

## Surface Mount Multilayer Varistors

### Normal Surge Protection (NA) Series

#### Features:

- Fast Response < 0.5 ns
- Low Capacitance
- Low Clamping Voltage and High Energy Absorption

#### Application Fields:

- Telecommunications
- Automotive Systems
- Data Systems
- Power Supplies

#### Ordering Information:

Part Number	Working Voltage (max)		Breakdown Voltage 1 mA (V)	Peak Current (max) 8/20 $\mu$ s (A)	Clamping Voltage (max)		Energy Absorption (max) 10/1000 $\mu$ s (J)	Typical Capacitance Ref. 1 KHz (pF)
	AC (V <sub>RMS</sub> )	DC (V)			(A)	(V)		
MLV0402NA006V0020	4	5.5	8 (7.5~10.5)	20	1	20	0.05	200
MLV0402NA009V0020	6	9	12 (10.2~13.8)	20	1	23	0.05	135
MLV0402NA011V0020	8	11	15 (12.8~17.3)	20	1	25	0.05	75
MLV0402NA014V0020	11	14	18 (15.3~20.7)	20	1	30	0.05	50
MLV0402NA018V0020	14	18	24 (21.6~26.4)	20	1	39	0.05	45
MLV0603NA006V0030	4	5.5	8 (7.5~10.5)	30	1	20	0.1	360
MLV0603NA009V0030	6	9	12 (10.2~13.8)	30	1	23	0.1	300
MLV0603NA014V0030	11	14	18 (15.3~20.7)	30	1	30	0.1	210
MLV0603NA018V0030	14	18	24 (21.6~26.4)	30	1	39	0.1	160
MLV0603NA022V0030	17	22	27 (24.3~29.7)	30	1	44	0.1	145
MLV0603NA030V0030	25	30	39 (35.1~42.9)	30	1	65	0.1	110
MLV0603NA038V0030	30	38	47 (42.3~51.7)	30	1	77	0.1	90
MLV0805NA006V0080	4	5.5	8 (7.5~10.5)	80	1	20	0.1	1400
MLV0805NA009V0080	6	9	12 (10.2~13.8)	80	1	23	0.1	650
MLV0805NA011V0100	8	11	15 (12.75~17.25)	100	1	25	0.2	410
MLV0805NA014V0100	11	14	18 (15.3~20.7)	100	1	30	0.2	350
MLV0805NA018V0100	14	18	24 (21.6~26.4)	100	1	39	0.2	300
MLV0805NA022V0100	17	22	27 (24.3~29.7)	100	1	44	0.2	250
MLV0805NA026V0100	20	26	33 (29.7~36.3)	100	1	54	0.3	220
MLV0805NA030V0100	25	30	39 (35.1~42.9)	100	1	65	0.3	200
MLV0805NA038V0100	30	38	47 (42.3~51.7)	100	1	77	0.3	150
MLV0805NA045V0080	35	45	56 (50.4~61.6)	80	1	90	0.3	110
MLV1206NA006V0100	4	5.5	8 (7.5~10.5)	100	1	20	0.2	3100
MLV1206NA014V0100	11	14	18 (15.3~20.7)	100	1	30	0.3	800
MLV1206NA018V0100	14	18	24 (21.6~26.4)	100	1	38	0.3	620
MLV1206NA022V0100	17	22	27 (24.3~29.7)	100	1	44	0.4	700
MLV1206NA026V0100	20	26	33 (29.7~36.3)	100	1	54	0.5	480
MLV1206NA030V0100	25	30	39 (35.1~42.9)	100	1	65	0.6	400

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	AC (V <sub>RMS</sub> )	DC (V)			(A)	(V)		
MLV1206NA038V0100	30	38	47 (42.3~51.7)	100	1	77	0.7	260
MLV1206NA045V0100	35	45	56 (50.4~61.6)	100	1	90	0.8	230
MLV1206NA056V0100	40	56	68 (61.2~74.8)	100	1	110	1.0	200
MLV1206NA065V0100	50	65	82 (73.8~90.2)	100	1	135	0.5	175
MLV1206NA085V0100	60	85	100 (90~110)	100	1	165	0.6	150
MLV1210NA006V0250	4.5	5.5	8 (7.5~10.5)	250	2.5	20	0.5	5200
MLV1210NA018V0250	14	18	24 (21.6~26.4)	250	2.5	38	0.8	1150
MLV1210NA022V0250	17	22	27 (24.3~29.7)	250	2.5	44	1.0	1720
MLV1210NA026V0250	20	26	33 (29.7~36.3)	250	2.5	54	1.2	610
MLV1210NA030V0250	25	30	39 (35.1~42.9)	250	2.5	65	1.4	920
MLV1210NA038V0250	30	38	47 (42.3~51.7)	250	2.5	77	1.6	780
MLV1210NA045V0250	35	45	56 (50.4~61.6)	250	2.5	90	2.0	400
MLV1210NA056V0250	40	56	68 (61.2~74.8)	250	2.5	110	2.3	300
MLV1210NA085V0200	60	85	100 (90~110)	200	2.5	165	1.4	210
MLV1812NA018V0500	14	18	24 (21.6~26.4)	500	5	38	1.7	2000
MLV1812NA030V0500	25	30	39 (35.1~42.9)	500	5	65	2.9	2500
MLV1812NA038V0500	30	38	47 (42.3~51.7)	500	5	77	3.5	2200
MLV1812NA045V0500	35	45	56 (50.4~61.6)	500	5	90	4.2	1000
MLV2220NA018V1000	14	18	24 (21.6~26.4)	1000	10	38	3.1	8500
MLV2220NA030V1000	25	30	39 (35.1~42.9)	1000	10	65	5.5	3900
MLV2220NA038V1000	30	38	47 (42.3~51.7)	1000	10	77	6.3	4600
MLV2220NA056V1000	40	56	68 (61.2~74.8)	1000	10	110	8.8	4000

## Surface Mount Multilayer Varistors

### Product Identification:

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

(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

**B** – Bulk

### Operating Temperatures:

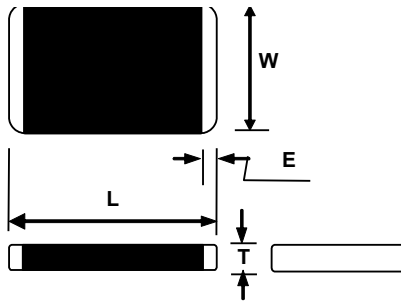
-55°C to +85°C for size 0603 or smaller

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

## Surface Mount Multilayer Varistors

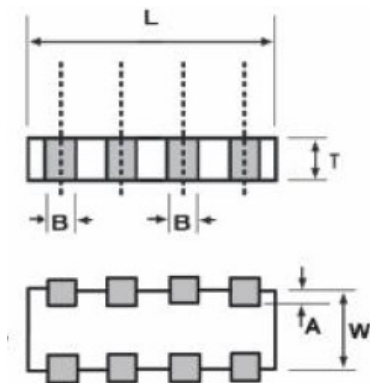
### Shape and Dimensions:

#### 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

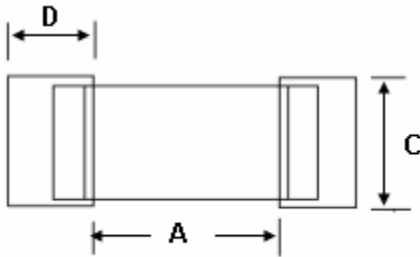
### Terms and Definitions:

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

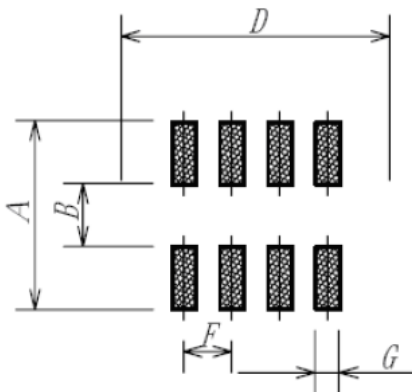
## Recommended Land Patterns:

### 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

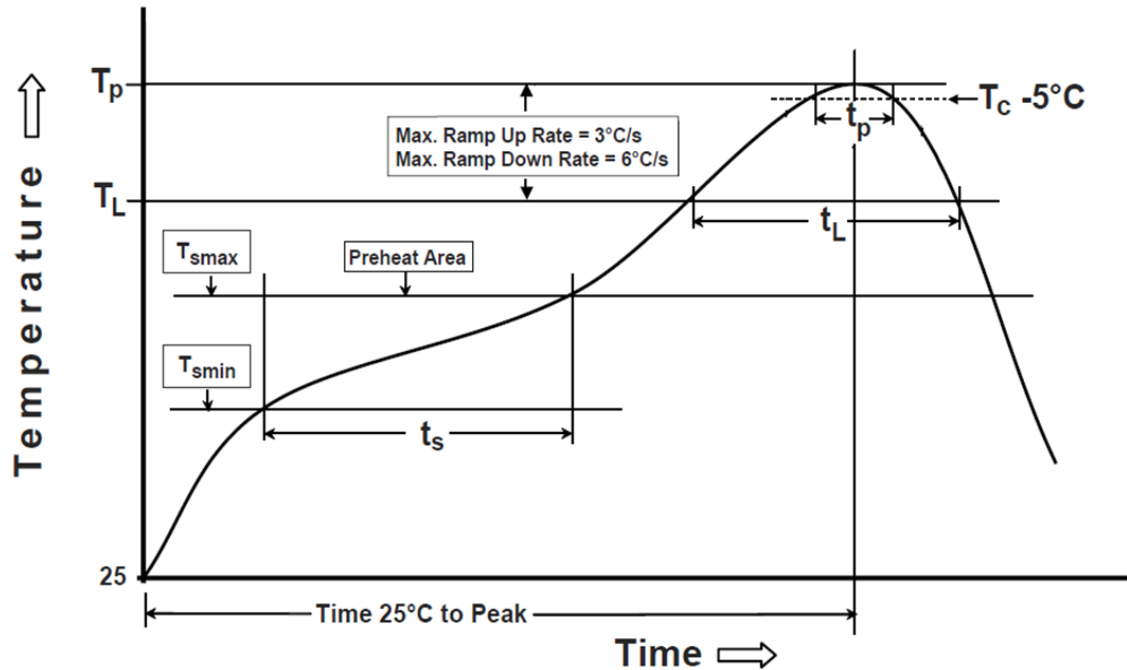
### Environmental Tests:

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 $T_{smax}$ )	$150^\circ\text{C}$ $200^\circ\text{C}$ 60~120 seconds
Ramp-up rate ( $T_L$ to $T_p$ )	$3^\circ\text{C/second}$ max.
Liquidous temperature ( $T_L$ ) Time ( $t_L$ ) maintained above $T_L$	$217^\circ\text{C}$ 60~150 seconds
Peak package body temperature ( $T_p$ )	$260^\circ\text{C}$
Time ( $t_p$ )* within $5^\circ\text{C}$ of the specified classification temperature ( $T_c$ )	30 seconds *
Ramp-down rate ( $T_p$ to $T_L$ )	$6^\circ\text{C/second}$ max.
Time $25^\circ\text{C}$ 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 to AEM's website for updated catalog and terms and conditions of sale.*