

CHAPTER ONE: INTRODUCTION.....	1
OBJECTIVES.....	1
SCOPE AND FORMAT	1
REASONS FOR DOING THE STUDY	1
METHODOLOGY	1
ABOUT THE AUTHOR.....	2
RELATED BCC REPORTS	2
BCC ONLINE SERVICES.....	2
DISCLAIMER	2
 CHAPTER TWO: SUMMARY.....	 3
<i>SUMMARY TABLE GLOBAL ELECTRONIC COMPONENTS MARKET</i> <i>BY TYPE OF RESIN, THROUGH 2017 (MILLION POUNDS).....</i>	 <i>3</i>
<i>SUMMARY FIGURE GLOBAL ELECTRONIC COMPONENTS MARKET</i> <i>BY TYPE OF RESIN, 2011-2017 (MILLION POUNDS).....</i>	 <i>4</i>
SUMMARY (CONTINUED)	5
 CHAPTER THREE: RESINS USED IN ELECTRONIC COMPONENTS	 6
OVERVIEW.....	6
TYPES OF RESINS	6
THERMOPLASTICS	7
STYRENICS	7
High Impact Polystyrene (HIPS)	7
Background	7
Properties	7
Applications.....	7
Reinforced Polystyrene Products	8
Styrenic Polymer Producer Scenario	8
The New Domestic Styrenic Scenario.....	9
Processing	9
Overview.....	9
<i>TABLE 1 FABRICATION METHODS AND USES FOR POLYSTYRENE.....</i>	<i>10</i>
Injection Molding	10
NYLONS.....	10
Background	10
Properties	11
Major Types	11
Nylon 66	11
Nylon 6	12
Similarities and Difference between Properties of Nylon 6 and Nylon 66.....	 12
<i>TABLE 2 COMPARISON OF NYLON 6 AND NYLON 66 PROPERTIES</i>	<i>12</i>
Other Nylons.....	13
Overview.....	13

Nylon 46	13
Nylon 6/9	13
Nylon 6/10 and Nylon 6/12	13
Nylon 11	13
Nylon 12	14
Reinforced Nylons.....	14
Background	14
Processing	14
Electric/Electronic Applications.....	15
<i>TABLE 3 EXAMPLES OF NYLON RESINS USED TO MOLD</i>	
<i>ELECTRONIC COMPONENTS</i>	15
Market Estimates and Forecasts	16
<i>TABLE 4 GLOBAL NYLON MARKET FOR ELECTRONIC</i>	
<i>COMPONENTS, THROUGH 2017 (MILLION POUNDS)</i>	16
Recent Developments	17
New Nylon Resins Target Electronic Uses	17
DuPont Expands Asia Nylon Compounding.....	17
Ascend Performance Materials LLC Plans	
Increases in Number of Nylon Plants.....	17
DSM Buys Mitsubishi Chemical's Novamid.....	17
DSM Increases Capacity for New Nylon Grades.....	17
New Nylon Grades for High-Current Circuit	
Breakers.....	17
Arkema Increasing Nylon Production in China	18
Solvay Advanced Polymers Buys Rhodia.....	18
THERMOPLASTIC POLYESTERS	18
Background	18
Polybutylene Terephthalate (PBT)	18
Background	18
Properties	19
Applications.....	19
Selected Key PBT Trade Names	20
New Developments and Products.....	20
PBTs Developed for MIDs	20
New Chinese PBT Plant	21
Non-Halogenated PBTs for E/E Products	21
Polyethylene Terephthalate (PET)	21
Overview.....	21
Properties and Grades	21
Modified PET Resins	22
Engineering-Grade PET	23
Reinforced PET	23
Electronic/Electrical Applications	24
Producers and Capacities	25

Specific PET Products Used to Mold Electronic Components	25
New Developments	25
Indorama Bought Several Eastman Units	25
Japanese Firms Merge Their Respective PET Businesses.....	26
DAK Americas Completed the Eastman Withdrawal from the PET Business.....	26
DAK Americas Also Purchased Wellman's PET Business.....	26
M&G Group is Planning a new PET Plant.....	26
Polycyclohexyldimethylene Terephthalate (PCT).....	26
Background	26
Properties	27
Ticona Engineering Polymers	27
Market Estimates and Forecasts	28
<i>TABLE 5 GLOBAL PBT ELECTRONIC COMPONENT MARKET, THROUGH 2017 (MILLION POUNDS).....</i>	<i>28</i>
<i>TABLE 6 GLOBAL PET/PCT ELECTRONIC COMPONENT MARKET, THROUGH 2017 (MILLION POUNDS).....</i>	<i>29</i>
POLYPHENYLENE SULFIDE (PPS).....	29
Background	29
Properties.....	29
Advantages and Disadvantages.....	30
Applications	31
Other Technology Considerations.....	31
Producers	31
New Developments.....	32
Chinese Company Claims Large PPS Capacity	32
Low-Chlorine PPS Geared for E/E Applications	32
PPS Grades for Thin-Walling and High-Flow Characteristics.....	33
Dainippon Ink (DIC) Acquires Solvay's PPS Compounding Business in Europe.....	33
Market Estimates and Forecasts	33
<i>TABLE 7 GLOBAL PPS ELECTRONIC COMPONENT MARKET, THROUGH 2017 (MILLION POUNDS).....</i>	<i>34</i>
POLYIMIDES/PEI/PAI.....	34
Background	34
Properties.....	35
Early E/E Applications	35
Vespel Parts.....	36
A Major Electric/Electronic Application—Dielectric Interlayers	36

Polyimide Films	37
Polyetherimides (PEIs).....	38
Background	38
Properties	38
Applications.....	39
Polyamide-imides (PAIs)	39
Background	39
Properties	39
Applications.....	40
Producers.....	40
New Developments	40
Polyetheramides Used to Produce Fiber-Optic	
Connectors	40
Sabic Increases Ultem Production in Spain	41
New Thermoplastic Polyimide Blends.....	41
Market Estimates and Forecasts	41
<i>TABLE 8 GLOBAL POLYIMIDE ELECTRONIC COMPONENT</i>	
<i>MARKET, THROUGH 2017 (MILLION POUNDS).....</i>	<i>41</i>
POLYCARBONATES	42
Background	42
General Grades	42
Properties	42
Overview.....	42
Property Advantages and Disadvantages.....	43
Polyester Carbonates.....	43
Impact of Bisphenol A on Polycarbonate Usage.....	44
Processing	44
Applications	44
Alloys/Blends	44
Marketing	45
Fiber-Reinforced Polycarbonates	45
Producers and Capacities	45
Producers and Capacities (Continued).....	46
<i>TABLE 9 MAJOR POLYCARBONATE PRODUCERS AND TRADE</i>	
<i>NAMED PRODUCTS</i>	<i>47</i>
A New Development—Thinnest Commercial	
Polycarbonate	47
Market Estimates and Forecasts	47
<i>TABLE 10 GLOBAL POLYCARBONATE ELECTRONIC COMPONENT</i>	
<i>MARKET, THROUGH 2017 (MILLION POUNDS).....</i>	<i>48</i>
POLYPHTHALAMIDES (PPA)	48
Background	48
Properties and Applications	49
Producers	50

Market Estimates and Forecasts	50
<i>TABLE 11 GLOBAL POLYPHTHALAMIDE ELECTRONIC</i>	
<i>COMPONENT MARKET, THROUGH 2017 (MILLION POUNDS)</i>	50
New Developments	51
New Grades of Polyphthalamide Have High Flow	
and Reflectivity	51
Improved Corrosion-Resistant PPA Grades	51
LIQUID CRYSTAL POLYMERS (LCP)	51
Background	51
Properties	51
Applications	52
Background	52
Electrical/Electronics	52
LCP Fiber-Reinforced Products.....	53
Producers	53
New Developments and Products	54
New Reinforced Grades	54
LCP Finds Growth in Smaller and Thinner	
Connectors	54
MIDs Using LCPs	54
LCPs Provide High Heat Resistance.....	54
Ticona Now Producing LCPs in China.....	54
Market Estimates and Forecasts	55
<i>TABLE 12 GLOBAL ELECTRONIC COMPONENT MARKET,</i>	
<i>THROUGH 2017 (MILLION POUNDS)</i>	55
POLYSULFONES	56
Background	56
Types of Polysulfones	56
Overview.....	56
Polyarylsulfones	57
Grades	57
Properties	57
Applications of Polysulfones.....	57
Electrical/Electronic Applications.....	58
Producer Scenario.....	58
Solvay	58
RTP	59
Sumitomo Chemical.....	59
Polysulfone Producers and Trade Named Products.....	59
Recent Developments	59
BASF Low-Friction Wear Polysulfone Grades	59
BASF to Build Plant in Asia.....	59
Market Estimates and Forecasts	60

<i>TABLE 13 GLOBAL POLYSULFONE ELECTRONIC COMPONENT MARKET, THROUGH 2017 (MILLION POUNDS)</i>	60
ALLOYS/BLENDS	60
Background	60
PPO/HIPS	61
Background	61
Properties	61
Grades	61
Applications.....	62
PPO/Nylon	62
Background and Properties.....	62
Grades and Applications.....	63
Use of PC/PBT Blends	63
Recent Alloy/Blend Developments.....	63
New LCP/PPS Alloys Aim for Complex Parts	63
PEEK/PBI Blends for High Heat Applications.....	64
Market Estimates and Forecasts	64
<i>TABLE 14 GLOBAL POLYMER ALLOY/BLEND ELECTRONIC COMPONENT MARKET, THROUGH 2017 (MILLION POUNDS)</i>	64
FLUOROPOLYMERS	65
Background	65
Properties and Applications	65
Producers	65
Market Estimates and Forecasts	65
<i>TABLE 15 GLOBAL FLUOROPOLYMER COMPONENT MARKET, THROUGH 2017 (MILLION POUNDS)</i>	66
POLYKETONES	66
Background	66
Properties.....	66
Polyketone Composites.....	67
Applications	67
Producers	67
Recent Developments	68
Daicel-Evonik Joint Venture	68
Victrex Activities.....	68
New Polyketones Can Provide Lower Cost and/or Higher Performance	68
Market Estimates and Forecasts	68
<i>TABLE 16 GLOBAL POLYKETONE ELECTRONIC COMPONENT MARKET, THROUGH 2017 (MILLION POUNDS)</i>	69
THERMOPLASTIC MARKET ESTIMATES AND FORECASTS SUMMARY.....	69

<i>TABLE 17 GLOBAL TOTAL THERMOPLASTIC RESIN MARKET FOR ELECTRONIC COMPONENTS, THROUGH 2017 (MILLION POUNDS)</i>	70
THERMOSET RESINS	70
OVERVIEW	70
FIBER-REINFORCED GRADES	71
GENERAL PROPERTIES	71
<i>TABLE 18 FIBER-REINFORCED THERMOSET PROPERTIES AND MANUFACTURING PROCESSES</i>	71
EPOXY RESINS	71
Background	71
Chemistry.....	72
Chemical Epoxy Types	72
Processing	72
Technology	73
Epoxy Systems.....	73
Background	73
Non-Molded.....	73
Laminating Systems.....	73
Molded Epoxies	74
Advanced Epoxy Composites.....	74
General Applications	74
Electronic Applications.....	75
Molded Epoxies	76
Important Epoxy Grades and Producers	76
Market Estimates and Forecasts	76
<i>TABLE 19 GLOBAL EPOXY RESIN ELECTRONIC COMPONENT MARKET, THROUGH 2017 (MILLION POUNDS)</i>	77
POLYURETHANES	77
Background	77
Polyureas.....	78
RIM Products	78
RRIM Products	78
SRIM Products.....	79
Additional Details.....	79
Applications	79
Key Polyurethane Suppliers	79
Market Estimates and Forecasts	80
<i>TABLE 20 GLOBAL POLYURETHANE ELECTRONIC COMPONENT MARKET, THROUGH 2017 (MILLION POUNDS)</i>	80
PHENOLICS	80
Background	80
Grades	81
Molding Compounds	81

Background	81
Typical Applications for Phenolic Molding	
Compounds	82
Electric/Electronic Applications.....	82
Producers	83
Market Estimates and Forecasts	83
<i>TABLE 21 GLOBAL PHENOLIC ELECTRONIC COMPONENT</i>	
<i>MARKET, THROUGH 2017 (MILLION POUNDS).....</i>	<i>83</i>
UNSATURATED POLYESTERS	84
Background	84
Ingredients of Unsaturated Polyester Formulations	84
<i>TABLE 22 INGREDIENTS OF UNSATURATED POLYESTER</i>	
<i>FORMULATIONS IN DESCENDING ORDER OF COMMERCIAL</i>	
<i>USE.....</i>	<i>85</i>
Applications	85
Overview.....	85
Electrical/Electronic.....	86
Market Estimates and Forecasts	86
<i>TABLE 23 GLOBAL UNSATURATED POLYESTER COMPONENT</i>	
<i>MARKET, THROUGH 2017 (MILLION POUNDS).....</i>	<i>87</i>
DIALLYL PHTHALATE (DAP).....	87
Overview	87
Background and Applications	87
Producers	88
Market Estimates and Forecasts	88
<i>TABLE 24 GLOBAL DAP ELECTRONIC COMPONENT MARKET,</i>	
<i>THROUGH 2017 (MILLION POUNDS).....</i>	<i>88</i>
BT-EPOXY RESINS AND CYANATE ESTERS.....	88
COMPOSITES.....	89
THERMOSET MARKET ESTIMATE AND FORECAST	
SUMMARY.....	90
<i>TABLE 25 GLOBAL TOTAL THERMOSET RESIN ELECTRONIC</i>	
<i>COMPONENT MARKET, THROUGH 2017 (MILLION POUNDS).....</i>	<i>90</i>
 CHAPTER FOUR: RECENT RESIN DEVELOPMENTS RELATED TO	
ELECTRONIC COMPONENTS	91
DUPONT ACTIVITIES.....	91
 CHAPTER FIVE: TICONA ADVANCES.....	92
BAYER MATERIAL SCIENCE DEVELOPMENT	92
 CHAPTER SIX: ELECTRONIC COMPONENT PRODUCTS.....	93
INTRODUCTION	93
ACTIVE DEVICES	93
ACTIVE/PASSIVE DEVICES	93

PASSIVE DEVICES.....	93
FOCUS OF THIS REPORT	94
DIELECTRIC PROPERTIES OF PLASTICS.....	94
OVERVIEW	94
BACKGROUND	94
<i>TABLE 26 DIELECTRIC CONSTANTS OF SELECTED MATERIALS</i>	
<i>(DK)</i>	95
<i>TABLE 27 DIELECTRIC CONSTANTS FOR SELECTED</i>	
<i>THERMOPLASTICS (DK)</i>	95
RESIN CONSUMPTION	96
BACKGROUND	96
MARKETS	96
GROWTH.....	96
TECHNOLOGIES	97
REINFORCED PLASTICS MOVE AHEAD IN ELECTRONICS	97
PRINTED CIRCUIT BOARDS (PCBS).....	97
BACKGROUND	97
OVERVIEW	98
PROPERTY REQUIREMENTS.....	98
Electrical	98
Mechanical	99
Other Property Requirements.....	99
PHYSICAL COMPOSITION	99
ASSEMBLY TECHNOLOGIES.....	99
ISSUES FACING PLASTICS USAGE.....	100
PCB SUBSTRATES	100
<i>TABLE 28 IMPORTANT TECHNICAL FACTORS TO CONSIDER</i>	
<i>WHEN SELECTING PCB SUBSTRATE MATERIALS</i>	100
RIGID SUBSTRATES	101
Overview	101
Standard FR-4 Epoxy Resin.....	101
SPECIFIC MATERIALS USED IN PCBS	102
Higher-Performance Epoxies	102
Polyimides.....	102
Cyanate Esters	102
Silicon-Carbon	103
PTFE	103
BT Resins	103
Phenolics	103
Melamine	103
Other Materials	103
Copper Foils	103
Glass Cloth.....	104
Types of Reinforcements	104

OTHER DEVELOPMENTS.....	104
Impact of Lead-Free Soldering.....	104
Aramid Fibers.....	105
Production of Rigid PCBs.....	105
NEW DEVELOPMENTS.....	106
ENVIRONMENTAL ISSUES.....	106
Overview.....	106
Some Recycling Technologies for PCBs.....	106
FLEXIBLE PRINTED CIRCUIT BOARDS.....	107
Background.....	107
Technology.....	107
Standards.....	107
Advantages.....	107
Materials Used.....	108
Overview.....	108
Polyimides.....	108
Polyesters.....	108
Liquid Crystalline Polymers.....	108
Aramids.....	109
Epoxy Resins.....	109
Adhesiveless Laminates.....	109
Rigid-Flex Circuits.....	109
Comparison Between Rigid and Flexible Circuit Boards.....	109
<i>TABLE 29 COMPARISON BETWEEN RIGID AND FLEX CIRCUIT</i>	
<i>BOARDS.....</i>	<i>110</i>
SOLDERING.....	110
Background.....	110
Some Technologies.....	110
Lead-Free Electronic Soldering.....	111
PRODUCTION STATISTICS.....	111
INDUSTRY TRENDS.....	112
MARKET SIZES.....	112
MARKET ESTIMATES AND FORECASTS.....	113
<i>TABLE 30 TOTAL GLOBAL PCB MARKET BY RESIN TYPE</i>	
<i>THROUGH 2017 (MILLION POUNDS).....</i>	<i>113</i>
<i>TABLE 31 GLOBAL PCB MARKET BY THERMOSET RESIN</i>	
<i>THROUGH 2017 (MILLION POUNDS).....</i>	<i>114</i>
<i>TABLE 32 GLOBAL PCB MARKET BY THERMOPLASTIC RESIN,</i>	
<i>THROUGH 2017 (MILLION POUNDS).....</i>	<i>114</i>
ELECTRONIC PACKAGING.....	114
OVERVIEW.....	114
BACKGROUND.....	115
THROUGH-HOLE TECHNOLOGY— A TYPE OF PCB	
ASSEMBLY.....	115

WIRE BONDING	116
TAPE AUTOMATED BONDING (TAB)	116
Overview	116
Advantages	116
CHIP-ON-BOARD (COB).....	117
Background	117
Advantages	117
Substrate Materials.....	118
FLIP CHIP BONDING	118
DUAL-IN-LINE	119
SURFACE-MOUNT TECHNOLOGY (SMT)	119
Background	119
The Process	119
Additional Details.....	120
Design and Manufacturing Process	120
Advantages Versus Through-Hole	121
Wave Soldering Moving to Vapor Phase/IR.....	121
Resin and Material Usage.....	122
More Details on the Competitive Resin Scenario with SMT and Previously Discussed Electronic Packaging Technologies	122
OTHER KEY, SELECTED ELECTRONIC PACKAGING/INTERCONNECTION TECHNOLOGIES	123
Multichip Modules (MCMs).....	123
Definitions	123
Background	123
Rationale for Use	123
Types of MCMs.....	124
Materials Used.....	124
Problems for MCMs	124
Pin Grid Arrays (PGAs).....	125
Overview.....	125
DGA Versus BGA.....	125
High-Density Chips	125
Background	125
Technology.....	126
Materials Used.....	126
Background	126
Epoxy Alternatives	126
Alternatives with Polyimides	127
MOLDED/3D PCBS	127
Background	127
Technology	128
Manufacturing	128

History.....	128
How Do They Differ From PCBs?	129
Materials Used.....	129
Market Target.....	129
Process Technologies	129
Impact of MIDs	130
New Plastics for MIDs.....	130
Lanxess.....	130
BASF	131
Ticona	131
Evonik.....	131
ENCAPSULANTS	131
Definitions and Background	131
Primary Purposes of Encapsulation	132
Organic Encapsulants	133
Overview.....	133
Background	133
Impact of Thermoplastics	133
Background	133
Types and Application Modes.....	134
<i>TABLE 33 ENCAPSULANTS – APPLICATION MODE, ADVANTAGES AND DISADVANTAGES.....</i>	<i>134</i>
Epoxy Encapsulation Formulations.....	134
<i>TABLE 34 EPOXY ENCAPSULANT FORMULATIONS</i>	<i>135</i>
Encapsulated Electrical Components	135
Background	135
Specific Encapsulant Applications	136
Epoxy Encapsulant Systems	136
Specifications and Standards.....	137
Overview.....	137
UL 1694 Looks at Circuit Boards.....	137
Silicone Encapsulants.....	138
Major Selected Encapsulant Producers and Their Product Lines	139
Huntsman.....	139
Lord Chemical.....	139
Loctite.....	139
<i>TABLE 35 SELECTED ENCAPSULANT SUPPLIERS.....</i>	<i>140</i>
A New Development	140
Market Estimates and Forecasts	140
<i>TABLE 36 GLOBAL ELECTRONIC ENCAPSULATION MARKET BY RESIN TYPE, THROUGH 2017 (MILLION POUNDS).....</i>	<i>141</i>
<i>TABLE 37 GLOBAL ENCAPSULANT MARKET BY THERMOSET RESIN, THROUGH 2017 (MILLION POUNDS).....</i>	<i>141</i>

<i>TABLE 38 GLOBAL ENCAPSULATION MARKET BY THERMOPLASTIC RESIN, THROUGH 2017 (MILLION POUNDS).....</i>	<i>142</i>
CHAPTER SEVEN: MOLDED ELECTRONIC PRODUCTS	143
OVERVIEW	143
BACKGROUND	143
RESINS USED	143
DEMAND.....	144
<i>TABLE 39 DEMAND FOR PASSIVE ELECTRONIC COMPONENTS (%)....</i>	<i>144</i>
MARKET DRIVERS.....	144
CONNECTORS	145
Background	145
Trends	145
Materials and Applications for Electronic Connectors	145
Industrial Applications.....	146
Function of Connectors.....	146
The Industry	146
Electronic Connector Types.....	146
Resin Selection.....	146
Resin Selection (Continued)	147
Standards	148
NEMA AND ANSI	148
Manufacturers	148
<i>TABLE 40 SELECTED MANUFACTURERS OF HIGH DENSITY, MULTIPIN CONNECTORS.....</i>	<i>149</i>
End-Use Markets.....	149
Background	149
Communications Industry	150
Automotive Industry.....	150
Background	150
Resin Scenario.....	150
Other Markets.....	151
New Resin Developments.....	151
New Polyester Advantages.....	151
Nylon Activities.....	151
Market Estimates and Forecasts	152
<i>TABLE 41 GLOBAL CONNECTOR MARKET BY RESIN THROUGH 2017 (MILLION POUNDS)</i>	<i>152</i>
<i>TABLE 42 GLOBAL CONNECTOR MARKET BY THERMOPLASTIC RESIN THROUGH 2017 (MILLION POUNDS).....</i>	<i>153</i>
<i>TABLE 43 GLOBAL CONNECTOR MARKET BY THERMOSET RESIN, THROUGH 2017 (MILLION POUNDS).....</i>	<i>153</i>
SWITCHES.....	154
Background	154
Market Estimates and Forecasts	154

<i>TABLE 44 GLOBAL SWITCH MARKET BY RESIN, THROUGH 2017 (MILLION POUNDS)</i>	155
<i>TABLE 45 GLOBAL SWITCH MARKET BY THERMOPLASTIC RESINS, THROUGH 2017 (MILLION POUNDS)</i>	155
<i>TABLE 46 GLOBAL SWITCH MARKET BY THERMOSET RESIN, THROUGH 2017 (MILLION POUNDS)</i>	156
BOBBINS.....	156
Background	156
<i>TABLE 47 SELECTED BOBBIN MOLDERS</i>	157
Market Estimates and Forecasts	157
<i>TABLE 48 GLOBAL BOBBIN MARKET BY RESIN, THROUGH 2017 (MILLION POUNDS)</i>	157
<i>TABLE 49 GLOBAL BOBBIN MARKET BY THERMOPLASTIC RESIN, THROUGH 2017 (MILLION POUNDS)</i>	158
<i>TABLE 50 GLOBAL BOBBIN MARKET BY THERMOSET RESINS, THROUGH 2017 (MILLION POUNDS)</i>	158
RELAYS.....	159
Background	159
Market Estimates and Forecasts	159
<i>TABLE 51 GLOBAL RELAY MARKET BY RESIN THROUGH 2017 (MILLION POUNDS)</i>	159
<i>TABLE 52 GLOBAL RELAY MARKET BY THERMOPLASTIC RESIN, THROUGH 2017 (MILLION POUNDS)</i>	160
<i>TABLE 53 GLOBAL RELAY MARKET BY THERMOSET RESIN, THROUGH 2017 (MILLION POUNDS)</i>	160
CAPACITORS.....	160
Background	160
Applications	161
Dielectric Materials	161
Capacitor Types	161
Consumption by Market Segment	162
Market Estimates and Forecasts	162
<i>TABLE 54 TOTAL GLOBAL CAPACITOR MARKET BY THERMOPLASTIC RESIN THROUGH 2017 (MILLION POUNDS)</i>	163
OTHER MOLDED ELECTRONIC COMPONENTS	163
Resistors.....	163
Background	163
Applications.....	164
Inductors/Transformers.....	164
Plastic Usage	165
Market Estimates and Forecasts (Other Molded Electronic Components)	165
<i>TABLE 55 OTHER GLOBAL ELECTRONIC COMPONENT MARKET BY RESINS, THROUGH 2017 (MILLION POUNDS)</i>	165

<i>TABLE 56 GLOBAL OTHER ELECTRONIC COMPONENT MARKET BY THERMOPLASTIC RESIN, THROUGH 2017 (MILLION POUNDS)</i>	166
<i>TABLE 57 GLOBAL OTHER ELECTRONIC COMPONENT MARKET BY THERMOSET RESIN, THROUGH 2017 (MILLION POUNDS)</i>	166
CHAPTER EIGHT: RECENT PATENTS RELATED TO THE INDUSTRY	167
RECENT PATENTS RELATED TO THE INDUSTRY.....	167
RECENT PATENTS RELATED TO ...(CONTINUED)	168
RECENT PATENTS RELATED TO ...(CONTINUED)	169
SUMMARY OF MARKET ESTIMATES AND FORECASTS FOR ELECTRONIC DEVICES	170
<i>TABLE 58 TOTAL GLOBAL RESIN ELECTRONIC COMPONENT MARKET BY APPLICATION, THROUGH 2017 (MILLION POUNDS)</i>	170
<i>TABLE 59 TOTAL THERMOPLASTIC RESIN ELECTRONIC COMPONENT MARKET BY APPLICATION, THROUGH 2017 (MILLION POUNDS)</i>	171
<i>TABLE 60 TOTAL GLOBAL THERMOSET PLASTIC ELECTRONIC COMPONENT MARKET BY APPLICATION, THROUGH 2017 (MILLION POUNDS)</i>	172
CHAPTER NINE: CHANGES IN ELECTRONIC COMPONENT MANUFACTURE WHICH COULD IMPACT RESIN CHOICES	173
CHANGES IN ELECTRONIC COMPONENT... ..	173
CHANGES IN ELECTRONIC COMPONENT...(CONTINUED).....	174
CHAPTER TEN: APPLICATIONS AND INDUSTRY TRENDS.....	175
OVERVIEW.....	175
SNAPSHOT OF THE ELECTRONIC DEVICE MARKET	175
EXAMPLES OF STATIONARY ELECTRONIC DEVICES.....	176
COMPUTERS.....	176
Overview	176
Desktops.....	177
ELECTRONIC DISPLAYS	177
Background	177
Flat-Panels Displays	178
The Future of CRT Technology	178
PRINTERS.....	179
Overview	179
Ink Jet printers.....	179
Monochrome Laser Printers.....	179
Color Laser Printers	179
Manufacturers	179
Printer Market Matures.....	180
“ALL-IN-ONE” MACHINES.....	180

PHONES.....	180
Corded	180
Cordless.....	180
FACSIMILE MACHINES (FAX MACHINES)	181
Overview	181
Background	181
SCANNERS	181
Background	181
EXAMPLES OF MOBILE ELECTRONIC DEVICES.....	182
CELLULAR PHONES	182
History.....	182
Overview	182
Producers	182
Current Market Update	182
NOTEBOOKS/NETBOOKS.....	183
Overview	183
Netbooks.....	183
TABLETS/I-PADS.....	184
E-READERS	184
I-PODS/MP3	185
COMBINATION-TYPE MOBILE ELECTRONIC ENCLOSURES.....	185
SPECIAL END-USE MARKET FOR PLASTIC ELECTRONIC COMPONENTS —AUTOMOTIVE UNDER-THE HOOD.....	185
OVERVIEW	185
<i>TABLE 61 HISTORICAL, CURRENT AND PROJECTED U.S. AUTOMOTIVE SALES (MILLION UNITS).....</i>	<i>185</i>
<i>TABLE 62 ESTIMATED HYBRID SALES FOR THE U.S. (THOUSAND UNITS).....</i>	<i>186</i>
CAFÉ ISSUES.....	186
OVERVIEW OF ELECTRONIC COMPONENTS	187
FLEXIBLE CIRCUITRY.....	188
MATERIAL USAGE.....	189
EXPANDED USE OF ENCAPSULATED COMPONENTS.....	190
BOBBINS/CONNECTORS	190
SWITCHES/sockets	191
IGNITION COMPONENTS.....	191
CHAPTER ELEVEN: TECHNOLOGY TRENDS RELATED TO ELECTRONIC COMPONENTS	192
BACKGROUND	192
IMPORTANCE OF MINIATURIZATION	192
PACKAGING.....	193
CONCEPT OF MICROMOLDING.....	193
REPLACEMENT OF CERAMICS WITH PLASTICS.....	194

THIN-WALLING ELECTRONIC COMPONENTS.....	195
BACKGROUND	195
THIN-WALLING IS NOT A NOVEL CONCEPT	195
EFFECTS ON PERFORMANCE REQUIREMENTS AND DESIGN.....	195
APPLICATION REQUIREMENTS.....	196
MATERIAL AND PROCESS SELECTION	196
PROPERTIES REQUIRED	197
CHALLENGES IN DOWNSIZING	198
SOFTWARE THAT AIDS THIN-WALL DESIGN.....	198
PRINTED ELECTRONICS	198
FLEXIBLE ELECTRONICS.....	199
Overview	199
Concept of Plastic Electronics	199
Concept of Plastic Electronics (Continued).....	200
Advantages.....	201
Potential Market Size.....	201
 CHAPTER TWELVE: ELECTRONIC COMPONENT INDUSTRY	
OVERVIEW	202
TOP ELECTRONIC INDUSTRY MANUFACTURERS.....	202
TABLE 63 TOP GLOBAL SEMICONDUCTOR COMPANIES—2010 (\$ BILLIONS).....	202
MARKETING ASPECTS	203
OUTSOURCING	203
WHAT PLASTIC MOLDERS ARE DOING	203
UPSTREAM MANUFACTURING	204
CONTRACT MANUFACTURING.....	204
 CHAPTER THIRTEEN: RESIN PRODUCERS	205
OVERVIEW	205
TABLE 64 TRADE NAMES OF SELECTED, KEY RESINS USED IN ELECTRONIC COMPONENTS AND RELATED ELECTRONIC PRODUCTS.....	205
TABLE 64 (CONTINUED).....	206
TABLE 64 (CONTINUED).....	207
TABLE 64 (CONTINUED).....	208
MAJOR RESIN PRODUCERS SUPPLYING PRODUCT TO THE ELECTRONIC COMPONENT MARKET	208
THERMOSETS.....	208
Epoxies	208
Polyurethanes	208
Phenolics	208
Polyesters	209
DAP	209

THERMOPLASTICS.....	209
Nylons	209
Polyesters.....	209
PPS.....	210
Polyimides.....	210
Polycarbonates.....	210
LCPs.....	210
Polysulfones	210
Fluoropolymers	211
Polyphthalamides.....	211
Polyketones	211
Polymer Alloys/Blends.....	211
New Developments	211
DuPont Sells Several Resins to Ticona	211
DuPont Resumes Delayed Chinese Expansion Plans.....	211
Solvay Advanced Polymers Moves Further into the Electronics Market	212
Ticona to Produce LCPs in China	212
Dow Chemical Merges its Plastic Unit	212
Styron to Become Trinseo.....	212
BASF and Ineos Combine Styrenics Business	212
BASF Introduces New Grades for Electronic Components	213
CHAPTER FOURTEEN: PRICING.....	214
<i>TABLE 65 LIST PRICES FOR SELECTED RESINS USED TO MOLD ELECTRONIC COMPONENTS (\$/LB)</i>	214
CHAPTER FIFTEEN: MOLDERS OF ELECTRONIC COMPONENTS.....	215
<i>TABLE 66 TOP ELECTRICAL/ELECTRONIC INJECTION MOLDERS (\$ MILLIONS)</i>	215
CHAPTER SIXTEEN ENVIRONMENTAL ISSUES.....	216
OVERVIEW.....	216
PRINTED CIRCUIT BOARD DISPOSAL	216
HALOGEN-FREE PRINTED CIRCUIT BOARDS.....	216
RECYCLING	217
ELECTRONIC INDUSTRY INTERFACE.....	217
OVERVIEW	217
REASONS FOR INCREASED ENVIRONMENTAL REGULATIONS FOR ELECTRONIC EQUIPMENT	218
THE EUROPEAN UNION'S ROHS DIRECTIVE	219
THE WEEE DIRECTIVE.....	220

CHAPTER SEVENTEEN: TESTING AGENCIES AND REQUIREMENTS	
RELATED TO ELECTRONIC COMPONENTS	221
OVERVIEW	221
FIRE PROTECTION STANDARDS FOR ELECTRONIC	
COMPONENTS	221
UNDERWRITERS LABORATORIES (UL)	221
BACKGROUND	221
FLAMMABILITY STANDARDS	222
Definitions.....	222
Flammability Tests.....	223
Overview.....	223
UL 94 Vertical Burn Tests	223
<i>TABLE 67 CRITERIA FOR UL 94V CLASSIFICATIONS</i>	
<i>(INCHES/MINUTE)</i>	224
UL Horizontal Burn Test (UL 94 HB)	224
Summary of UL 94 Material Ratings.....	224
<i>TABLE 68 BURN SPECIFICATION FOR UL 04 MATERIAL RATINGS</i>	224
UL 1950	225
CHAPTER EIGHTEEN: SELECTED COMPANY PROFILES	226
AOC, INC.....	226
ASAHI KASEI CHEMICAL	226
ASHLAND SPECIALTY CHEMICALS	226
BASF.....	227
BAYER MATERIAL SCIENCE.....	227
CHEVRON PHILLIPS CHEMICAL	228
CYTEC INDUSTRIES, INC.	228
DSM ENGINEERING PLASTICS	229
DUPONT, INC.	229
EMS GRIVORY, INC.....	230
HUNTSMAN ADVANCED MATERIALS.....	230
INTERPLASTIC CORPORATION.....	231
LOCTITE, INC.....	231
MITSUBISHI ENGINEERING PLASTICS.....	232
QUANTUM COMPOSITES.....	232
ROGERS CORPORATION.....	233
SABIC INNOVATIVE PLASTICS	233
SOLVAY ADVANCED POLYMERS LLC.....	234
SUMITOMO BAKELITE NORTH AMERICA	234
TICONA, INC.....	235
TORAY PLASTICS	236
VICTREX, USA, LTD.	236
CHAPTER NINETEEN: ACRONYMS	237

ACRONYMS.....	237
ACRONYMS (CONTINUED)	238