

## Surface Mount Multilayer Varistors

### ESD Protection (ES) Series

#### Features:

- Fast Response < 0.5 ns
- Low Working Voltage 5 V
- Low Capacitance
- Low Leakage Current < 1  $\mu$ A
- Low Clamping Voltage

#### Application Fields:

- Cell Phones
- Digital Cameras
- PDAs
- MP3
- Notebooks

Part Number	Working Voltage (Max)	Clamping Voltage (Max)	Leakage Current (Max)	Typical Capacitance Value (1 MHz)	Tolerance of Cap.
	DC(V)	(V)	ILDC( $\mu$ A)	C (pF)	(%)
MLV0402ES005V0100N	5.5	55	1	100	$\pm$ 30
MLV0402ES005V0056N	5.5	55	1	56	$\pm$ 30
MLV0402ES005V0033N	5.5	55	1	33	$\pm$ 30
MLV0402ES005V0022N	5.5	55	1	22	$\pm$ 30
MLV0402ES005V0010N	5.5	60	1	10	$\pm$ 30
MLV0402ES005V0005P	5.5	76	1	5	5~9 pF
MLV0402ES012V0100N	12	55	1	100	$\pm$ 30
MLV0402ES012V0056N	12	55	1	56	$\pm$ 30
MLV0402ES012V0033N	12	55	1	33	$\pm$ 30
MLV0402ES012V0022N	12	55	1	22	$\pm$ 30
MLV0402ES012V0010N	12	60	1	10	$\pm$ 30
MLV0402ES012V0005P	12	80	1	5	5~9 pF
MLV0402ES024V0003N	24	120	1	3	$\pm$ 30
MLV0402ES024V02R5P	24	198	1	2.5	2~4 pF
MLV0402ES024V00R8P	24	200	1	0.8	0.8~1.5 pF
MLV0603ES005V0100N	5.5	55	1	100	$\pm$ 30
MLV0603ES005V0056N	5.5	55	1	56	$\pm$ 30
MLV0603ES005V0033N	5.5	55	1	33	$\pm$ 30
MLV0603ES005V0022N	5.5	55	1	22	$\pm$ 30
MLV0603ES005V0010N	5.5	60	1	10	$\pm$ 30
MLV0603ES005V0005P	5.5	76	1	5	5~9 pF
MLV0603ES012V0100N	12	55	1	100	$\pm$ 30
MLV0603ES012V0056N	12	55	1	56	$\pm$ 30
MLV0603ES012V0033N	12	55	1	33	$\pm$ 30
MLV0603ES012V0022N	12	55	1	22	$\pm$ 30
MLV0603ES012V0010N	12	60	1	10	$\pm$ 30
MLV0603ES012V0005P	12	80	1	5	5~9 pF
MLV0603ES024V0003N	24	120	1	3	$\pm$ 30
MLV0603ES024V02R5P	24	198	1	2.5	2~4 pF
MLV0603ES024V00R8P	24	200	1	0.8	0.8~1.5 pF
MLV0805ES005V0100N	5.5	50	1	100	$\pm$ 30
MLV0805ES005V0056N	5.5	50	1	56	$\pm$ 30

## Surface Mount Multilayer Varistors

### Product Identification:

MLV 0402 ES 012V 0100 N T  
(1) (2) (3) (4) (5) (6) (7)

(1) Series Code:

**MLV** – Surface Mount Multilayer Varistor

**MVA** -- MLV Array

(2) Size Code:

Standard EIA Chip Size

(3) Application Code:

**ES** – Electro-static Discharge Protection

**NA** – Normal Surge Protection

**HA** – High Surge Protection

(4) Max. Working Voltage:

**012V** – 12 V

(5) Capacitance for ES Series:

**0100** – 100 pF

**02R5** – 2.5 pF

Peak Current for HA/NA Series: **0100** – 100 A

(6) Capacitance Tolerance for ES Series:

**N** – ± 30%

**P** – **Special**

(7) Packaging Code:

**T** – Tape & Reel

### Operating Temperatures:

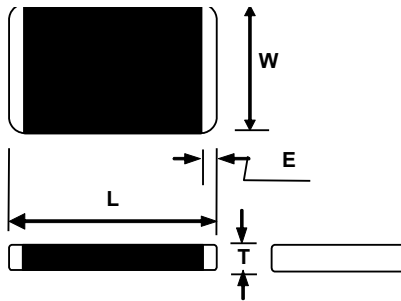
-55°C to +85°C for size 0603 or smaller

-55°C to +125°C for size 0805 or larger

## Surface Mount Multilayer Varistors

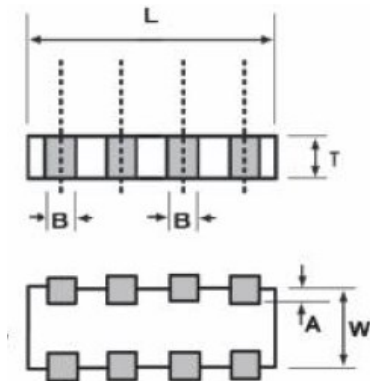
### Shape and Dimensions:

#### MLV Series



Size	L (mm)	W (mm)	T (mm)	E (mm)
0201	0.60 ± 0.03	0.30 ± 0.03	0.30 ± 0.03	0.30 ± 0.03
0402	1.00 ± 0.10	0.50 ± 0.10	0.50 ± 0.10	0.25 ± 0.10
0603	1.60 ± 0.15	0.80 ± 0.15	0.90 max.	0.30 ± 0.10
0805	2.00 ± 0.20	1.25 ± 0.15	1.00 max.	0.30 ± 0.10
1206	3.20 ± 0.20	1.60 ± 0.15	1.20 max.	0.50 ± 0.20
1210	3.20 ± 0.20	2.50 ± 0.20	1.50 max.	0.50 ± 0.20
1812	4.50 ± 0.20	3.20 ± 0.20	2.00 max.	0.60 ± 0.20
2220	5.70 ± 0.20	5.00 ± 0.20	3.00 max.	0.60 ± 0.20

#### ESD Array



Size	0508	0612
L (mm)	2.00 ± 0.20	3.20 ± 0.20
W (mm)	1.25 ± 0.20	1.60 ± 0.15
T (mm)	0.80 max.	0.95 max.
A (mm)	0.20 ± 0.10	0.20 ± 0.10
B (mm)	0.25 ± 0.05	0.40 ± 0.15

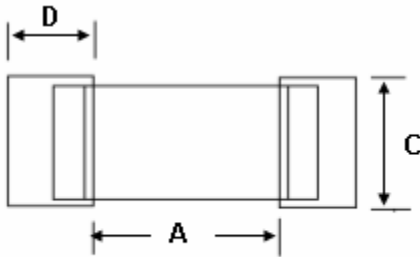
### Terms and Definitions:

Term	Definition
Max. Working Voltage	Maximum steady-state DC operating voltage with typical leakage current less than 50 $\mu$ A at 25°C
Varistor Voltage (BDV)	Breakdown DC voltage measured at current of 1 mA
Max. Clamping Voltage	Maximum peak voltage across the part, measured at a specified pulse current and waveform
Surge Current	Maximum peak current with the specified 8/20 $\mu$ s waveform without damage
Surge Shift $\Delta$ V/V	The change of varistor voltage after applying the specified surge current
Energy Absorption	Maximum energy dissipated with a specified 10/1000 $\mu$ s waveform without damage
Typical Capacitance	Capacitance measured with voltage bias less than 0.5 $V_{RMS}$ at 1 KHz or 1 MHz
Nonlinear Exponent $\alpha$	$\alpha = (\log(V_{1mA}/V_{0.1mA}) / \log(I_{V1mA}/I_{V0.1mA}))$
Leakage Current	Typical leakage current at 25 °C < 50 $\mu$ A; Maximum leakage 200 $\mu$ A.
Cut-off Frequency	The frequency of -3 dB insertion loss

# Surface Mount Multilayer Varistors

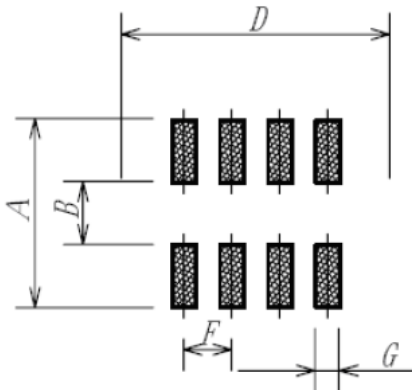
## Recommended Land Patterns:

### MLV Series



Size	Solder pad layout		
	A (mm)	C (mm)	D (mm)
0201	0.25~0.35	0.20~0.30	0.25~0.35
0402	0.4~0.6	0.5~0.6	0.5~0.7
0603	0.9~1.2	0.6~1.0	0.8~1.2
0805	1.0~1.5	1.2~1.5	1.0~1.4
1206	1.8~2.5	1.2~1.8	1.0~1.4
1210	1.8~2.5	2.2~3.0	1.0~1.4
1812	2.5~3.3	2.8~3.6	1.2~1.8
2220	3.8~4.6	4.8~5.5	1.2~1.8

### ESD Array Series



Size	A (mm)	B (mm)	D (mm)	F (mm)	G (mm)
0508	2.10	0.40	2.50	0.50	0.35
0612	2.60	0.80	3.60	0.80	0.50

## Surface Mount Multilayer Varistors

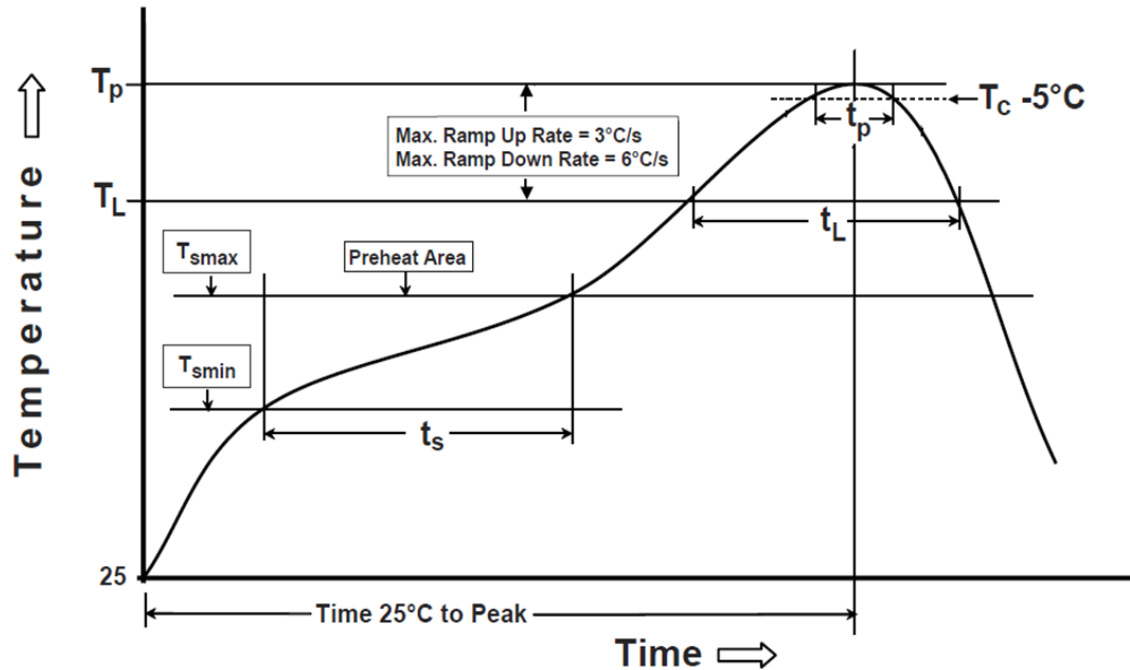
### Environmental Tests:

No.	Test	Requirement	Test condition	Test reference
1	Soldering heat resistance	BDV change $\leq \pm 10\%$ No mechanical damage	One dip at 260°C for 5 sec.	MIL-STD-202 Method 210 IEC 60068-2-20
2	Solderability	New solder coverage $\geq 80\%$	One dip at 255°C for 5 sec. Non-active flux	MIL-STD-202 Method 208 IEC 60068-2-20
3	Maximum surge current	BDV change $\leq \pm 10\%$ No mechanical damage	100 pulses of 8/20 $\mu\text{s}$ with maximum surge current and 30 sec. interval at 25°C and 30 ~ 65% RH	CECC 42000 IEC 1051-1 Test 4.5
4	Maximum surge energy	BDV change $\leq \pm 10\%$ No mechanical damage	100 pulses of 10/1000 $\mu\text{s}$ with maximum surge current and 90 sec. interval at 25°C and 30 ~ 65% RH	CECC 42000
5	Thermal cycling	BDV change $\leq \pm 10\%$ No mechanical damage Leakage current $\leq 200 \mu\text{A}$	5 cycles between -40°C and 125°C with 30 min. dwell time at the temperature extremes and 60 min. dwell time at 25°C	CECC 42000 IEC 60068-2-14
6	Low temperature resistance	BDV change $\leq \pm 10\%$ No mechanical damage Leakage current $\leq 200 \mu\text{A}$	1000 hr at -50°C	IEC 60068-2-1
7	Low temperature load resistance	BDV change $\leq \pm 10\%$ No mechanical damage Leakage current $\leq 200 \mu\text{A}$	1000 hr at -50°C with working voltage applied	IEC 60068-2-1
8	High temperature resistance	BDV change $\leq \pm 10\%$ No mechanical damage Leakage current $\leq 200 \mu\text{A}$	1000 hr at 150°C	MIL-STD-202 Method 108 CECC 42000
9	High temperature load resistance	BDV change $\leq \pm 10\%$ No mechanical damage Leakage current $\leq 200 \mu\text{A}$	1000 hr at 85°C with working voltage applied	CECC 42000
10	Humidity resistance	BDV change $\leq \pm 10\%$ No mechanical damage Leakage current $\leq 200 \mu\text{A}$	500 hr at 40°C and 90 ~ 95% RH	MIL-STD-202 Method 103 IEC 60068-2-3 CECC 42000;
11	Humidity load resistance	BDV change $\leq \pm 10\%$ No mechanical damage Leakage current $\leq 200 \mu\text{A}$	500 hr at 40°C and 90 ~ 95% RH with working voltage applied	MIL-STD-202 Method 103 IEC 60068-2-3 CECC 42000
12	ESD contact test*	Varistor voltage change > 115% working voltage	Contact electrostatic discharge 100 times with 1 second intervals at 8 KV (Level 4 ) and polarity: +,-	IEC 61000-4-2
13	ESD air test*	Varistor voltage change > 115% working voltage	Air contact electrostatic discharge 100 times with 1 second intervals at 15 KV (Level 4 ) and polarity: +,-	IEC 61000-4-2

\* For ES series only.

## Surface Mount Multilayer Varistors

### Soldering Temperature Profile:



Profile Feature	Pb-Free Assembly
<b>Preheat/Soak</b> Temperature Min ( $T_{smin}$ ) Temperature Max ( $T_{smax}$ ) Time ( $t_s$ ) from ( $T_{smin}$ to $T_{smax}$ )	150°C 200°C 60~120 seconds
Ramp-up rate ( $T_L$ to $T_p$ )	3°C/second max.
Liquidous temperature ( $T_L$ ) Time ( $t_L$ ) maintained above $T_L$	217°C 60~150 seconds
Peak package body temperature ( $T_p$ )	260°C
Time ( $t_p$ )* within $5^\circ\text{C}$ of the specified classification temperature ( $T_c$ )	30 seconds *
Ramp-down rate ( $T_p$ to $T_L$ )	6°C/second max.
Time 25°C to peak temperature	8 minutes max.
* Tolerance for peak profile temperature ( $T_p$ ) is defined as a supplier minimum and a user maximum	

## Disclaimer

*Specifications are subject to change without notice. AEM products are designed for specific applications and should not be used for any purpose (including, without limitation, automotive, aerospace, medical, life-saving applications, or any other application which requires especially high reliability for the prevention of such defect as may directly cause damage to the third party's life, body or property) not expressly set forth in applicable AEM product documentation. It is the customer's responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Warranties granted by AEM shall be deemed void for products used for any purpose not expressly set forth in applicable AEM product documentation. AEM shall not be liable for any claims or damages arising out of products used in applications not expressly intended by AEM as set forth in applicable AEM product documentation. The sale and use of AEM products is subject to AEM terms and conditions of sale. Please refer*