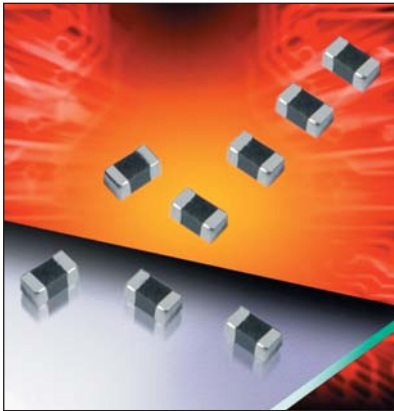


## AVX Multilayer Ceramic Transient Voltage Suppressors



### GENERAL DESCRIPTION

TransGuard® multilayer varistors are zinc oxide (ZnO) based ceramic semiconductor devices with non-linear voltage-current characteristics (bi-directional) similar to back-to-back zener diodes. They have the added advantage of greater current and energy handling capabilities as well as EMI/RFI attenuation.

The increasing use of electronics technologies in all areas require reliable protection against transient voltages that could damage the electronics circuitry as well as EMI/RFI attenuation to prevent signal distortion and to meet regulatory requirements. AVX TransGuard components help achieve both functions with single component.

### GENERAL CHARACTERISTICS

- Operating Temperature: -55°C to +125°C
- Working Voltage: 3.3 - 85Vdc
- Case Size: 0402 - 1812
- Energy: 0.05 - 4.2J
- Peak Current: 20 - 2000A

### FEATURES

- Bi-Directional protection
- Very fast response to ESD strikes
- Multi-strike capability
- High Reliability
- EMI/RFI Filtering
- Wide range of components

### APPLICATIONS

- IC Protection
- Micro Controllers
- Relays
- I/O Ports
- Keyboard Protection
- Portable devices
- Industrial Controllers
- Automation
- Smart Grid
- Telecom
- LED Lights
- Cameras
- Base Stations
- Motion detector
- Alarms
- and more

### HOW TO ORDER

<b>VC</b> ↓ <b>Varistor Chip</b>	<b>1206</b> ↓ <b>Case Size</b>	<b>18</b> ↓ <b>Working Voltage</b>	<b>D</b> ↓ <b>Energy Rating</b>	<b>400</b> ↓ <b>Clamping Voltage</b>	<b>R</b> ↓ <b>Packaging</b>	<b>P</b> ↓ <b>Termination</b>
	0402	03 = 3.3Vdc	B = 0.2J	100 = 12V	D = 7" (1000)*	P = Ni/Sn plated
	0603	05 = 5.6Vdc	C = 0.3J	150 = 18V	R = 7" (4000 or 2000)*	
	0805	09 = 9Vdc	D = 0.4J	200 = 22V	T = 13" (10,000)*	
	1206	12 = 12Vdc	E = 0.5J	250 = 27V	W = 13" (10,000)**	
	1210	05 = 5.6Vdc	F = 0.7J	300 = 32V		
	1812	09 = 9Vdc	H = 1.2J	380 = 38V		
		12 = 12Vdc		390 = 42V		
		14 = 14Vdc		400 = 42V		
		18 = 18Vdc		540 = 54V		
		22 = 22Vdc	J = 1.5J	580 = 60V		
		26 = 26Vdc	K = 0.6J	620 = 67V		
		30 = 30Vdc	L = 0.8J	650 = 67V		
		31 = 31Vdc	S = 1.9-2.0J	770 = 77V		
		38 = 38Vdc	Y = 6.5-12J	800 = 80V		
		42 = 42Vdc		101 = 100V		
		48 = 48Vdc		111 = 110V		
		56 = 56Vdc		151 = 150V		
		85 = 85Vdc				

\*Not available for 0402  
\*\*Only available for 0402

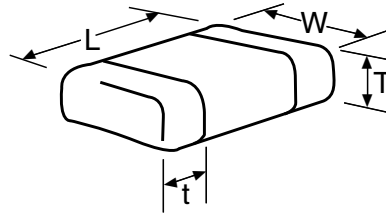
### ELECTRICAL CHARACTERISTICS

AVX PN	V <sub>w</sub> (DC)	V <sub>w</sub> (AC)	V <sub>B</sub>	V <sub>C</sub>	I <sub>VC</sub>	I <sub>L</sub>	E <sub>T</sub>	I <sub>P</sub>	Cap	Freq	Case
VC060303A100	3.3	2.3	5.0±20%	12	1	100	0.1	30	1450	K	0603
VC080503A100	3.3	2.3	5.0±20%	12	1	100	0.1	40	1400	K	0805
VC080503C100	3.3	2.3	5.0±20%	12	1	100	0.3	120	5000	K	0805
VC120603A100	3.3	2.3	5.0±20%	12	1	100	0.1	40	1250	K	1206
VC120603D100	3.3	2.3	5.0±20%	12	1	100	0.4	150	4700	K	1206
VC040205X150	5.6	4.0	8.5±20%	18	1	35	0.05	20	175	M	0402
VC060305A150	5.6	4.0	8.5±20%	18	1	35	0.1	30	750	K	0603
VC080505A150	5.6	4.0	8.5±20%	18	1	35	0.1	40	1100	K	0805
VC080505C150	5.6	4.0	8.5±20%	18	1	35	0.3	120	3000	K	0805
VC120605A150	5.6	4.0	8.5±20%	18	1	35	0.1	40	1200	K	1206
VC120605D150	5.6	4.0	8.5±20%	18	1	35	0.4	150	3000	K	1206
VC040209X200	9.0	6.4	12.7±15%	22	1	25	0.05	20	175	M	0402
VC060309A200	9.0	6.4	12.7±15%	22	1	25	0.1	30	550	K	0603
VC080509A200	9.0	6.4	12.7±15%	22	1	25	0.1	40	750	K	0805
VC080512A250	12.0	8.5	16±15%	27	1	25	0.1	40	525	K	0805
VC040214X300	14.0	10.0	18.5±12%	32	1	15	0.05	20	85	K	0402
VC060314A300	14.0	10.0	18.5±12%	32	1	15	0.1	30	350	K	0603
VC080514A300	14.0	10.0	18.5±12%	32	1	15	0.1	40	325	K	0805
VC080514C300	14.0	10.0	18.5±12%	32	1	15	0.3	120	900	K	0805
VC120614A300	14.0	10.0	18.5±12%	32	1	15	0.1	40	600	K	1206
VC120614D300	14.0	10.0	18.5±12%	32	1	15	0.4	150	1050	K	1206
VC121016J390	16.0	13.0	25.5±10%	40	2.5	10	1.6	500	3100	K	1210
VG181216P390	16.0	11.0	24.5±10%	40	5	15	2.9	1000	7000	K	1812
VG181216P400	16.0	11.0	24.5±10%	42	5	10	2.9	1000	5000	K	1812
VG222016Y400	16.0	11.0	24.5±10%	42	10	10	7.2	1500	13000	K	2220
VC040218X400	18.0	13.0	25.5±10%	42	1	10	0.05	20	65	M	0402
VC060318A400	18.0	13.0	25.5±10%	42	1	10	0.1	30	150	K	0603
VC080518A400	18.0	13.0	25.5±10%	42	1	10	0.1	30	225	K	0805
VC080518C400	18.0	13.0	25.5±10%	42	1	10	0.3	100	550	K	0805
VC120618A400	18.0	13.0	25.5±10%	42	1	10	0.1	30	350	K	1206
VC120618D400	18.0	13.0	25.5±10%	42	1	10	0.4	150	900	K	1206
VC120618E380	18.0	13.0	25.5±10%	38	1	15	0.5	200	930	K	1206
VC121018J390	18.0	13.0	25.5±10%	42	5	10	1.6	500	3100	K	1210
VG181218P440	18.0	14.0	27.5±10%	44	5	15	2.9	800	5000	K	1812
VG121022R440	22.0	17.0	27±10%	44	2.5	15	1.7	400	1600	K	1210
VC060326A580	26.0	18.0	34.5±10%	60	1	10	0.1	30	155	K	0603
VC080526A580	26.0	18.0	34.5±10%	60	1	10	0.1	30	120	K	0805
VC080526C580	26.0	18.0	34.5±10%	60	1	10	0.3	100	250	K	0805
VC120626D580	26.0	18.0	34.5±10%	60	1	10	0.4	120	500	K	1206
VC120626F540	26.0	20.0	33.0±10%	54	1	15	0.7	200	600	K	1206
VC121026H560	26.0	18.0	34.5±10%	60	5	10	1.2	300	2150	K	1210
VG181226P570	26.0	23.0	35.0±10%	57	5	15	3.0	600	3000	K	1812
VG181226P540	26.0	20.0	35.0±10%	54	5	15	3.0	800	3000	K	1812
VG222026Y570	26.0	23.0	35.0±10%	57	10	15	6.8	1100	7000	K	2220
VC060330A650	30.0	21.0	41.0±10%	67	1	10	0.1	30	125	K	0603
VC080530A650	30.0	21.0	41.0±10%	67	1	10	0.1	30	90	M	0805

### ELECTRICAL CHARACTERISTICS

AVX PN	V <sub>w</sub> (DC)	V <sub>w</sub> (AC)	V <sub>B</sub>	V <sub>C</sub>	I <sub>vc</sub>	I <sub>L</sub>	E <sub>T</sub>	I <sub>P</sub>	Cap	Freq	Case
VC080530C650	30.0	21.0	41.0±10%	67	1	10	0.3	80	250	K	0805
VC120630D650	30.0	21.0	41.0±10%	67	1	10	0.4	120	400	K	1206
VC121030G620	30.0	21.0	41.0±10%	67	5	10	0.9	220	1750	K	1210
VC121030H620	30.0	21.0	41.0±10%	67	5	10	1.2	280	1850	K	1210
VC121030S620	30.0	21.0	41.0±10%	67	5	10	1.9	300	1500	K	1210
VC080531C650	31.0	25.0	39.0±10%	65	1	10	0.3	80	250	K	0805
VC120631M650	31.0	25.0	39.0±10%	65	1	15	1.0	200	500	K	1206
VG181231P650	31.0	25.0	39±10%	65	5	15	3.7	800	2600	K	1812
VG222031Y650	31.0	25	39.0±10%	65	10	15	9.6	1200	6100	K	2220
VC080538C770	38.0	30.0	47.0±10%	77	1	10	0.3	80	200	K	0805
VC120638N770	38.0	30.0	47.0±10%	77	1	15	1.1	200	400	K	1206
VG121038S770	38.0	30.0	47.0±10%	77	2.5	15	2.0	400	1000	K	1210
VG181238U770	38.0	30.0	47.0±10%	77	5	15	4.2	800	1300	K	1812
VG222038Y770	38.0	30.0	47.0±10%	77	10	15	12	2000	4200	K	2220
VC120642L800	42.0	32.0	51.0±10%	80	1	15	0.8	180	600	K	1206
VC120645K900	45.0	35.0	56.0±10%	90	1	15	0.6	200	260	K	1206
VG181245U900	45.0	35.0	56.0±10%	90	5	15	4.0	500	1800	K	1812
VC120648D101	48.0	34.0	62.0±10%	100	1	10	0.4	100	225	K	1206
VC121048G101	48.0	34.0	62.0±10%	100	5	10	0.9	220	450	K	1210
VC121048H101	48.0	34.0	62.0±10%	100	5	10	1.2	250	500	K	1210
VC120656F111	56.0	40.0	68.0±10%	110	1	15	0.7	100	180	K	1206
VG181256U111	56.0	40.0	68.0±10%	110	5	15	4.8	500	1100	K	1812
VG222056Y111	56.0	40	68.0±10%	110	10	15	9	1000	2800	K	2220
VC121060J121	60.0	42.0	76.0±10%	120	5	10	1.5	250	400	K	1210
VC120665L131	65.0	50.0	82.0±10%	135	1	15	0.8	100	250	K	1206
VC120665M131	65.0	50.0	82.0±10%	135	1	15	1.0	150	250	K	1206
VG121065P131	65.0	50.0	82±10%	135	2.5	15	2.7	350	600	K	1210
VG181265U131	65.0	50.0	82.0±10%	135	5	15	4.5	400	800	K	1812
VG222065Y131	65.0	50	82.0±10%	135	10	15	6.5	800	3000	K	2220
VC121085S151	85.0	60.0	100±10%	150	1	35	2.0	250	275	K	1210
VG181285U161	85.0	60.0	100±10%	165	5	15	4.5	400	500	K	1812

V <sub>w</sub> (DC)	DC Working Voltage (V)	Working Voltage (µA)
V <sub>w</sub> (AC)	AC Working Voltage (V)	E <sub>T</sub> Transient Energy Rating (J, 10x1000µS)
V <sub>B</sub>	Typical Breakdown Voltage (V @ 1mA <sub>DC</sub> )	I <sub>P</sub> Peak Current Rating (A, 8x20µS)
V <sub>B</sub> Tol	V <sub>B</sub> Tolerance is ± from Typical Value	Cap Typical Capacitance (pF) @ frequency specified and 0.5 V <sub>RMS</sub>
V <sub>C</sub>	Clamping Voltage (V @ I <sub>vc</sub> )	Freq Frequency at which capacitance is measured (K = 1kHz, M = 1MHz)
I <sub>vc</sub>	Test Current for V <sub>C</sub> (A, 8x20µS)	
I <sub>L</sub>	Maximum Leakage Current at the	

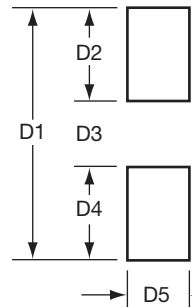


### DIMENSIONS: mm (inches)

AVX Style		0402	0603	0805	1206	1210	1812	2220
(L) Length	mm (in.)	1.00±0.10 (0.040±0.004)	1.60±0.15 (0.063±0.006)	2.01±0.20 (0.079±0.008)	3.20±0.20 (0.126±0.008)	3.20±0.20 (0.126±0.008)	4.50±0.30 (0.177±0.012)	5.70±0.40 (0.224±0.016)
(W) Width	mm (in.)	0.50±0.10 (0.020±0.004)	0.80±0.15 (0.031±0.006)	1.25±0.20 (0.049±0.008)	1.60±0.20 (0.063±0.008)	2.49±0.20 (0.098±0.008)	3.20±0.30 (0.126±0.012)	5.00±0.40 (0.197±0.016)
(T) Max Thickness	mm (in.)	0.6 (0.024)	0.9 (0.035)	1.02 (0.040)	1.02 (0.040) 1.70 (0.067) <sup>1)</sup> 1.80 (0.071) <sup>2)</sup>	1.70 (0.067)	2.00 (0.080)	2.50 (0.098)
(t) Land Length	mm (in.)	0.25±0.15 (0.010±0.006)	0.35±0.15 (0.014±0.006)	0.71 max. (0.028 max.)	0.94 max. (0.037 max.)	1.14 max. (0.045 max.)	1.00 max. (0.039 max.)	1.00 max. (0.039 max.)

1) Applicable for: VC120618E380, VC120626F540, VC120631M650, VC120638N770, VC120642L800, VC120645K900, VC120656F111

2) Applicable for: VC120642L800, VC120660M131



### SOLDERING PAD: mm (inches)

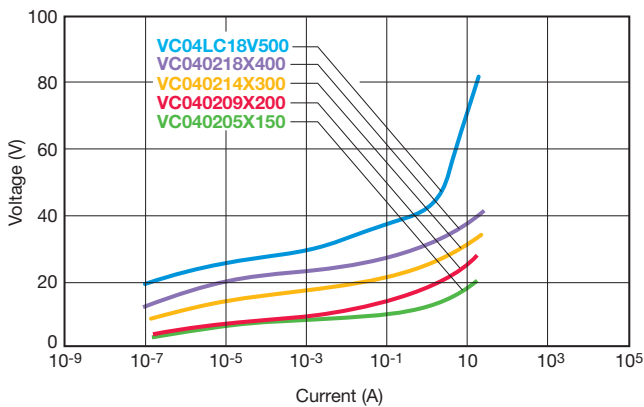
Pad Layout	0402	0603	0805	1206	1210	1812	2220
D1	1.70 (0.067)	2.54 (0.100)	3.05 (0.120)	4.06 (0.160)	4.06 (0.160)	5.60 (0.220)	6.60 (0.26)
D2	1.61 (0.024)	0.89 (0.035)	1.02 (0.040)	1.02 (0.040)	1.02 (0.040)	1.00 (0.039)	1.00 (0.039)
D3	1.51 (0.020)	0.76 (0.030)	1.02 (0.040)	2.03 (0.080)	2.03 (0.080)	3.60 (0.142)	4.60 (0.18)
D4	1.61 (0.024)	0.89 (0.035)	1.02 (0.040)	1.02 (0.040)	1.02 (0.040)	1.00 (0.039)	1.00 (0.039)
D5	1.51 (0.020)	0.76 (0.030)	1.27 (0.050)	1.65 (0.065)	2.54 (0.100)	3.00 (0.118)	5.00 (0.20)

## AVX Multilayer Ceramic Transient Voltage Suppressors

### TYPICAL PERFORMANCE CURVES (0402 CHIP SIZE)

#### VOLTAGE/CURRENT CHARACTERISTICS

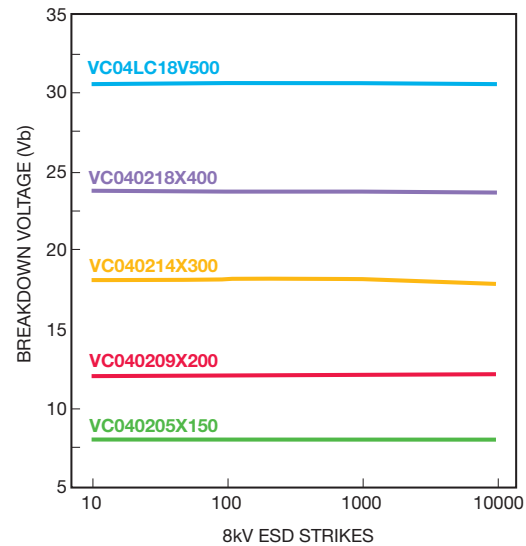
Multilayer construction and improved grain structure result in excellent transient clamping characteristics up to 20 amps peak current, while maintaining very low leakage currents under DC operating conditions. The VI curves below show the voltage/current characteristics for the 5.6V, 9V, 14V, 18V and low capacitance StaticGuard parts with currents ranging from parts of a micro amp to tens of amps.



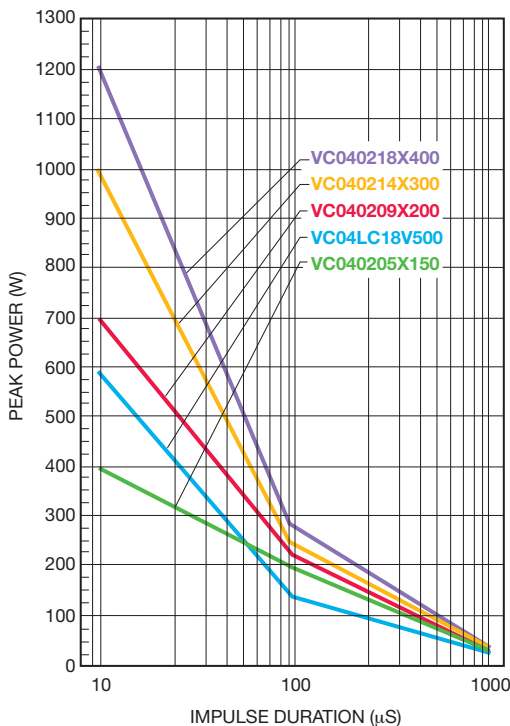
#### PULSE DEGRADATION

Traditionally varistors have suffered degradation of electrical performance with repeated high current pulses resulting in decreased breakdown voltage and increased leakage current. It has been suggested that irregular intergranular boundaries and bulk material result in restricted current paths and other non-Schottky barrier paralleled conduction paths in the ceramic. Repeated pulsing of TransGuard® transient voltage suppressors with 150Amp peak 8 x 20µS waveforms shows negligible degradation in breakdown voltage and minimal increases in leakage current. This does not mean that TransGuard® suppressors do not suffer degradation, but it occurs at much higher current.

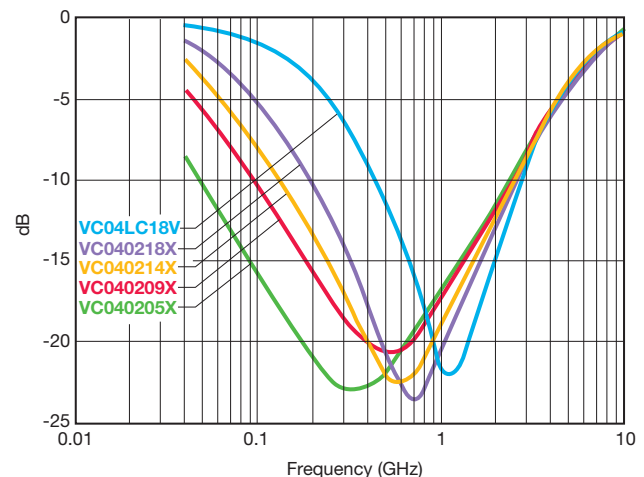
#### ESD TEST OF 0402 PARTS



#### PEAK POWER VS PULSE DURATION



#### INSERTION LOSS CHARACTERISTICS

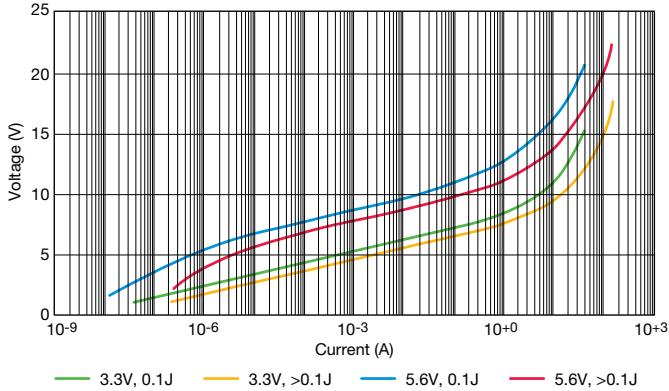


### TYPICAL PERFORMANCE CURVES (0603, 0805, 1206 & 1210 CHIP SIZES)

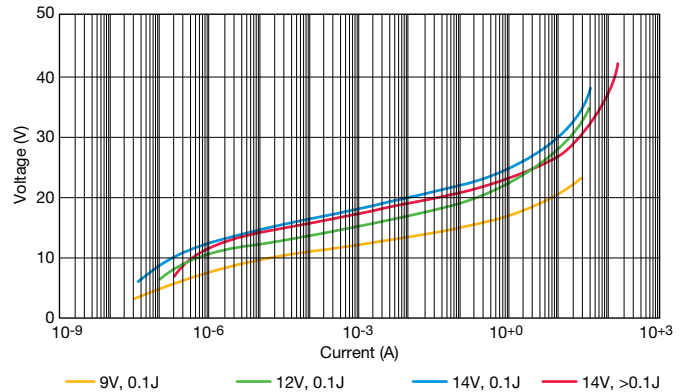
#### VOLTAGE/CURRENT CHARACTERISTICS

Multilayer construction and improved grain structure result in excellent transient clamping characteristics up to 500 amps peak current, depending on case size and energy rating, while maintaining very low leakage currents under DC operating conditions. The VI curve below shows the voltage/current characteristics for the 3.3V, 5.6V, 12V, 14V, 18V, 26V, 30V, 48V and 60VDC parts with currents ranging from parts of a micro amp to tens of amps.

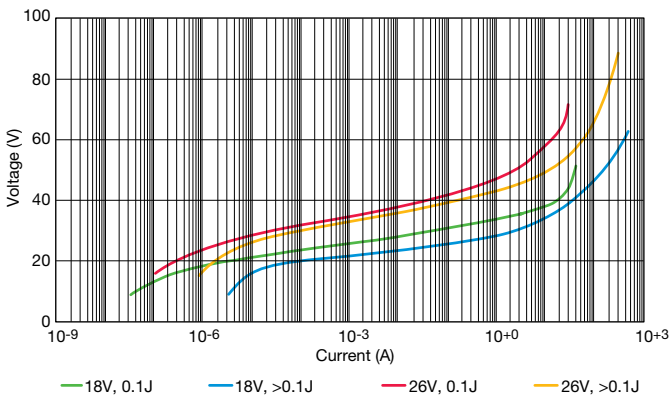
**VI Curves - 3.3V and 5.6V Products**



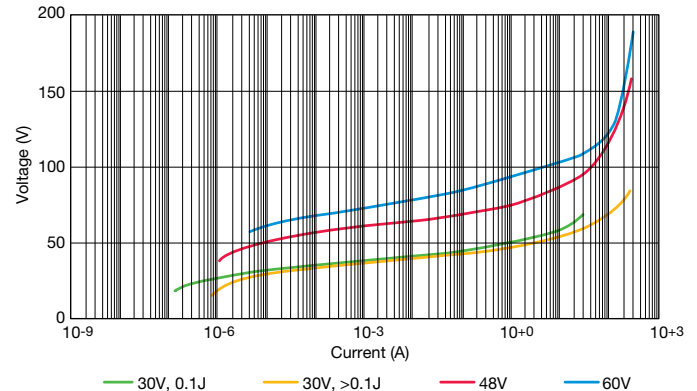
**VI Curves - 9V, 12V, and 14V Products**



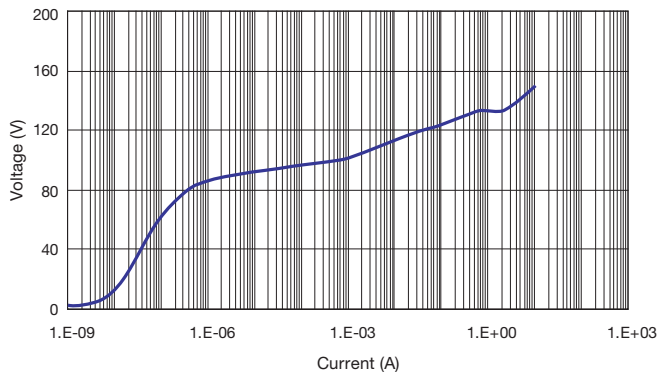
**VI Curves - 18V and 26V Products**



**VI Curves - 30V, 48V, and 60V Products**



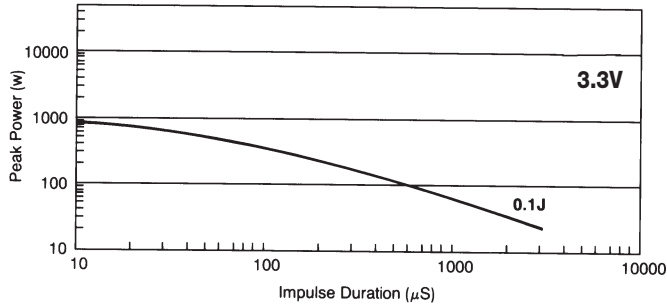
**VI Curve - 85V Product**



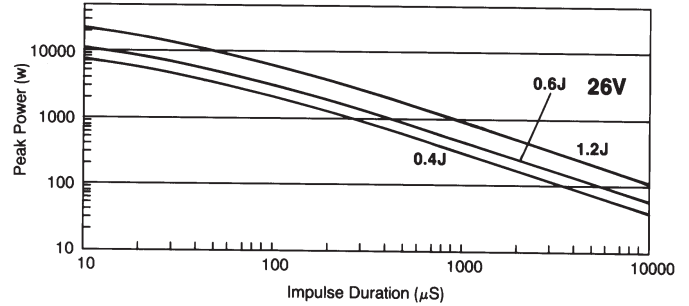
## AVX Multilayer Ceramic Transient Voltage Suppressors

### TYPICAL PERFORMANCE CURVES (0603, 0805, 1206 & 1210 CHIP SIZES)

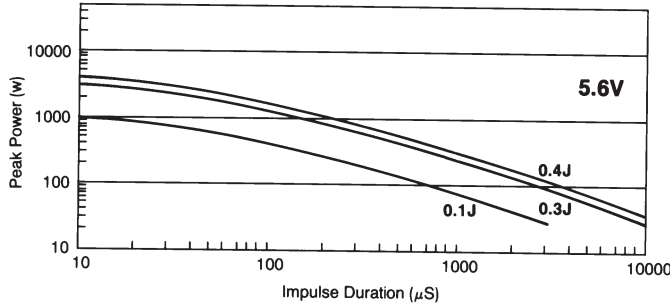
TYPICAL PULSE RATING CURVE  
3.3V MULTILAYER TRANSGUARD®



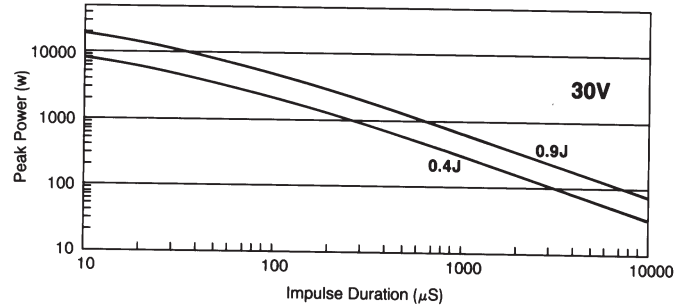
TYPICAL PULSE RATING CURVE  
26V MULTILAYER TRANSGUARD®



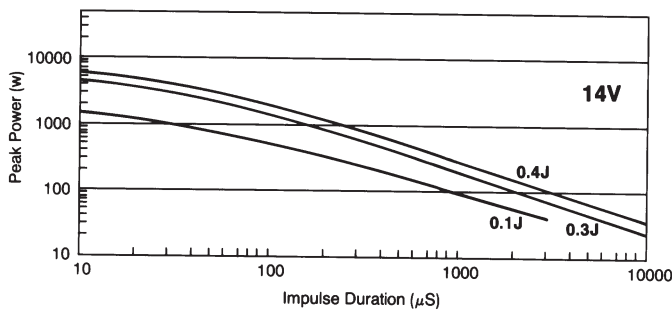
TYPICAL PULSE RATING CURVE  
5.6V MULTILAYER TRANSGUARD®



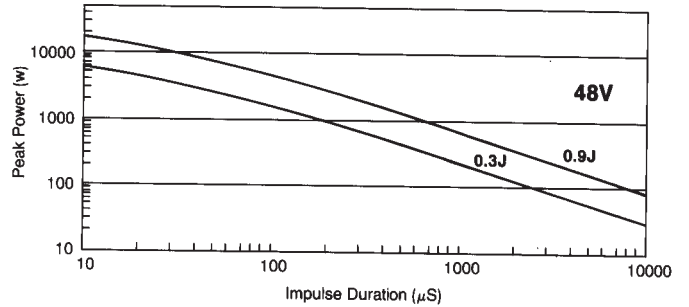
TYPICAL PULSE RATING CURVE  
30V MULTILAYER TRANSGUARD®



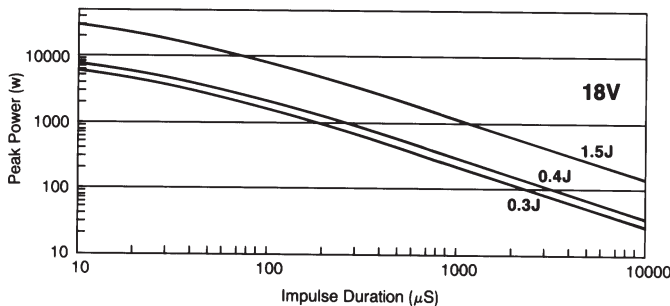
TYPICAL PULSE RATING CURVE  
14V MULTILAYER TRANSGUARD®



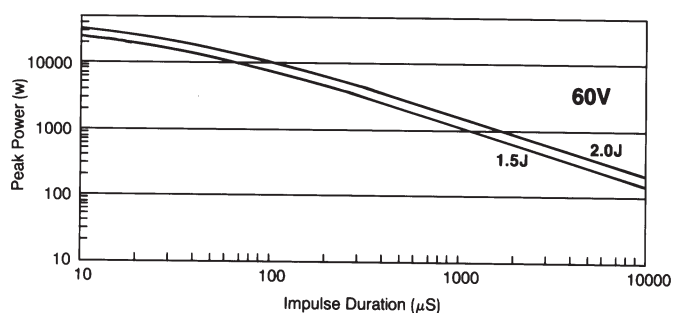
TYPICAL PULSE RATING CURVE  
48V MULTILAYER TRANSGUARD®



TYPICAL PULSE RATING CURVE  
18V MULTILAYER TRANSGUARD®



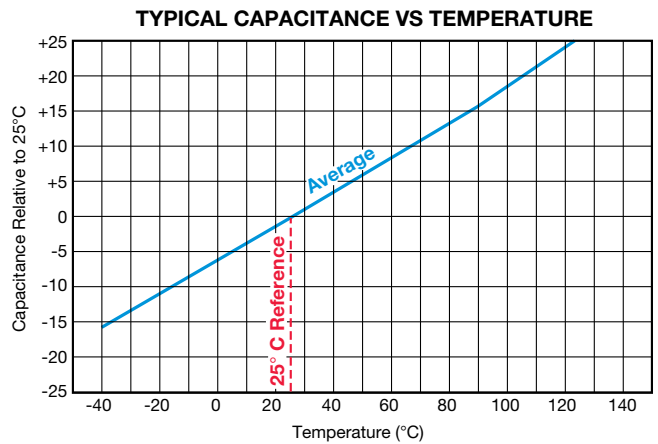
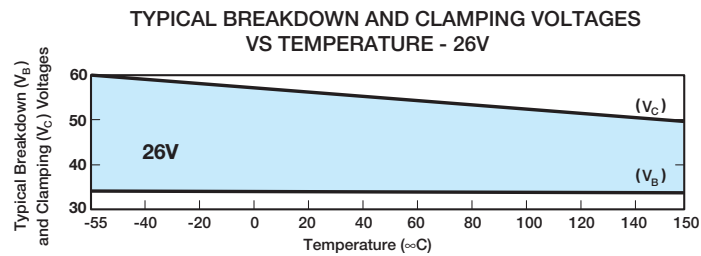
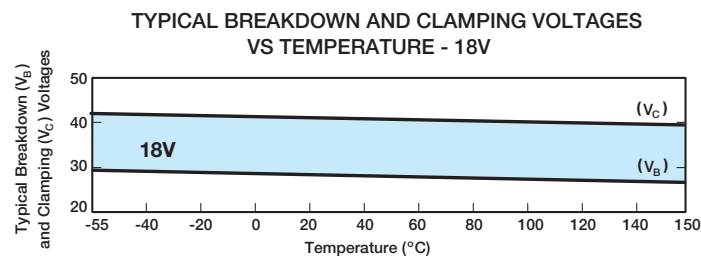
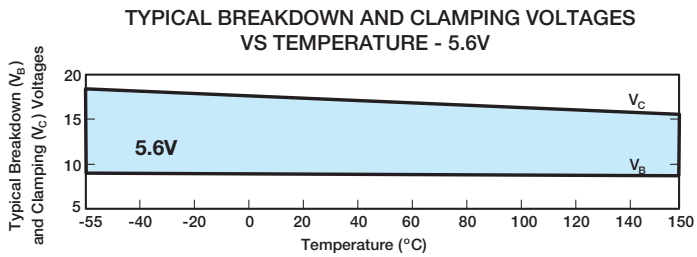
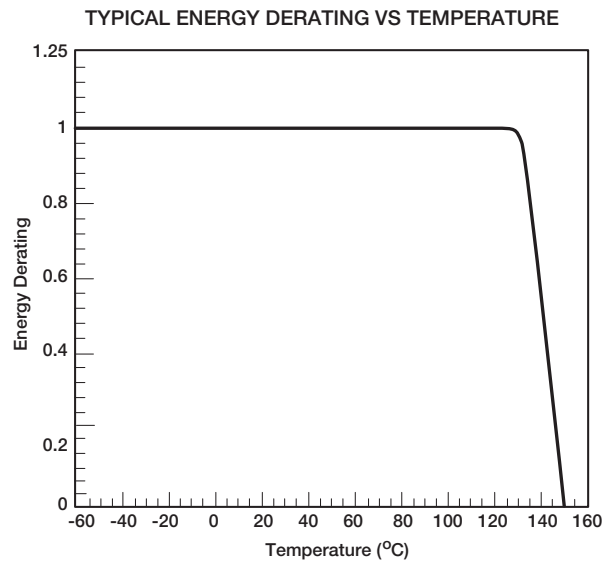
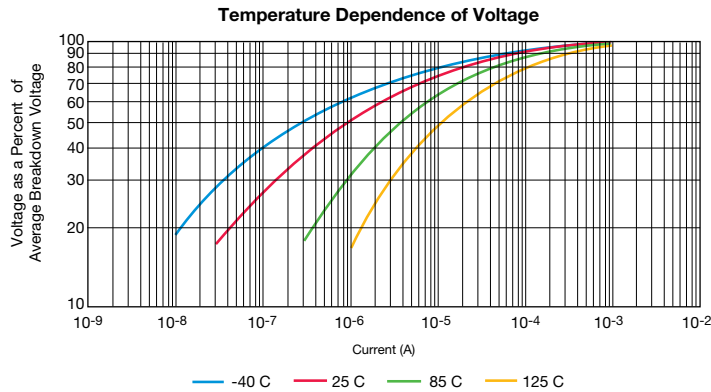
TYPICAL PULSE RATING CURVE  
60V MULTILAYER TRANSGUARD®



### TYPICAL PERFORMANCE CURVES (0603, 0805, 1206 & 1210 CHIP SIZES)

#### TEMPERATURE CHARACTERISTICS

TransGuard® suppressors are designed to operate over the full temperature range from -55°C to +125°C. This operating temperature range is for both surface mount and axial leaded products.





### TYPICAL PERFORMANCE CURVES (0603, 0805, 1206 & 1210 CHIP SIZES)

#### PULSE DEGRADATION

Traditionally varistors have suffered degradation of electrical performance with repeated high current pulses resulting in decreased breakdown voltage and increased leakage current. It has been suggested that irregular intergranular boundaries and bulk material result in restricted current paths and other non-Schottky barrier paralleled conduction paths in the ceramic. Repeated pulsing of both 5.6 and 14V TransGuard® transient voltage suppressors with

150 Amp peak  $8 \times 20\mu\text{s}$  waveforms shows negligible degradation in breakdown voltage and minimal increases in leakage current. This does not mean that TransGuard® suppressors do not suffer degradation, but it occurs at much higher current. The plots of typical breakdown voltage vs number of 150A pulses are shown below.

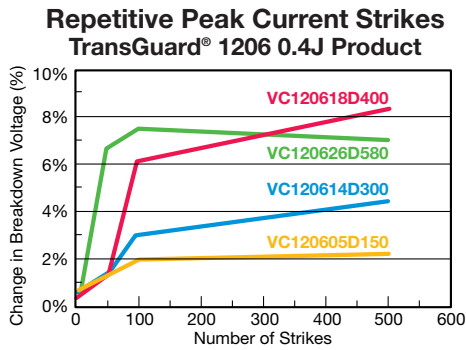


Figure 1

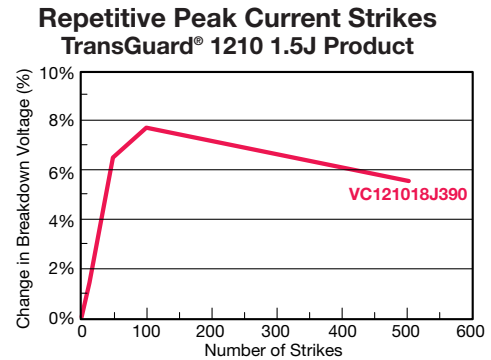


Figure 3

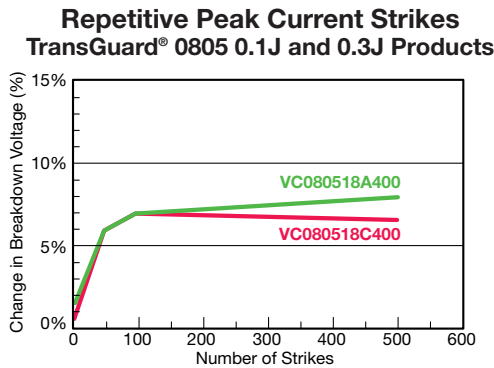


Figure 2

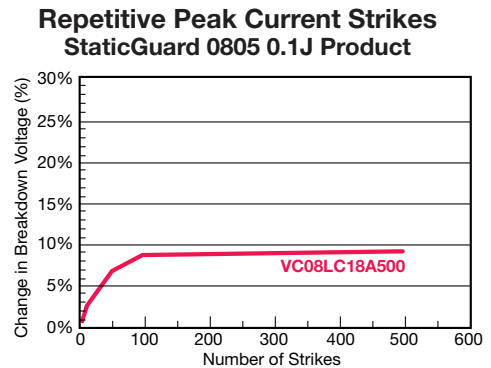
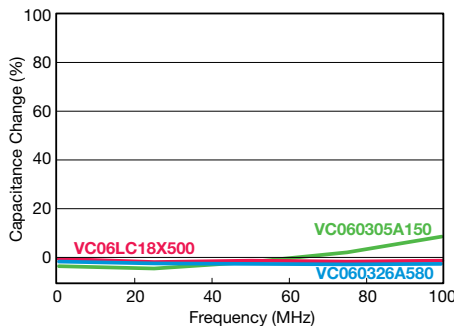


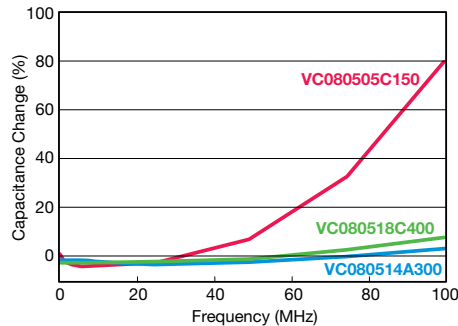
Figure 4

#### CAPACITANCE/FREQUENCY CHARACTERISTICS

TransGuard® Capacitance vs Frequency 0603



TransGuard® Capacitance vs Frequency 0805



TransGuard® Capacitance vs Frequency 1206

