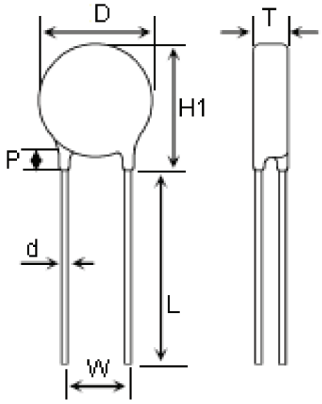
Metal Oxide Varistors

Straight Lead



Dimensions Table

Series	5D	7D	10D	14D	20D
D max	7	9.5	14	17.5	24
d*	0.6	0.6	0.8	0.8	1
W**	5	5	7.5	7.5	10
H max	12.5	14.5	20	22.5	29.5
H1 max	10	12	17	20.5	28
T max	4.9	4.9	8.5	8.5	9
P max	3	3	3	3	3

* ±0.02, ** ±1

Dimensions : Millimetres

Characteristics

- High performance transient voltage suppression
- Short response time to surge voltage
- Low standby power dissipation
- Excellent clamping characteristics
- High performance withstanding surge currents
- High reliability

Applications

- Surge protection in:
  - Consumer electronics
  - Industrial electronics
  - Communication electronics
  - Measuring and controlling systems
  - Electronic home appliances
- Protection against surges induced by lighting striking incoming power lines
- Suppression of surges caused by switching inductive loads such as transformers, relays and coils
- Protection of rectification diodes, SCRs, power transistors, semiconductor devices, etc

Definition of Varistor Terms

Rated RMS Voltage, Rated DC Voltage

The maximum designated values of power system voltage that may be applied continuously between the terminals of a device

Varistor Voltage

Test characteristic that is used to classify varistors by type. A test current of 1 mA DC is typically used to determine varistor voltage classification type. Varistor voltage clamping characteristics can be defined at various test levels

Rated Peak Single Pulse Transient Current

Maximum surge current, 8 / 20 µs waveform which a varistor is rated to withstand for a single surge

Rated Single Pulse Transient Energy

Maximum allowable energy for a single impulse (see specified waveforms)

Maximum Clamping Voltage

Measured peak voltage across the device terminals when a current impulse of specified amplitude and waveform is conducted through the varistor

Typical Capacitance

Typical capacitance values are measured at a test frequency of 1 KHz. Capacitance values are only for reference purpose only, not subject to outgoing inspection

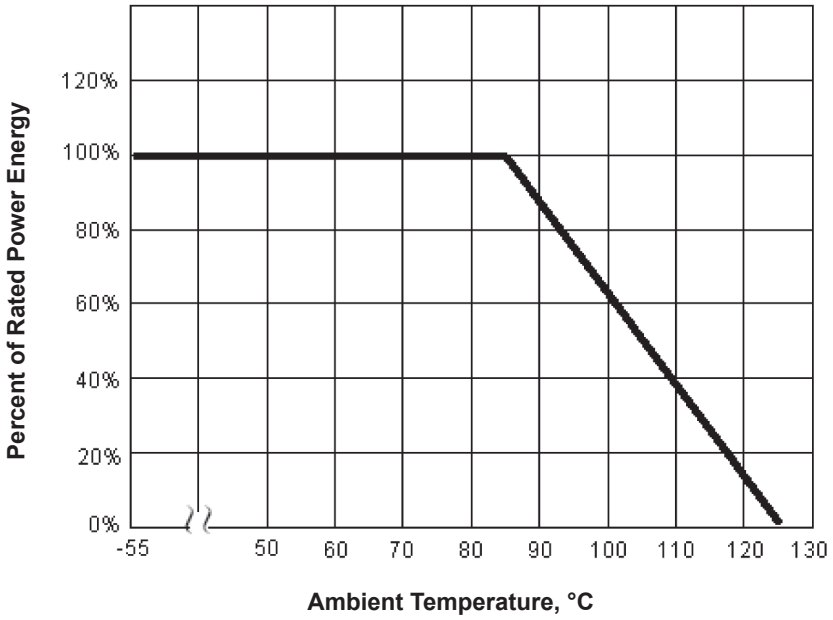
General Characteristics

Storage Temperature	: -55°C to +125°C
Operating Surface Temperature	: 125°C
Operating Ambient Temperature	: -55°C to +85°C (without derating)
Maximum Voltage Temperature Coefficient	: < -0.05% / °C
Minimum Insulation Resistance	: 1,000 MΩ
Hi Pot (Leads To Case, 1 Minimum)	: 2,500V DC
Typical Response Time	: <15 nano-seconds
Epoxy Rating	: 94V-0
Current / Energy Derating (>85°C)	: -2.5% / °C
DC Leakage Current	: 200 µA maximum (at rated dc working voltage)
Solderability	: MIL-STD-202F

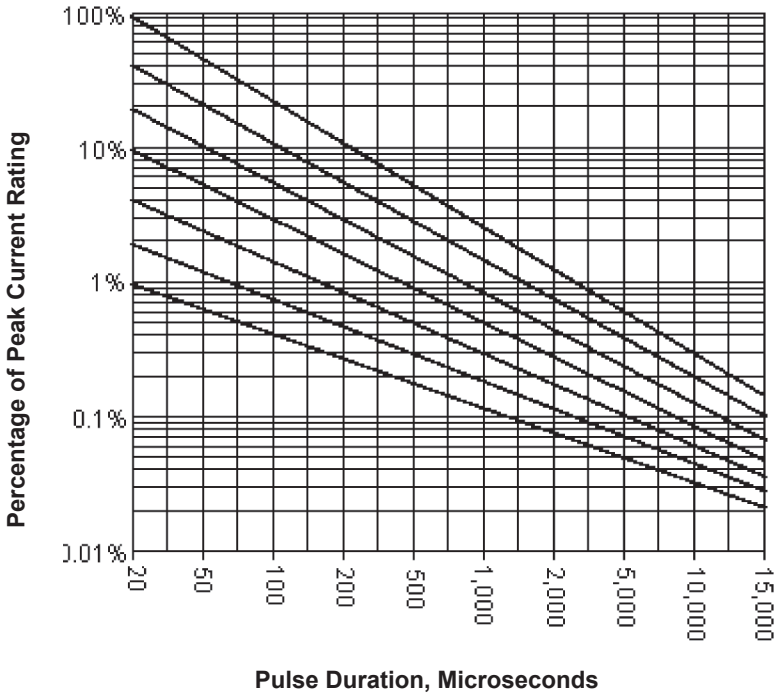
Power Dissipation Ratings (P, in-watts)

Disc Size	11V AC to 40V AC	50V AC to 680V AC
5 mm	0.01	0.15
7 mm	0.02	0.25
10 mm	0.05	0.4
14 mm	0.1	0.6
20 mm	0.2	1

Energy Derating Versus Temperature



Peak Current Per Pulse Versus Pulse Duration



Number of Pulses on Order from 100% Respectively :

1 Pulse
10 Pulses
10^2 Pulses
10^3 Pulses
10^4 Pulses
10^5 Pulses
10^6 Pulses

Varistors - 5D Series

Max. Allowable Voltage		Varistor Voltage		Withstanding Surge Current (8 / 20 µs)	Max. Clamping Voltage (8 / 20 µs)		Max. Energy		Typical Capacitance	Part Number
ACrms	DC	DC	Volts	1 time	Vc	Ip	2 ms	10 / 1,000 s	at 1 KHz	
Volts	Volts	Min.	Max.	Amperes	Volts	Amperes	Joules		PF	
11	14	16	20	100	36	1	0.4	0.6	1,500	MCV180K05DS
14	18	20	24	100	43	1	0.6	0.8	1,260	MCV220K05DS
17	22	24	30	100	53	1	0.7	0.9	1,050	MCV270K05DS
20	26	30	36	100	65	1	0.9	1.2	850	MCV330K05DS
25	31	35	43	100	77	1	1.1	1.3	600	MCV390K05DS
30	38	42	52	100	93	1	1.4	1.6	500	MCV470K05DS
35	45	50	62	100	110	1	1.5	1.9	400	MCV560K05DS
40	56	61	75	100	135	1	1.8	2.3	360	MCV680K05DS
50	66	74	90	400	135	5	2.4	3	350	MCV820K05DS
75	102	108	132	400	200	5	3	5	250	MCV121K05DS
95	127	135	165	400	250	5	3.5	5.5	180	MCV151K05DS
130	175	185	225	400	340	5	5	8.5	140	MCV201K05DS
150	200	216	264	400	395	5	6.5	10	115	MCV241K05DS
230	300	324	396	400	595	5	9	13	80	MCV361K05DS
250	330	351	429	400	650	5	10	15	75	MCV391K05DS
275	370	387	473	400	710	5	11	16	65	MCV431K05DS
300	385	423	517	400	775	5	13	19	55	MCV471K05DS
420	560	612	748	400	1,120	5	21	30	30	MCV681K05DS

Varistors - 7D Series

Max. Allowable Voltage		Varistor Voltage		Withstanding Surge Current (8 / 20 µs)	Max. Clamping Voltage (8 / 20 µs)		Max. Energy		Typical Capacitance	Part Number
ACrms	DC	DC	Volts	1 time	Vc	Ip	2 ms	10 / 1,000 s	at 1 KHz	
Volts	Volts	Min.	Max.	Amperes	Volts	Amperes	Joules		PF	
11	14	16	20	250	36	2.5	0.8	1	2,900	MCV180K07DS
14	18	20	24	250	43	2.5	0.9	1.3	2,400	MCV220K07DS
17	22	24	30	250	53	2.5	1	1.4	1,800	MCV270K07DS
20	26	30	36	250	65	2.5	1.2	1.7	1,500	MCV330K07DS
25	31	35	43	250	77	2.5	1.5	2.1	1,230	MCV390K07DS
30	38	42	52	250	93	2.5	1.8	2.5	950	MCV470K07DS
35	45	50	62	250	110	2.5	2.2	3.1	890	MCV560K07DS
40	56	61	75	250	135	2.5	2.5	3.8	850	MCV680K07DS
50	66	74	90	1,200	135	10	3.5	5.5	830	MCV820K07DS
75	102	108	132	1,200	200	10	5	7.8	570	MCV121K07DS
95	127	135	165	1,200	250	10	6.5	9.7	400	MCV151K07DS
130	175	185	225	1,200	340	10	10	13	275	MCV201K07DS
150	200	216	264	1,200	395	10	11	16	230	MCV241K07DS
230	300	324	396	1,200	595	10	15	25	155	MCV361K07DS
250	330	351	429	1,200	650	10	17	26	145	MCV391K07DS
275	370	387	473	1,200	710	10	20	28	130	MCV431K07DS
300	385	423	517	1,200	775	10	21	30	115	MCV471K07DS
420	560	612	748	1,200	1120	10	32	45	78	MCV681K07DS

Varistors - 10D Series

Max. Allowable Voltage		Varistor Voltage		Withstanding Surge Current (8 / 20 µs)	Max.Clamping Voltage (8 / 20 µs)		Max. Energy		Typical Capacitance	Part Number
ACrms	DC	DC	Volts	1 time	Vc	Ip	2 ms	10 / 1,000 s	at 1 KHz	
Volts	Volts	Min.	Max.	Amperes	Volts	Amperes	Joules		PF	
11	14	16	20	500	36	5	1.5	2.1	6,000	MCV180K10DS
14	18	20	24	500	43	5	2	2.5	5,000	MCV220K10DS
17	22	24	30	500	53	5	2.5	3	4,000	MCV270K10DS
20	26	30	36	500	65	5	3	4	3,500	MCV330K10DS
25	31	35	43	500	77	5	3.5	4.6	3,100	MCV390K10DS
30	38	42	52	500	93	5	4.5	5.5	2,800	MCV470K10DS
35	45	50	62	500	110	5	5.5	7	2,400	MCV560K10DS
40	56	61	75	500	135	5	6.5	8.2	2,100	MCV680K10DS
50	66	74	90	2,500	135	25	8	12	1,600	MCV820K10DS
75	102	108	132	2,500	200	25	12	18	1,200	MCV121K10DS
95	127	135	165	2,500	250	25	16	22	1,100	MCV151K10DS
130	175	185	225	2,500	340	25	20	30	640	MCV201K10DS
150	200	216	264	2,500	395	25	25	35	560	MCV241K10DS
230	300	324	396	2,500	595	25	35	47	380	MCV361K10DS
250	330	351	429	2,500	650	25	40	60	350	MCV391K10DS
275	370	387	473	2,500	710	25	45	65	310	MCV431K10DS
300	385	423	517	2,500	775	25	46	70	280	MCV471K10DS
420	560	612	748	2,500	1,120	25	50	74	130	MCV681K10DS

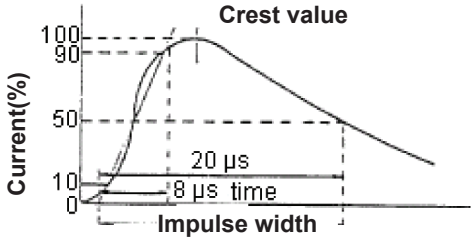
Varistors - 14D Series

Max. Allowable Voltage		Varistor Voltage		Withstanding Surge Current (8 / 20 µs)	Max. Clamping Voltage (8 / 20 µs)		Max. Energy		Typical Capacitance	Part Number
ACrms	DC	DC	Volts	1 time	Vc	Ip	2 ms	10 / 1,000 s	at 1 KHz	
Volts	Volts	Min.	Max.	Amperes	Volts	Amperes	Joules		PF	
11	14	16	20	1,000	36	10	3.5	4	15,000	MCV180K14DS
14	18	20	24	1,000	43	10	4	5	12,000	MCV220K14DS
17	22	24	30	1,000	53	10	5	6	8,500	MCV270K14DS
20	26	30	36	1,000	65	10	6	7.5	7,200	MCV330K14DS
25	31	35	43	1,000	77	10	7	8.6	6,300	MCV390K14DS
30	38	42	52	1,000	93	10	8.5	10	5,500	MCV470K14DS
35	45	50	62	1,000	110	10	10	11	4,800	MCV560K14DS
40	56	61	75	1,000	135	10	12	14	4,000	MCV680K14DS
50	66	74	90	4,500	135	50	15	22	3,300	MCV820K14DS
75	102	108	132	4,500	200	50	22	34	2,600	MCV121K14DS
95	127	135	165	4,500	250	50	30	45	2,000	MCV151K14DS
130	175	185	225	4,500	340	50	38	60	1,370	MCV201K14DS
150	200	216	264	4,500	395	50	45	66	1,060	MCV241K14DS
230	300	324	396	4,500	595	50	70	98	725	MCV361K14DS
250	330	351	429	4,500	650	50	72	102	665	MCV391K14DS
275	370	387	473	4,500	710	50	75	115	600	MCV431K14DS
300	385	423	517	4,500	775	50	80	125	570	MCV471K14DS

Varistors - 20D Series

Max. Allowable Voltage		Varistor Voltage		Withstanding Surge Current (8 / 20 µs)	Max. Clamping Voltage (8 / 20 µs)		Max. Energy		Typical Capacitance	Part Number
ACrms	DC	DC	Volts	1 time	Vc	Ip	2 ms	10 / 1,000 s	at 1 KHz	
Volts	Volts	Min.	Max.	Amperes	Volts	Amperes	Joules		PF	
11	14	16	20	2,000	36	20	10	12	27,000	MCV180K20DS
14	18	20	24	2,000	43	20	13	15	20,000	MCV220K20DS
17	22	24	30	2,000	53	20	15	17	15,000	MCV270K20DS
20	26	30	36	2,000	65	20	22	22	12,200	MCV330K20DS
25	31	35	43	2,000	77	20	24	26	10,000	MCV390K20DS
30	38	42	52	2,000	93	20	30	33	9,350	MCV470K20DS
35	45	50	62	2,000	110	20	35	38	8,000	MCV560K20DS
40	56	61	75	2,000	135	20	40	43	6,800	MCV680K20DS
50	66	74	90	6,500	135	100	37	48	5,600	MCV820K20DS
75	102	108	132	6,500	200	100	40	55	4,100	MCV121K20DS
95	127	135	165	6,500	250	100	50	70	3,200	MCV151K20DS
130	175	185	225	6,500	340	100	70	95	2,200	MCV201K20DS
150	200	216	264	6,500	395	100	82	110	1,900	MCV241K20DS
230	300	324	396	6,500	595	100	120	163	1,320	MCV361K20DS
250	330	351	429	6,500	650	100	130	180	1,210	MCV391K20DS
275	370	387	473	6,500	710	100	140	190	1,120	MCV431K20DS
300	385	423	517	6,500	775	100	150	220	1,000	MCV471K20DS

Mechanical Ratings

<table>
<tr><td>Characteristics</td><td>Test method and specifications</td></tr>
<tr><td>Standard Test Condition</td><td>Temperature range : 5 to 35°C
Relative humidity : 45 to 85% R.H.</td></tr>
<tr><td>Varistor Voltage</td><td>Voltage across the varistor measured at 1 mA DC rectangular pulse current</td></tr>
<tr><td>Maximum Allowable Voltage</td><td>Maximum continuous sinusoidal RMS voltage or DC voltage which may be applied within the specified environmental temperature range</td></tr>
<tr><td>Maximum Clamping Voltage</td><td>Peak voltage across the varistor under condition of a specified standard impulse current (8 / 20 μs)
 
</td></tr>
<tr><td>Withstanding Surge Current</td><td>Maximum current across the varistor measured at a given standard waveform (8 / 20 μs) applied one time or two times with the varistor voltage less than ±10%</td></tr>
<tr><td>Rated Transient Average Power Dissipation</td><td>Maximum average power which may be dissipated due to a group of pulses occurring within a specified isolated time period, without causing device failure</td></tr>
<tr><td>Maximum Energy</td><td>The maximum energy within the varistor voltage change of ±10% when one impulse of 2 ms or 10 / 1,000 μs is applied</td></tr>
<tr><td>Capacitance (Reference)</td><td>Capacitance between the terminals of the varistor measured at 1 KHz,1 VRMS, zero bias and room temperature (Exception 100 pF below measured at 1 MHz)</td></tr>
<tr><td>Temperature Coefficient of Varistor Voltage</td><td>(V at 85°C to V at 25°C) / (V at 25°C × 60) × 100 (% / °C) should be less than -0.05% / °C</td></tr>
<tr><td>Withstanding Voltage (Body insulation)</td><td>The specified voltage shall be applied both terminals of the varistor connected together and metal foil closely wrapped round its body for 1 minute without breakdown</td></tr>
<tr><td>Impulse Life</td><td>The variation of varistor voltage should less than ±10% after the impulse listed below is applied 10,000 times continuously with the interval of 10 seconds at room temperature
<table>
<tr><td rowspan="3">5D series</td><td>MCV180K05DS to MCV680K05DS</td><td>0.5A (2 ms)</td></tr>
<tr><td>MCV681K05DS</td><td>NA</td></tr>
<tr><td>MCV820K05DS to MCV471K05DS</td><td>20A (8 / 20 μs)</td></tr>
<tr><td rowspan="3">7D series</td><td>MCV180K07DS to MCV680K07DS</td><td>18A (8 / 20 μs)</td></tr>
<tr><td>MCV681K07DS</td><td>NA</td></tr>
<tr><td>MCV820K07DS to MCV471K07DS</td><td>50A (8 / 20 μs)</td></tr>
<tr><td rowspan="3">10D series</td><td>MCV180K10DS to MCV680K10DS</td><td>50A (8 / 20 μs)</td></tr>
<tr><td>MCV681K10DS</td><td>NA</td></tr>
<tr><td>MCV820K10DS to MCV112K10DS</td><td>100A (8 / 20 μs)</td></tr>
<tr><td rowspan="2">14D series</td><td>MCV180K14DS to MCV680K14DS</td><td>75A (8 / 20 μs)</td></tr>
<tr><td>MCV820K14DS to MCV112K14DS</td><td>150A (8 / 20 μs)</td></tr>
<tr><td rowspan="2">20D series</td><td>MCV180K20DS to MCV680K20DS</td><td>100A (8 / 20 μs)</td></tr>
<tr><td>MCV820K20DS to MCV112K20DS</td><td>200A (8 / 20 μs)</td></tr>
</table></td></tr>
</table>

Mechanical Ratings

<table>
<tr><th>Characteristics</th><th>Test Method and Specifications</th></tr>
<tr><td>Terminal Pull Strength</td><td>The two terminals shall be no outstanding damage visually after gradually applying the force listed below
<table>
<tr><th>Terminal Diameter</th><th>Force</th></tr>
<tr><td>0.6 mm</td><td>9.8 N (1 kgf)</td></tr>
<tr><td>0.8 mm</td><td>9.8 N (1 kgf)</td></tr>
<tr><td>1 mm</td><td>19.6 N (2 kgf)</td></tr>
</table></td></tr>
<tr><td>Terminal Bending Strength</td><td>Hold the specimen and keep its lead-out axis vertical Suspend 1 Kg weight on the terminal. Bend the specimen through 90° then return to the original position. Repeat the procedure in the opposite direction. Test and examine every terminal</td></tr>
<tr><td>Vibration</td><td>Varistors subjected to simple harmonic motion of 0.75 mm amplitude between limits of 10 to 55 Hz. Frequency scan shall be traversed in 1 minute. This motion shall then be applied for period of 2 hours in each of three mutually perpendicular directions. Thereafter, varistors shall be no outstanding damage visually</td></tr>
<tr><td>Solderability</td><td>The two terminals shall be covered uniformly with solder approximately 95% after dipping the terminals to a depth of approximately 3 mm from the body in a soldering bath of 260 ±5°C for 2 ±0.5 seconds</td></tr>
<tr><td>Resistance to Soldering Heat</td><td>Varistors shall be no outstanding damage and the variation varistor voltage should be less than ±5% (ΔVB / VB = ±5%) after each lead shall be dipped into a solder bath having a temperature 300 ±5°C to a point 2 to 2.5 mm from the body of the unit, using the shielding board (thickness 1.5 mm), be held there for a specified time (5D series 5 ±1 second the other series 10 ±1 second), and then be stored at room ambient for 1 to 2 hours</td></tr>
<tr><td>Dry Heat (High Temperature)</td><td>Varistors shall be subjected to 125 ±2°C, for 1,000 hours in a thermostatic bath without load and then stored at room ambient condition for 1 to 2 hours. The variation of varistor voltage should be less than ±5% (ΔVB / VB = ±5%)</td></tr>
<tr><td>Damp Heat (Humidity)</td><td>Varistors shall be subjected to 40 ±2°C, 90 to 95% R.H. for 1,000 hours in a thermostatic bath without load and then stored at room ambient condition for 1 to 2 hours.
The variation of varistor voltage should be less then ±5%(ΔVB / VB = ±5%)</td></tr>
<tr><td>Cold (Low Temperature Storage)</td><td>Varistors shall be subjected to -40 ±2°C for 1,000 hours in a thermostatic bath without load and then stored at room ambient condition for 1 to 2 hours. The variation of varistor voltage should be less than ±5% (ΔVB / VB = ±5%)</td></tr>
<tr><td>Temperature Cycle
(Thermal Shock)</td><td>The temperature cycling listed below shall be repeated 5 times and the variation of varistor voltage should be less than ±5% and no outstanding damage visually
<table>
<tr><th>Step</th><th>Temperature (°C)</th><th>Time (Minutes)</th></tr>
<tr><td>1</td><td>40 ±2</td><td>30 ±2</td></tr>
<tr><td>2</td><td>Room Temperature</td><td>3 Maximum</td></tr>
<tr><td>3</td><td>125 ±2</td><td>30 ±2</td></tr>
<tr><td>4</td><td>Room Temperature</td><td>3 Maximum</td></tr>
</table></td></tr>
<tr><td>Dry Heat Load (High Temperature)</td><td>Varistors shall be subjected to 85 ±2°C for 1,000 hours in a thermostatic bath with maximum allowable voltage continuously applied and then stored at room ambient condition for 1 to 2 hours. The variation of varistor voltage should be less than ±10% (ΔVB / VB = ±10%)</td></tr>
</table>

Materials Safety Data Sheet

Component type / Wistron P/N : Varistor

Main Purposes	%	Chemical Substances	Chemical formula	%	Typical ppm
Ceramic	26	Zinc oxide	ZnO	89.7	-
		Bismuth trioxide	Bi_2O_3	2.8	69 PPm pb
		Boron trioxide	B_2O_3	0.005	-
		Titanium dioxide	TiO_2	0	-
		Nickel oxide	NiO	0.75	-
		Aluminium trioxide	Al_2O_3	0.018	-
Silver Paste	2	Silver	Ag	80	10PPm pb
		Glass	-	4	
Coating	40	Epoxy resin	-	30 to 40	5 PPm pb
		Filler	-	45 to 55	
Wire	30	Copper	Cu	96	66 PPm pb
Plating (Lead free)	2	Nickel	Ni	0	
		Tin	Sn	96	
Plating (Lead contained)	0.04	Nickel	Ni	100	2,200
		Lead	Pb	10	200
		Tin	Sn	90	1,300

Part Number Explanation:

MCV	121	K	10	D	S
	Varistor Voltage	Tolerance	Disk Size Code	Disk Type	Lead Type Taping Code

Varistor Voltage : (DC volt) (from 180 to 112) two significant digits followed by number of zeros
: 180 = 18V, 101=100V, 102=1,000V
Tolerance : K = ±10%
Disk Size Code : 05 = 5mm, 07 = 7mm, 10 = 10mm, 14 = 14mm, 20 = 20mm
Disk Type : D = Standard disk type
Lead Type Taping Code : S = Straight Lead