

TABLE OF CONTENTS

Chapter	Title	Page
1	INTRODUCTION	1
2	DESCRIPTION OF INTEGRATED CIRCUITS	3
	Thin-Film Integrated Circuits	4
	Substrate	5
	Resistors	5
	Capacitors	6
	Inductors and Transformers	8
	Active Elements	8
	Interconnections	8
	Packages	8
	Future Thin-Film Integrated Circuits	9
	Solid Integrated Circuits	12
	Substrate	13
	Resistors	13
	Capacitors	14
	Inductors and Transformers	15
	Active Components	15
	Isolation	16
	Interconnections	16
	Packaging	17
	Future Solid Integrated Circuits	17
3	INTEGRATED CIRCUIT FABRICATION	19
	Brief Review of Fabrication Processes	19
	Detailed Description of Fabrication Processes	21
	Mask Making	21
	Substrate Preparation	23
	Circuit Delineation	24
	Finishing	27
	Fabrication Equipment	29
	Mask Making Equipment	29
	Substrate Preparation Equipment	29
	Circuit Delineation Equipment	30
	Finishing Equipment	32
	Integrated Circuit Materials	32
	Future Developments	33
	Automation in Mask Making	33

TABLE OF CONTENTS

Chapter	Title	Page
	Automation in Thermocompression Bonding	34
	Automation in Circuit Delineation	34
	Manufacture of Combination Integrated Circuits	35
4	FABRICATION INVESTMENT AND UNIT COST	36
	Solid Integrated Circuit Unit Cost - Volume Relationship	36
	Effect of Volume Changes on Unit Cost	38
	Effect of Changing Yield on Unit Cost	38
	Effect of Changes in Circuits/Slice on Unit Cost	39
	Solid Integrated Circuit Investment - Volume Relationship	39
	Thin-Film Unit Cost - Volume Relationship	41
	Effect of Volume Changes on Unit Cost	42
	Effect of Changes in Circuits/Plate on Unit Cost	42
	Thin-Film Investment - Volume Relationship	42
	Unit Costs of Completely Integrated Thin-Film Circuits	43
5	EVALUATION OF INTEGRATED CIRCUITS	45
	Size and Weight	45
	Performance	47
	Power Handling Ability	47
	Frequency Capability	47
	Speed	48
	Noise	48
	Element Value Ranges	48
	Element Tolerances	48
	Availability	49
	Reliability	50
	Repairability	52
	Design Flexibility	52
	Cost	52
	Projection of Integrated Circuit Prices	53
	Overall Integrated Circuit Cost to the Individual User	56
	Conclusion	58

TABLE OF CONTENTS

Chapter	Title	Page
6	APPLICATIONS	59
	Government	59
	Industrial	60
	Consumer	61
7	EXTENT OF USE	62
8	INTEGRATED CIRCUIT USER	73
	Make or Buy	73
	The Effect of Integrated Circuits on the User's Organization	75
	Standardization.....	75
	Prototype Construction	75
	Production	76
	Testing	76
	Inventory	76
	Maintenance	76
	Marketing	77
	Conclusion	77
9	THE INTEGRATED CIRCUITS MANUFACTURER	78
	What the Integrated Circuits Manufacturer Should Have	78
	Facilities and Equipment.....	78
	Personnel	79
	Capital.....	80
	What the Integrated Circuits Manufacturer Must Do Well	81
	Selling Function	81
	Product Development	82
	Order Processing	83
	Aspects of Production	83
	Inventory	84
	Research and Development	84
	Competitive Environment	84
10	THE IMPACT OF THE INTEGRATED CIRCUIT ON THE ELECTRONICS INDUSTRY	86
	Standardization of Electronic Circuits	86
	Technology and Applications	87

TABLE OF CONTENTS

Chapter	Title	Page
	Structure of the Electronics Industry	88
	Education and Personnel	88
APPENDIX		
A	DESCRIPTION OF VARIOUS CIRCUITS	90
	Hand-Wired Circuit	90
	Cordwood Circuit	90
	Micromodule	90
	Dot or Pellet Circuit	91
	Chip Circuit	92
B	INTEGRATED CIRCUITS COST ANALYSIS	93
	Calculation of Thin-Film and Solid Integrated Circuit Unit Cost	93
	Labor	93
	Materials	96
	Overhead	96
	Packaging	96
	Calculation of Thin-Film Active Element Cost	103
	Calculation of Investment Cost	104
C	MARKET FOR INTEGRATED CIRCUITS	105
	Projection of the National Economy	105
	Personal Consumption Expenditures	105
	Gross Private Domestic Investment	107
	Net Exports	108
	Government Expenditures for Goods and Services	108
	Projection of Equipment Sales	110
	Consumer Electronic Equipment Sales	110
	Industrial Electronic Equipment Sales	113
	Military and Space Electronic Equipment Sales	116
	BIBLIOGRAPHY	120
	GLOSSARY OF TERMS	123