Decimal or 8421 Code	·
Excess 3 Code	· Gray Code
2-Out-of-5 Code	
Using Complements	16
Decimal (Base 10) Complements	· Binary (Base 2) Complements
The 2's Complement	
Binary to Decimal Conversion Chart	20
Hex to Decimal Conversion Chart	20
<b>2. Understanding and Applying Boolean Algebra .....</b>	<b>27</b>
The Three Basic Gates	28
The "OR" Gate	· The "AND" Gate
The Inverter	
Inverted Functions (NAND, NOR)	30
Multiple Inputs	31
Truth Tables	31
How to Generate Switching Functions from Truth Tables	
Sum-of-Products	38
Product of Sums	39
Checklist of Boolean Algebra Rules	41
DeMorgan's Theorem	43
Positive vs. Negative Logic	44
Implied Gates	45
How to Simplify and Manipulate Equations	46
Using Maps to Simplify	49
How to Simplify	51
The Karnaugh Map	54
Two-Variable	· Three-Variable
Four Variable	· Five-Variable

Simplifying	59
The Quine McCluskey Method	62
Examples of Solved Problems	70

### 3. Definition of Logic Families ..... 75

Early Logic	75
Switching Modes	77
Resistor Transistor Logic (RTL)	79
Diode Transistor Logic (DTL)	81
Fan-Out	82
Transistor Transistor Logic (TTL)	84
Schottky ( $T^2L$ )	84
Integrated Injection Logic ( $I^2L$ )	87
MOS Logic	88
NMOS	90
PMOS	91
VMOS	91
CMOS	92

### 4. Checklist of Logic Circuits ..... 95

Arithmetic Circuits	95
Full-Adder · Half-Subtractor	
Full-Subtractor	
Number System Decoders	103
Two-Variable · Three-Variable · BCD to	
Decimal · Binary to Octal · Excess 3 to	
Decimal · BCD to Seven-Segment	

### 5. Examples of Flip-Flops and Counters ..... 111

The Latch	111
The Set-Clear Flip-Flop	112
Clocked Flip-Flop	112
D-Type Flip-Flop	113
Master-Slave J-K Flip-Flop	114
Binary Counters	117
Base-X Counters	119
The Reset Method · The Count-Advance	
Method · Synchronism · Symmetry	
Shift Registers	125
Applications · The Ring Counter	
Counter Applications	128
90° Phase Shift · The Frequency	
Counter · The Digital Clock	

<b>6. Understanding Microprocessors .....</b>	<b>135</b>
Building a Microprocessor	135
Arithmetic Logic Unit (ALU) · Program	
Memory and Program Counter · Timing and Control	
Instruction Word Formats	142
Example of a "Worked Out" Program	144
Another "Worked-Out" Program	
The 8080 Microprocessor	147
The 6800 Microprocessor	150
More Microprocessors	157
<b>7. Explanation of Memory Devices .....</b>	<b>163</b>
Magnetic Core	163
Magnetic Drum	164
Charge-Coupled Devices (CCD)	164
Bubble Memory	164
Fundamentals of Semiconductor Memory	165
Bipolar RAM	166
MOS Static RAMs	169
MOS Dynamic RAMs	170
Bipolar ROMs	171
MOS ROMs	173
Understanding Magnetic Recording	174
Magnetic Tape	178
Cassettes · Large Tape Systems	
Magnetic Discs	182
Floppy Discs · Rigid Discs	
Example of Data Encoding	184
NRZI	185
FM	185
MFM	185
Comparisons · Two-of-Seven	
<b>8. How to Interface with the Computer .....</b>	<b>193</b>
Checklist of Common Alphanumeric Codes	193
ASCII · 5-Bit Baudot Code · The Hollerith Code · Extended Binary-Coded-Decimal Interchange (EBCDIC) · Typical Format on Paper Tape	
Examples of D/A and A/D Computers	199