Maida Multilayer Varistors

ESD and Transient Voltage Suppression
in sizes from 0402 to 2220

Maida Multilayer Varistors (MLVs) are leadless surface mount chips available in a wide range of size, voltage and capacitance values for use in a wide variety of applications

Understanding Multi-layer Varistors (MLVs)

0603 MLV Chips

What is an MLV?

Those familiar with Maida Development Company's disc varistors have some idea what a varistor is, but may be unfamiliar with multi-layer varistors (MLVs). MLVs are tiny ceramic chips terminated on each end. They can be used to protect circuits from electrostatic discharge and other high voltage surges. As with disc varistors, the purpose of an MLV is to protect an electronic circuit by carrying away unwanted high voltage spikes. All varistors, including MLVs, have two operating conditions. Under normal operation there is virtually no current draw. The varistor sits idle and uses little power. However, if a large voltage spike comes into the circuit the varistor suddenly begins to conduct electricity. The varistor will carry current away from the protected circuit and to ground. As soon as the large spike passes, the varistor stops conducting and resumes its idle state. Some people think of this as a resettable fuse. The varistor resets itself after each voltage spike.

Leaded Disc varistors are typically used to protect devices plugged into household electrical outlets. They protect against all the unusual over voltage pulses that may be present in your AC power lines. MLVs operate at lower voltages and are typically used in portable battery operated devices operating on DC voltage, such as mobile phones.

MLV Advantages over wire-leaded varistor discs

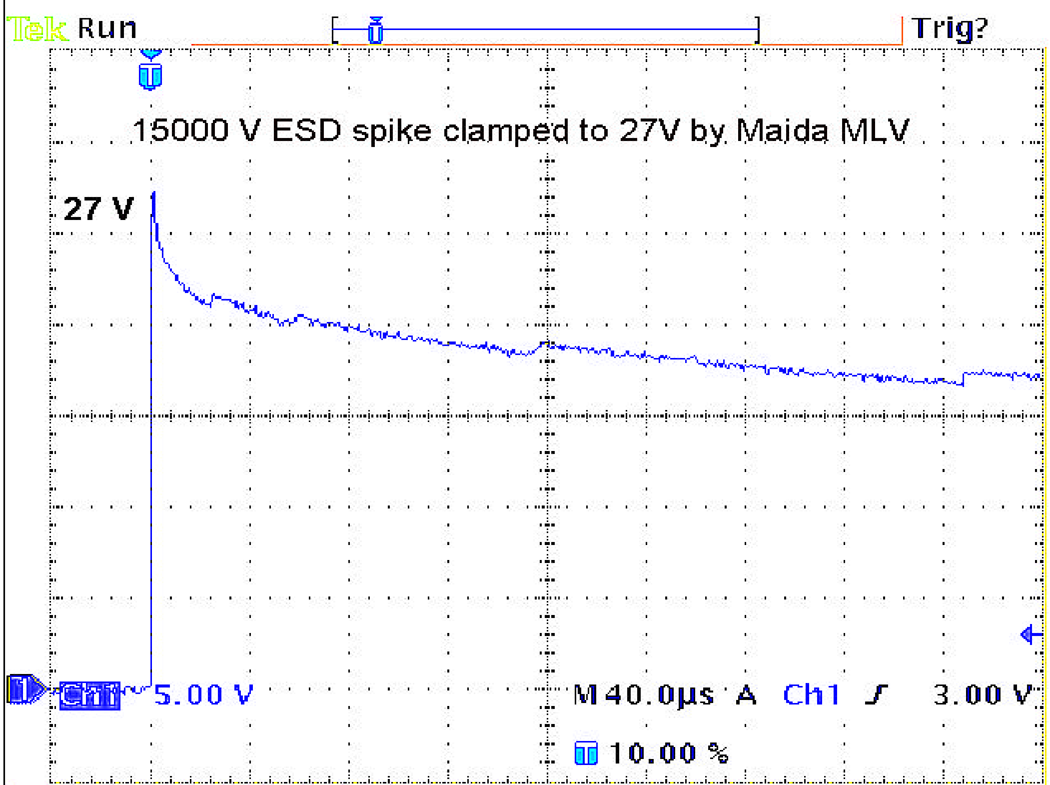
MLVs are surface mount chips sold without lead wires. They are soldered directly to the surface of a printed circuit board by the board manufacturer. Eliminating the lead wires gives MLVs an advantage over leaded discs. Capacitance and inductance in the lead wires is eliminated. This coupled with their very small size make MLVs react much faster to a pulse than a leaded disc can.

MLVs are also much easier for a board manufacturer to assemble. In many cases, leaded discs must be inserted through holes in a circuit board by hand followed by wave soldering. MLV chips can be placed onto the board by machine and easily soldered in a reflow oven along with other surface mount chips. In cases where an MLV is used to replace a low voltage varistor disc, the savings in time and processing can be significant.

The biggest advantage of MLVs is their small size. Surface mount chips lay flat on the board. Their low profile is essential in the tight designs now in use for mobile devices.

Using MLVs for ESD protection

Electrostatic Discharge (ESD) is nothing more than a sudden spark of current jumping from a charged object to any available ground. Anyone who has walked across a carpet in winter, and then touched a conductive surface has experienced the power of ESD. The spark we feel at our finger tip can be thousands of volts. The current flow is small. As soon as the stored charge is gone, the current flow stops. However, that voltage spike can be enough to destroy or lock up the delicate switch gates in semiconductors like MOSFETS and CMOS. Any handheld machine with a silicon "brain" is a potential victim of ESD pulses. Mobile phones, PDAs, pagers, remote controls, electronic games, etc. must all have a way to protect themselves from ESD damage. Each place that a discharge can enter the device must be protected. These include keypads, antennas, battery charger ports, and any other hole through the plastic case. MLVs are ideal for this job.



This oscilloscope trace shows what is left of a 15KV air discharged spike after passing through a Maida SV18P0603 multilayer varistor. The voltage has been dissipated in a few microseconds to a level of only 27 Volts.

EV Series for ESD protection

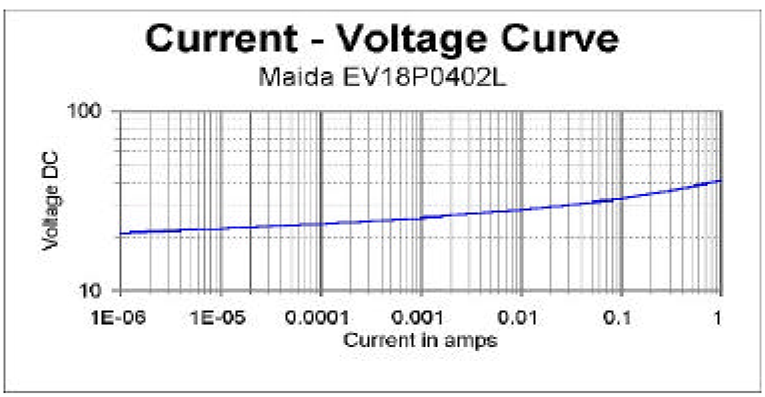
This is our lowest capacitance MLV series. All parts in this series are designed to protect sensitive components from high voltage Electrostatic Discharge (IEC 1000-4-2 8KV contact). Tests show that Maida MLVs will continue to provide circuit protection even after 100,000 8KV discharges. With capacitance values starting at less than 10pf for the EV18P0402L, these MLVs are ideal to protect high-speed circuits in portable hand held devices.

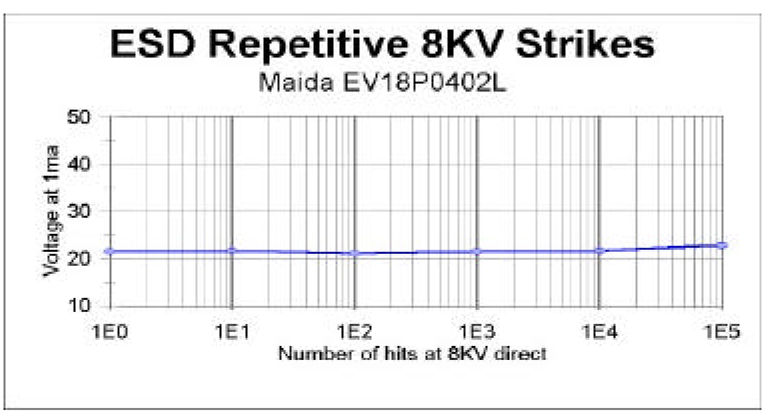
0402 (1005)

Maida	ximum Ratings	Electrical Characteristics					
	Continuous Applied		Typical Varistor Voltage at	Minimum Number of direct 8KV ESD pulses	Max 8x20 µs		Typical 1 V rms @1MHz
	(AC)	(DC)	1mA	tolerated	(V)	(A)	(pF)
EV18P0402L	14	<18	26	10000	55	1	9
EV18P0402	14	<18	26	10000	50	1	27

0603 (1608)

Maida	ximum Ratings	Electrical Characteristics					
	Continuous Applied		Typical Varistor Voltage at	Minimum Number of direct 8KV ESD pulses	Max 8x20 µs		Typical 1 V rms @1MHz
	(AC)	(DC)	1mA	tolerated	(V)	(A)	(pF)
EV18P0603L	14	<18	26	10000	48	1	40
EV18P0603	14	<18	26	10000	45	1	120





TV Series Low Capacitance Multilayer Varistor

The TV series is designed to suppress destructive transients that may damage circuits.

This series has the lowest capacitance value possible while still providing some surge protection. These parts handle less energy than the standard SV series MLV, but their lower capacitance makes them a better choice in some high speed circuits.

0603 (1608)									
Maida Style Number	**Maximum Ratings**				**Electrical Characteristics**				
	Continuous		Transient						
	Applied Voltage		Energy	Peak Current	Varistor Voltage (@1mA DC)		Max Clamping Voltage (@Test Current)		Typical Cap.
			10x1000 µs	8x20 µs	Vmin	Vmax	8x20 µs		1 V rms @1MHz
	(AC)	(DC)	(J)	(A)	(V)	(V)	(V)	(A)	(pF)
TV5R5P0603	4	5.5	0.05	20	6.9	9.3	20	1	210
TV9P0603	6.5	9	0.05	20	11	15	25	1	180
TV11P0603	8	11	0.05	20	13	17	30	1	170
TV14P0603	10	14	0.05	25	16.5	20.5	35	1	150
TV18P0603	14	18	0.05	25	22	27	45	1	120
TV22P0603	17	22	0.05	30	26	32	50	1	90
TV26P0603	20	26	0.05	30	32	38	60	1	60

0805 (2012)									
Maida Style Number	**Maximum Ratings**				**Electrical Characteristics**				
	Continuous		Transient						
	Applied Voltage		Energy	Peak Current	Varistor Voltage (@1mA DC)		Max Clamping Voltage (@Test Current)		Typical Cap.
			10x1000 µs	8x20 µs	Vmin	Vmax	8x20 µs		1 V rms @1MHz
	(AC)	(DC)	(J)	(A)	(V)	(V)	(V)	(A)	(pF)
TV5R5P0805	4	5.5	0.1	40	6.9	9.3	15	2	510
TV9P0805	6.5	9	0.15	40	11.3	15.2	20	2	320
TV11P0805	8	11	0.15	40	13	17	25	2	290
TV14P0805	10	14	0.15	40	17.5	23.7	30	2	250
TV18P0805	14	18	0.15	40	23	30	40	2	200
TV22P0805	17	22	0.15	40	28	34	50	2	180
TV26P0805	20	26	0.15	40	33	40	60	2	100

SV Series Standard Multilayer Varistor

The SV series is our standard MLV line. They have good surge suppression and moderate capacitance.

0603 (1608)

Maida Style Number	Maximum Ratings				Electrical Characteristics				
	Continuous		Transient		Varistor Voltage (@1mA DC)		Max Clamping Voltage (@Test Current)		Typical Cap.
	Applied Voltage		Energy	Peak Current					1 V rms
			10x1000 µs	8x20 µs	Vmin	Vmax	8x20 µs		@1KHz
	(AC)	(DC)	(J)	(A)	(V)	(V)	(V)	(A)	(pF)
SV5R5P0603	4	5.5	0.1	30	6.9	9.3	16	2	440
SV9P0603	6.5	9	0.1	30	11.3	15.2	23	2	380
SV11P0603	8	11	0.1	30	13	18	27	2	350
SV14P0603	10	14	0.1	30	17.5	23.7	30	2	290
SV18P0603	14	18	0.1	30	23	30	40	2	220
SV22P0603	17	22	0.1	30	28	34	50	2	170
SV26P0603	20	26	0.1	30	33	40	60	2	100
SV30P0603	25	30	0.1	30	38	46	65	2	40

0805 (2012)

Maida Style Number	Maximum Ratings				Electrical Characteristics				
	Continuous		Transient		Varistor Voltage (@1mA DC)		Max Clamping Voltage (@Test Current)		Typical Cap.
	Applied Voltage		Energy	Peak Current					1 V rms
			10x1000 µs	8x20 µs	Vmin	Vmax	8x20 µs		@1KHz
	(AC)	(DC)	(J)	(A)	(V)	(V)	(V)	(A)	(pF)
SV5R5P0805	4	5.5	0.3	120	6.9	9.3	15	2	1020
SV9P0805	6.5	9	0.3	120	11.3	15.2	24	2	640
SV11P0805	8	11	0.3	120	13	18	27	2	580
SV14P0805	10	14	0.3	120	17.5	23.7	30	2	500
SV18P0805	14	18	0.3	120	23	30	40	2	400
SV22P0805	17	22	0.3	120	28	34	50	2	360
SV26P0805	20	26	0.3	120	33	40	58	2	280
SV30P0805	25	30	0.3	120	38	46	65	2	200
SV39P0805	30	39	0.3	120	42	52	80	2	150

1206 (3216)

Maida Style Number	Maximum Ratings				Electrical Characteristics				
	Continuous		Transient		Varistor Voltage (@1mA DC)		Max Clamping Voltage (@Test Current)		Typical Cap.
	Applied Voltage		Energy	Peak Current					1 V rms
			10x1000 µs	8x20 µs	Vmin	Vmax	8x20 µs		@1KHz
	(AC)	(DC)	(J)	(A)	(V)	(V)	(V)	(A)	(pF)
SV5R5P1206	4	5.5	0.4	120	6.9	9.3	15	10	3700
SV9P1206	6.5	9	0.4	150	11.3	15.2	25	10	2170
SV14P1206	10	14	0.4	150	17.5	23.7	30	10	1670
SV18P1206	14	18	0.4	150	23	30	40	10	1030
SV26P1206	20	26	0.4	150	33	40	58	10	940
SV30P1206	25	30	0.4	150	38	46	66	10	890
SV48P1206	40	48	0.4	150	55	66	100	10	680

1210 (3225)

Maida Style Number	Maximum Ratings				Electrical Characteristics				
	Continuous		Transient		Varistor Voltage (@1mA DC)		Max Clamping Voltage (@Test Current)		Typical Cap.
	Applied Voltage		Energy	Peak Current					1 V rms
			10x1000 µs	8x20 µs	Vmin	Vmax	8x20 µs		@1KHz
	(AC)	(DC)	(J)	(A)	(V)	(V)	(V)	(A)	(pF)
SV18P1210	14	18	0.9	220	23	30	40	10	1350
SV26P1210	20	26	0.9	220	33	40	58	10	1200
SV30P1210	25	30	0.9	220	38	46	66	10	900
SV48P1210	40	48	0.9	250	55	66	100	10	780
SV60P1210	50	60	0.9	250	69	83	120	10	600

PV Series Power Multilayer Varistor

The PV series has higher energy handling capabilities than our standard series. These MLVs should be chosen where the application requires outstanding surge protection and high reliability.

0603 (1608)

Maida Style Number	Maximum Ratings				Electrical Characteristics				
	Continuous		Transient						
	Applied Voltage		Energy	Peak Current	Varistor Voltage (@1mA DC)		Max Clamping Voltage (@Test Current)		Typical Cap.
			10x1000 µs	8x20 µs	Vmin	Vmax	8x20 µs		1 V rms @1KHz
	(AC)	(DC)	(J)	(A)	(V)	(V)	(V)	(A)	(pF)
PV5R5P0603	4	5.5	0.15	40	6.9	9.3	15.5	2	960
PV14P0603	10	14	0.15	40	17.5	23.7	30	2	450
PV18P0603	14	18	0.15	40	23	30	40	2	380
PV22P0603	17	22	0.15	40	28	34	58	2	290

0805 (2012)

Maida Style Number	Maximum Ratings				Electrical Characteristics				
	Continuous		Transient						
	Applied Voltage		Energy	Peak Current	Varistor Voltage (@1mA DC)		Max Clamping Voltage (@Test Current)		Typical Cap.
			10x1000 µs	8x20 µs	Vmin	Vmax	8x20 µs		1 V rms @1KHz
	(AC)	(DC)	(J)	(A)	(V)	(V)	(V)	(A)	(pF)
PV5R5P0805	4	5.5	0.4	120	6.9	9.3	15.5	5	1530
PV14P0805	10	14	0.4	150	16.5	20.5	30	5	750
PV18P0805	14	18	0.4	150	23	30	40	5	640
PV22P0805	17	22	0.4	150	28	34	50	5	540
PV26P0805	20	26	0.4	150	33	40	58	5	480
PV30P0805	25	30	0.4	150	38	46	65	5	250

1206 (3216)

Maida Style Number	Maximum Ratings				Electrical Characteristics				
	Continuous		Transient						
	Applied Voltage		Energy	Peak Current	Varistor Voltage (@1mA DC)		Max Clamping Voltage (@Test Current)		Typical Cap.
			10x1000 µs	8x20 µs	Vmin	Vmax	8x20 µs		1 V rms @1KHz
	(AC)	(DC)	(J)	(A)	(V)	(V)	(V)	(A)	(pF)
PV5R5P1206	4	5.5	0.7	150	6.9	9.3	15.5	10	4800
PV14P1206	10	14	0.7	200	17.5	23.7	30	10	2200
PV18P1206	14	18	0.7	200	23	30	40	10	1700
PV26P1206	20	26	0.7	200	33	40	58	10	1550
PV30P1206	25	30	0.7	200	38	46	66	10	1430
PV48P1206	40	48	0.7	200	55	66	100	10	1070

1210 (3225)

Maida Style Number	Maximum Ratings				Electrical Characteristics				
	Continuous		Transient						
	Applied Voltage		Energy	Peak Current	Varistor Voltage (@1mA DC)		Max Clamping Voltage (@Test Current)		Typical Cap.
			10x1000 µs	8x20 µs	Vmin	Vmax	8x20 µs		1 V rms @1KHz
	(AC)	(DC)	(J)	(A)	(V)	(V)	(V)	(A)	(pF)
PV18P1210	14	18	1.5	500	23	30	40	10	2680
PV26P1210	20	26	1.5	300	33	40	58	10	2100
PV30P1210	25	30	1.5	250	38	46	66	10	1900
PV48P1210	40	48	1.5	250	55	66	100	10	1600
PV60P1210	50	60	1.5	250	69	83	140	10	1230
PV85P1210	67	85	1.5	250	98	118	160	10	590

1812 (4532)

Maida Style Number	Maximum Ratings				Electrical Characteristics				
	Continuous		Transient						
	Applied Voltage		Energy	Peak Current	Varistor Voltage (@1mA DC)		Max Clamping Voltage (@Test Current)		Typical Cap.
			10x1000 µs	8x20 µs	Vmin	Vmax	8x20 µs		1 V rms @1KHz
	(AC)	(DC)	(J)	(A)	(V)	(V)	(V)	(A)	(pF)
PV18P1812	14	18	2.5	500	23	30	40	10	3800
PV26P1812	20	26	3.0	500	33	40	58	10	2950
PV30P1812	25	30	3.7	500	38	46	66	10	2820
PV48P1812	40	48	4.0	400	55	66	100	10	2740
PV60P1812	50	60	4.5	400	69	83	140	10	2220
PV85P1812	67	85	5.8	400	98	118	160	10	1400

2220 (5750)

Maida Style Number	Maximum Ratings				Electrical Characteristics				
	Continuous		Transient						
	Applied Voltage		Energy	Peak Current	Varistor Voltage (@1mA DC)		Max Clamping Voltage (@Test Current)		Typical Cap.
			10x1000 µs	8x20 µs	Vmin	Vmax	8x20 µs		1 V rms @1KHz
	(AC)	(DC)	(J)	(A)	(V)	(V)	(V)	(A)	(pF)
PV5R5P2220	4	5.5	2	1000	6.9	9.3	15.5	10	15000
PV14P2220	10	14	2.5	1200	17.5	23.7	30	10	9600
PV18P2220	14	18	3	1200	23	30	40	10	6400
PV26P2220	20	26	5	1200	33	40	58	10	6200
PV30P2220	25	30	6	1200	38	46	66	10	5700
PV48P2220	40	48	8	1200	55	66	100	10	5200

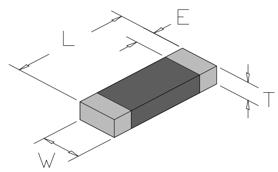
AV Series   Automotive Multilayer Varistor

The AV series is designed for ultimate reliability in automotive applications. Parts in this series are designed to withstand the 24.5V jump start condition that occurrs when two 12V batteries are connected together in series. These parts are our most reliable surge suppressors, but also our most expensive.

Protects 12V supply systems									
	Maximum Ratings				Electrical Characteristics				
			Transient						
Maida Style Number	Maxiumum Continuous DC Voltage	Jump Start Voltage 5 mins	Energy	Peak Current	Varistor Voltage (@1mA DC)		Max Clamping Voltage (@Test Current)		Typical Cap.
			10x1000 µs	8x20 µs	Vmin	Vmax	8x20 µs		1 V rms @1KHz
	(DC)	(V)	(J)	(A)	(V)	(V)	(V)	(A)	(pF)
AV18P0805	18	24.5	0.4	150	22	29	42	5	480
AV18P1206	18	24.5	0.7	200	22	29	40	10	1090
AV18P1210	18	24.5	1.5	500	22	29	40	10	1670
AV18P1812	18	24.5	3.0	800	22	29	40	10	9600
AV18P2220	18	24.5	6.0	1500	22	29	40	10	15000

Standard dimensions: inches (mm)

	CHIP SIZE						
	0402 (1005)	**0603 (1608)**	**0805 (2012)**	**1206 (3216)**	**1210 (3225)**	**1812 (4532)**	**2220 (5750)**
L	0.040±0.004 (1.0±0.10)	0.063±0.006 (1.60±0.15)	0.079±0.008) (2.00±0.20)	0.126±0.012 (3.2±0.30)	0.126±0.012 (3.20±0.30)	0.177±0.014 (4.5±0.35)	0.225±0.016 (5.7±0.40)
W	0.020±0.004 (0.5±0.10)	0.032±0.006 (0.80±0.15)	0.049±0.008 (1.25±0.20)	0.063±0.012 (1.60±0.30)	0.098±0.012 (2.50±0.30)	0.126±0.012 (3.20±0.30)	0.197±0.016 (5.0±0.40)
Tmax	0.024 (0.60)	0.035 (0.90)	0.043 (1.10)	0.067 (1.70)	0.071 (1.80)	0.079 (2.00)	0.079 (2.00)
E	0.010±0.006 (0.25±0.15)	0.014±0.006 (0.35±0.15)	0.018±0.010 (0.45±0.25)	0.022±0.010 (0.55±0.25)	0.024±0.012 (0.60±0.30)	0.028±0.016 (0.70±0.40)	0.028±0.016 (0.7±0.40)



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Maida MLVs are available in bulk package or on tape and reel.

Tape and Reel packaging available		
Size	**Pcs / Reel**	**carrier tape**
0402	10000	paper
0603	4000	plastic
0805	4000	plastic
1206	3000	plastic
1210	3000	plastic

Reflow Soldering Recommendations

The most common way to mount MLVs (and other similar chips) on a circuit board is to use a reflow solder process. Solder paste is applied to the circuit board at the contact points where the surface mount chips will be placed (called lands). All the chips to be soldered on a particular board are placed on their lands. Then the whole board is placed in an oven hot enough to melt the solder and cause it to 'reflow'. The solder melts and forms a smooth filet with the ends of the chips. The board is then cleaned in solvent to remove any residues.

In general we recommend that Maida MLV chips be reflow soldered at a temperature of 215 to 245°C with about 1 min at the peak temperature. This is a common range for most widely used solders and should be compatible with other surface mount chips.