



Multilayer Chip Varistor for Surge and ESD Protection – E Type Series

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1. Features

- 1.1 No polarity due to symmetrical current-voltage characteristics
- 1.2 Excellent electro static absorption capability
- 1.3 Variable capacitance
- 1.4 Working Voltage from 2.5 to 300 V_{RMS}; 3.3 to 385 Vdc
- 1.5 Suitable for ESD Protection

2. Applications

- 2.1 USB 3.0 Power and Data lines I/O Port protection
- 2.2 Notebook and PC Computers
- 2.3 Monitors and Flat Panel Displays
- 2.4 IEEE 1394 Firewire Ports
- 2.5 Video Graphics Cards
- 2.6 SIM ports Mobile phone
- 2.7 Digital Camera
- 2.9 MP3/MP4 player
- 2.10 LCD Module
- 2.11 HUB/ Telecom/ Wireless LAN
- 2.12 Keyboard

3. Type Designation

MV	06	E	050	T	050	-
Multilayer Varistor	Size 04 : 0402 06 : 0603	Type Series	MAX Working Voltage 050 : 5V 120 : 12V 240 : 24V	Packaging T : Paper tape 0402 : 10K 0603 : 4K	Capacitance 050 : 5(pF) 100 : 10(pF) 2R5 : 2.5(Pf)	Internal Code



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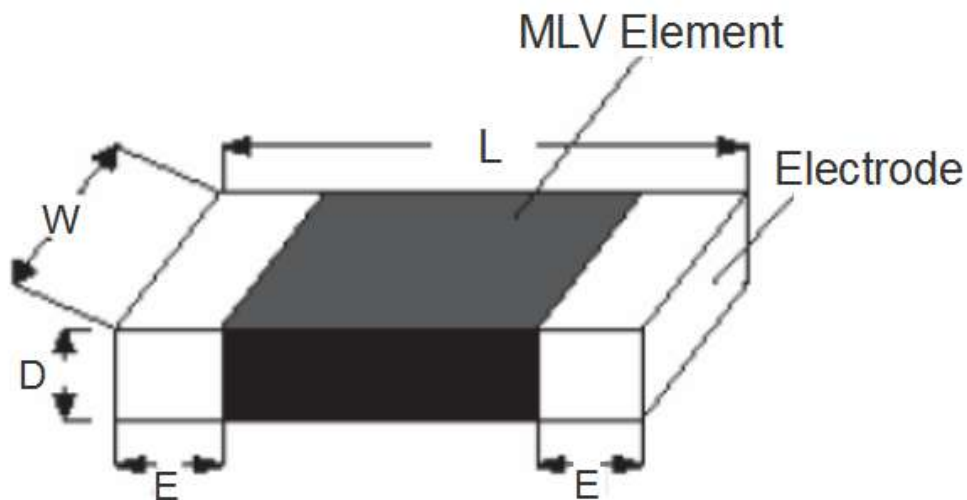
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4. Dimension



Type	L	W	D	E
	mm	mm	mm	mm
0402	1.0 ± 0.10	0.5 ± 0.10	0.6 max	0.25 ± 0.1
0603	1.6 ± 0.15	0.8 ± 0.15	0.9 max	0.3 ± 0.1



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5. Rating and Characteristics

Part No.	Size	Maximum Working Voltage	Maximum Clamping Voltage	Leakage Current	Capacitance	Cap. Tolerance
(Unit)		(VDC)	(V)	(uA)	(pF)	(%)
MV04E050T101-	0402	5	30	< 1	100	±30%
MV04E050T560-		5	50	< 1	56	±30%
MV04E050T330-		5	50	< 1	33	±30%
MV04E050T220-		5	50	< 1	22	±30%
MV04E050T100-		5	50	< 1	10	±30%
MV04E050T050-		5	50	< 1	5	+80%/-20%
MV04E120T101-		12	50	< 1	100	±30%
MV04E120T330-		12	40	< 1	33	±30%
MV04E120T220-		12	40	< 1	22	±30%
MV04E120T100-		12	60	< 1	10	±30%
MV04E120T050-		12	80	< 1	5	+80%/-20%
MV04E240T3R0-		24	100	< 1	3	+80%/-20%
MV04E240T2R5-		24	198	< 1	2.5	+80%/-20%
MV04E240T0R8-		24	200	< 1	0.8	+80%/-20%
MV06E050T101-	0603	5	30	< 1	100	±30%
MV06E050T560-		5	50	< 1	56	±30%
MV06E050T330-		5	50	< 1	33	±30%
MV06E050T220-		5	50	< 1	22	±30%
MV06E050T100-		5	50	< 1	10	±30%
MV06E050T050-		5	50	< 1	5	+80%/-20%
MV06E120T101-		12	50	< 1	100	±30%
MV06E120T330-		12	40	< 1	33	±30%
MV06E120T220-		12	40	< 1	22	±30%
MV06E120T100-		12	60	< 1	10	±30%
MV06E120T050-		12	80	< 1	5	+80%/-20%
MV06E240T3R0-		24	240	< 1	3	+80%/-20%
MV06E240T2R5-		24	198	< 1	2.5	+80%/-20%
MV06E240T0R8-		24	200	< 1	0.8	+80%/-20%



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6. Reliability Test

Environmental Specification	Test Method and Description			
High Temperature Storage/ Dry Heat	The specimen shall be subjected to $150 \pm 2^{\circ}\text{C}$ for 1000 ± 12 hours in a thermostatic bath without load and then stored at room temperature and humidity for 1 to 2 hours. Therefore, the change of varistor voltage shall be measured.			
Temperature Cycle	The temperature cycle of specified temperature shall be repeated five times and then stored at room temperature and humidity for one or two hours. The change of varistor voltage and mechanical damage shall be examined.	Step	Temperature	Period
		1	-40 ± 3	30Min ± 3
		2	Room Temperature	1 hour
		3	125 ± 3	30Min ± 3
		4	Room Temperature	1 hours
High Temperature Load	After being continuously applied the maximum allowable voltage at $85 \pm 2^{\circ}\text{C}$ for 1000 ± 2 hours, the specimen shall be stored at room temperature and humidity for one or two hours, Therefore the change of varistor voltage should be measured.			
Dry Heat Load				
Damp Heat Load/	The specimen should be subjected to $40 \pm 2^{\circ}\text{C}$, 90 to 95% RH and the maximum allowable voltage for 500 hours and then stored at room temperature and humidity for one or two hours. Therefore the change of varistor voltage should be measured.			
Humidity Load				
Low Temperature Storage/ Cold	The specimen should be subjected to $-50 \pm 2^{\circ}\text{C}$, without load for 500 hours and then stored at room temperature for one or two hours. Therefore the change of varistor voltage should be measured.			
Direct contact electrostatic discharge	1.Discharge: contact electrostatic discharge; 2.Voltage : 8KV (Level4)			
	3.Polarity : +,- ; 4.Number: 10 times ; 5.Interval time : 1sec			
Direct air electrostatic discharge	1.Discharge: air electrostatic discharge; 2.Voltage : 15KV (Level4)			
	3.Polarity : +,-; 4.Number: 10 times; 5.Interval time : 1~ 3sec			



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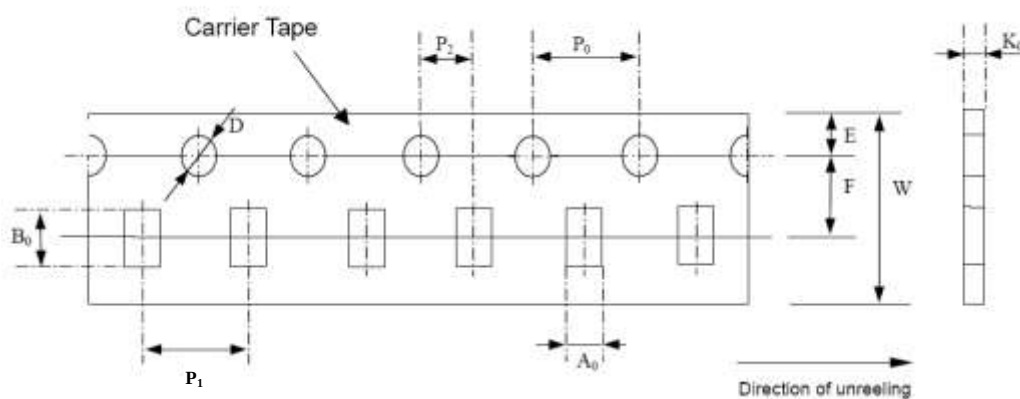
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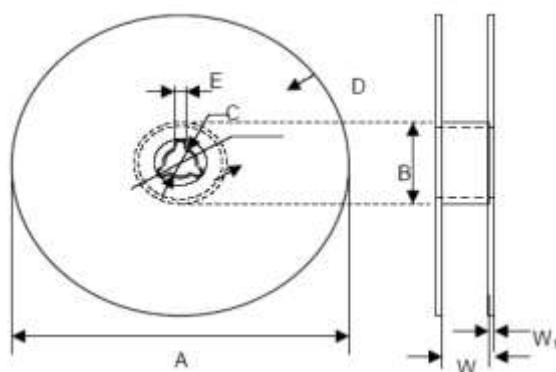
7. Taping and Reel

7.1 Packaging



Symbol	A_0 ± 0.10	B_0 0.10	K_0 0.10	D_0 ± 0.10	P_1 ± 0.10	P_2 ± 0.05	P_0 ± 0.05	W ± 0.20	E ± 0.10	F ± 0.05
0402	0.85	1.25	0.65	1.50	3.00	2.00	4.00	8.00	1.75	3.50
0603	1.08	1.88	0.95	1.50	4.00	2.00	4.00	8.00	1.75	3.50

7.2 Reel Dimensions



Symbol	A	B	C	D	E	W	W_1
0402	178.0 ± 1.0	60.0 ± 0.5	13.0 ± 0.2	21.1 ± 0.2	2.0 ± 0.5	9.0 ± 0.50	1.5 ± 0.15
0603	178.0 ± 1.0	60.0 ± 0.5	13.0 ± 0.2	21.1 ± 0.2	2.0 ± 0.5	9.0 ± 0.50	1.5 ± 0.15



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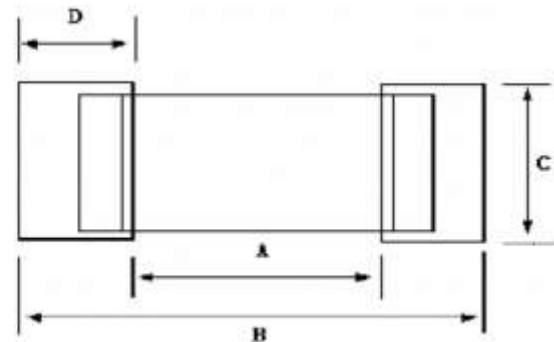
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8. Recommended land patterns

8.1 Solder pad layout

(Unit : mm)

	A	B	C	D
0402	0.4~0.6	1.4~1.8	0.5~0.6	0.6~1.2
0603	0.8~1.2	2.2~2.8	0.6~1.0	0.9~1.5

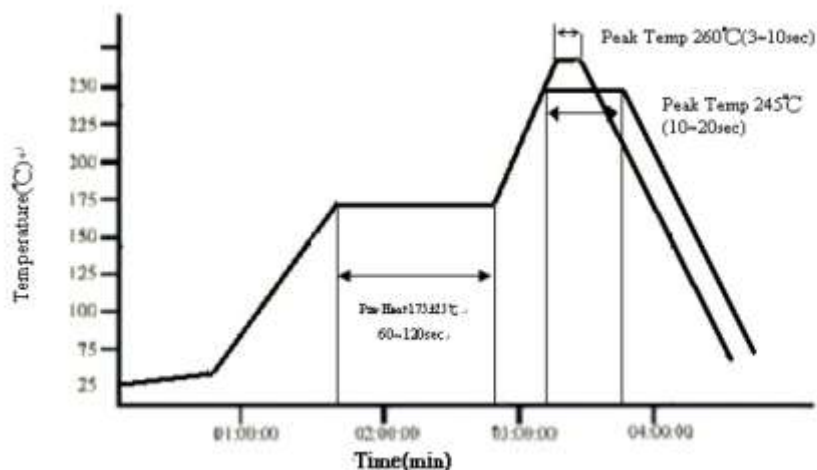


8.2 The SIR test of the solder paste shall be done (Based on JIS-Z-3284)

8.3 Steel plate and foot distance printing

Foot distance printing (mm/mils)	Steel Plate thickness (mm)
> 0.65mm/25 mil	0.18mm
0.65mm/25 mils~0.5mm/20mils	0.15mm
0.50mm/20 mils~0.40mm/16mils	0.12mm
>=0.40 mm/16 mils	0.10mm

8.4 Reflow and temperature





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8.5 IR reflow Pb Free Process suggestion profile

- (1) The solder recommend is Sn96.5/Ag 3.5 of 120 to 150 μ m
- (2) Ramp-up rate (217 $^{\circ}$ C to Peak) + 3 $^{\circ}$ C/second max
- (3) Temp. maintain at 175 +/-25 $^{\circ}$ C 180 seconds max
- (4) Temp. maintain above 217 $^{\circ}$ C 60-150 seconds
- (5) Peak temperature range 245 $^{\circ}$ C+20 $^{\circ}$ C/-10 $^{\circ}$ C time within 5 $^{\circ}$ C of actually peak temperature (tp) 10~20 seconds
- (6) Ramp down rate +6 $^{\circ}$ C/second max.

※ Perform adequate test in advance, as the reflow temperature profile will vary according to the conditions of the manufacturing process, and the specification of the reflow furnace.

8.6 Resistance to soldering heat-High Temperature Resistance: 260 $^{\circ}$ C,10sec-3times.

8.7 Hand Soldering

In hand soldering of the Varistors. Large temperature gradient between preheated the Varistors and the tip of soldering iron may cause electrical failures and mechanical damages such as cracking or breakings of the devices. The soldering shall be carefully controlled and carried out so that the temperature gradient is kept minimum with following recommended conditions for hand soldering.

8.7.1 Recommended Soldering Condition 1

(1) Solder:

0.12~0.18mm Thread solder (Sn96.5:Ag3.5) with soldering flux in the core.
Rosin-based and non-activated flux is recommended.

(2) Preheating:

The Varistors shall be preheated so that Temperature Gradient between the devices and the tip of soldering iron is 150 $^{\circ}$ C or below.

(3) Soldering Iron:

Rated Power of 20w max with 3mm soldering tip in diameter. Temperature of soldering iron tip 380 $^{\circ}$ C max,3-5sec (The required amount of solder shall be melted in advance on the soldering tip.)

(4) Cooling:

After soldering. The Varistors shall be cooled gradually at room ambient temperature.



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8.7.2 Recommended Soldering Condition 2 (Without preheating)

- (1) Solder iron tip shall not directly touch to ceramic dielectrics.
- (2) Solder iron tip shall be fully preheated before soldering while soldering iron tip to the external electrode of Varistors.

8.8 Post Soldering Cleaning

8.8.1 Residues of corrosive soldering fluxes on the PC board after cleaning may greatly have influences on the electrical characteristic and the reliability (such as humidity resistance) of the Varistors which have been mounted on the board. It shall be confirmed that the characteristic and the reliability of the devices are not affected by the applied cleaning conditions

8.8.2 When an ultrasonic cleaning is applied to the mounted Varistors on PC Boards. Following conditions are recommended for preventing failures or damages of the devices due to the large vibration energy and the resonance caused by the ultrasonic waves.

- (1) Frequency 29MHz max
- (2) Radiated Power 20w/lithr max
- (3) Period 5minuets max

9. Storage condition of products

9.1 Storage Conditions:

- (1) Storage Temperature: -10℃~+40℃
- (2) Relative humidity: $\leq 75\%RH$
- (3) Varistor must be kept away from sunlight and stored in a non-corrosive atmosphere.

9.2 Period of Storage: 1 year

10. ECN

Engineering Change Notice: The customer will be informed with ECN if there is significant modification on the characteristics and materials described in Approval Sheet.



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