

<b>Type Survey</b>	<b>8</b>
<b>1 General technical information</b>	<b>15</b>
1.1 Introduction	15
1.2 Definition	15
1.3 Microstructure and conduction mechanism	16
1.4 Construction	17
1.5 Equivalent circuits	18
1.6 $V//$ characteristics	20
1.6.1 Forms of presentation	20
1.6.2 Real $V//$ characteristic and ohmic resistance	21
1.6.3 Presentation of tolerance band	23
1.6.4 Overlapping $V//$ characteristics	23
1.7 Terms and descriptions	25
1.7.1 Operating voltage	25
1.7.2 Surge current	25
1.7.3 Energy absorption	25
1.7.4 Average power dissipation	27
1.7.5 Varistor voltage	27
1.7.6 Tolerance	27
1.7.7 Protection level (clamping voltage)	27
1.7.8 Capacitance	27
1.7.9 Response behavior, response time	28
1.7.10 Temperature coefficient	28
1.8 Derating	29
1.8.1 Derating for repetitive surge current	29
1.8.2 Derating at increased operating temperatures	29
1.9 Operating and storage temperature	29
1.10 Climatic categories	29
1.11 Overload response	30
1.11.1 Moderate overload	30
1.11.2 Heavy overload	31
1.12 Design notes	31
1.12.1 Physical protection, fuses	31
1.12.2 Potting and sealing, adhesion	31
1.12.3 Soldering	31
1.12.4 Storage of SIOV-CN varistors with AgPd electrodes	32
1.12.5 Prior damage	32
1.13 Designation system	33
<b>2 Selection procedure</b>	<b>35</b>
2.1 Overvoltage types and sources	35
2.1.1 Internal overvoltages	35
2.1.2 External overvoltages	35
2.2 Principle of protection and characteristic impedance	36
2.3 Areas of application for varistors	39
2.4 Series and parallel connection	40
2.4.1 Series connection	40

# Contents

---

	Page	
2.4.2	Parallel connection	40
2.4.2.1	Medium operating region	40
2.4.2.2	High-current region	40
2.5	Selection guide	41
2.5.1	Operating voltage	42
2.5.2	Surge current	42
2.5.2.1	Predefined surge current	42
2.5.2.2	Predefined voltage or network	42
2.5.2.3	Comparison: determined surge current / derating curve	46
2.5.3	Energy absorption	46
2.5.4	Average power dissipation	48
2.5.5	Maximum protection level	48
2.5.6	Selection by test circuit	49
<b>3</b>	<b>Application and design examples</b>	<b>51</b>
3.1	Switching off inductive loads	51
3.2	CE conformity	53
3.2.1	ESD	56
3.2.2	Energy of an ESD pulse	60
3.2.3	Burst	60
3.2.4	Surge voltages	60
3.2.5	Interference emission	63
3.2.6	EMC systems engineering	63
3.3	Protection of automotive electrical systems	63
3.3.1	Requirements	63
3.3.2	Transients	64
3.3.3	Fine protection	64
3.3.4	Tests	65
3.3.5	RFI suppression	67
3.4	Telecom	67
3.4.1	Requirements	67
3.4.2	Telecom varistors	68
3.5	S+M's PSpice simulation model	69
3.5.1	Varistor model	69
3.5.2	Application example	71
3.6	High-performance varistors for power electronics	74
3.7	Combined circuits	76
3.7.1	Stepped protection	76
3.7.2	Protective modules	76
<b>4</b>	<b>Quality</b>	<b>79</b>
4.1	Quality assurance procedure	79
4.1.1	Incoming inspection	79
4.1.2	Product assurance	79
4.1.3	Final inspection	79
4.2	AOQ	79
4.3	Reliability	81
4.3.1	Lifetime	81

---

	Page
4.3.2 Failure rate	81
4.4 Tests	83
4.5 Approvals	86
4.6 Environmental protection, hazardous materials	87
4.6.1 Environmental protection	87
4.6.2 Hazardous materials	88
<b>SMD varistors</b>	
SMD varistors, CN	<b>89</b>
Standard	89
Automotive	95
Telecom	97
Dimensions	99
SMD varistors, CU	<b>101</b>
Standard	101
Automotive	106
Telecom	108
Dimensions	110
Taping (CN andCU)	<b>111</b>
<b>Disk varistors</b>	
Disk varistors, SR	<b>115</b>
Standard	115
Automotive	118
Disk varistors, S	<b>121</b>
Standard	121
Automotive	139
Telecom	143
Disk varistors, Hicap	<b>145</b>
Automotive	145
Taping (S,SR andHicap)	<b>148</b>
<b>Block Varistors</b>	<b>161</b>
<b>Strap Varistors</b>	<b>167</b>
<b>PowerDisk</b>	<b>171</b>
<b>Arrester Blocks</b>	<b>173</b>
<b>Derating Curves</b>	<b>175</b>
<b>V// Characteristics</b>	<b>197</b>
<b>Symbols and Terms</b>	<b>214</b>