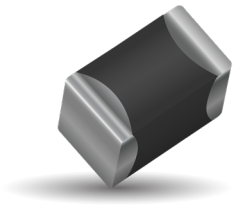
TransGuard®

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. KYOCERA 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

VC — Varistor Chip

VC = Varistor Chip
VG = Varistor Glass

1206 — Case Size

0402
0603
0805
1206
1210
1812
2220
3220

18 — Working Voltage

03 = 3.3Vdc
05 = 5.6Vdc
09 = 9Vdc
12 = 12Vdc
14 = 14Vdc
16 = 16Vdc
18 = 18Vdc
22 = 22Vdc
26 = 26Vdc
30 = 30Vdc
31 = 31Vdc
38 = 38Vdc
42 = 42Vdc
45 = 45Vdc
48 = 48Vdc
56 = 56Vdc
60 = 60Vdc
65 = 65Vdc
85 = 85Vdc

D — Energy Rating

X= 0.05J
A= 0.1J
B= 0.2J
C= 0.3J
D= 0.4J
E= 0.5J
F= 0.7J
G= 0.9J
H= 1.2J
J= 1.5-1.6J
K= 0.6J
M= 1.0J
N= 1.1J
P= 2.5-3.7J
R= 1.7J
L= 0.8J
S= 1.9-2.0J
U= 4.0-5.0J
W= 5.1-6.0J
Y= 6.5-12J

400 — Clamping Voltage

100 = 12V
150 = 18V
200 = 22V
250 = 27V
300 = 32V
380 = 38V
390 = 42V
400 = 42V
440 = 44V
490 = 49V
540 = 54V
560 = 60V
570 = 57V
580 = 60V
620 = 67V
650 = 67V
770 = 77V
800 = 80V
900 = 90V
101 = 100V
111 = 110V
121 = 120V
131 = 135V
151 = 150V
161 = 165V

R — Packaging

D = 7" (1000)*
R = 7" (4000 or 2000)*
T = 13" (10,000)*
W = 7" (10,000)**

*Not available for 0402
**Only available for 0402

P — Termination

P = Ni/Sn plated
Z = FLEXITERM®*
*Only available for VC0603 - VC1210

The following series are available with industry proven KYOCERA AVX flexible termination system **FLEXITERM®**:

VC0603, VC0805, VC1206, VC1210

FLEXITERM® is designed to enhance the mechanical flexure and temperature cycling performance provides up to 5mm of flexure without internal cracks.

FLEXITERM®

ELECTRICAL CHARACTERISTICS

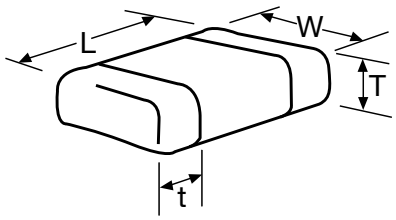
Part Number	V_W (DC)	V_W (AC)	V_B	V_C	I_{VC}	I_L	E_T	I_P	Cap	Freq	Case
	Vdc	Vac	V	V	A	µA	J	A	pF		
VC060303A100	3.3	2.3	5.0±20%	12	1	100	0.1	30	1450	K	0603
VC080503A100	3.3	2.3	5.0±20%	12	1	100	0.1	40	1400	K	0805
VC080503C100	3.3	2.3	5.0±20%	12	1	100	0.3	120	5000	K	0805
VC120603A100	3.3	2.3	5.0±20%	12	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
VG121018J380	18.0	14.0	22±10%	38	2.5	15	1.5	400	2300	K	1210
VC121018J390	18.0	13.0	25.5±10%	42	5	10	1.6	500	3100	K	1210
VG181218P380	18.0	14	22±10%	38	5	15	2.3	800	5000	K	1218
VG181218P440	18.0	14.0	27.5±10%	44	5	15	2.9	800	5000	K	1812
VG222018W380	18.0	14.0	22±10%	38	10	15	5.8	1200	18000	K	2220
VG121022R440	22.0	17.0	27±10%	44	2.5	15	1.7	400	1600	K	1210
VG222022Y440	22.0	17.0	27±10%	44	10	15	7.2	1200	18000	K	2220
VG222022Y490	22.0	17.0	30±10%	49	10	15	6.8	1200	12000	K	2220
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
VG121026S540	26.0	20.0	33±10%	54	2.5	15	1.9	400	1600	K	1210
VG181226P540	26.0	20	35±10%	54	5	15	3	800	3000	K	1812

ELECTRICAL CHARACTERISTICS

Part Number	V_W (DC)	V_W (AC)	V_B	V_C	I_{VC}	I_L	E_T	I_P	Cap	Freq	Case
	Vdc	Vac	V	V	A	µA	J	A	pF		
VG181226P570	26.0	23.0	35.0±10%	57	5	15	2.5	600	3000	K	1812
VG181226P540	26.0	20.0	35.0±10%	54	5	15	3.0	800	3000	K	1812
VG222026Y540	26.0	20.0	33.0±10%	54	10	15	7.8	1200	11000	K	2220
VG222026Y570	26.0	23.0	35.0±10%	57	10	15	6.8	1100	7000	K	2220
VG322026N570	26.0	20.0	33.0±10%	57	10	15	1.1	400	5500	K	3220
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
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
VG121031R650	31.0	25.0	39.0±10%	65	2.5	15	1.7	300	1200	K	1210
VG181231P650	31.0	25.0	39.0±10%	65	5	15	3.7	800	2600	K	1812
VG222031Y650	31.0	25.0	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
VG322038J920	38.0	30.0	47.0±10%	92	10	15	1.5	400	2600	K	3220
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
VG121045S900	45.0	35.0	56.0±10%	90	2.5	15	2	300	800	K	1210
VG181245U900	45.0	35.0	56.0±10%	90	5	15	4.0	500	1200	K	1812
VG222045Y900	45.0	35.0	56.0±10%	90	10	15	12	1000	5000	K	2220
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
VG121056P111	56.0	40.0	68.0±10%	110	2.5	15	2.3	250	500	K	1210
VG181256U111	56.0	40.0	68.0±10%	110	5	15	4.8	500	800	K	1812
VG222056Y111	56.0	40.0	68.0±10%	110	10	15	9	1000	2000	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	82.0±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	600	K	1812
VG222065Y131	65.0	50.0	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
VG222085Y161	85.0	60.0	100±10%	165	10	15	6.8	800	1500	K	2220

V_W (DC) DC Working Voltage (V)
V_W (AC) AC Working Voltage (V)
V_B Typical Breakdown Voltage (V @ $1mA_{DC}$)
V_C Clamping Voltage (V @ I_{VC})
I_{VC} Test Current for V_C (A, 8x20µS)
I_L Maximum Leakage Current at the Working Voltage (µA)

E_T Transient Energy Rating (J, 10x1000µS)
I_P Peak Current Rating (A, 8x20µS)
Cap Typical Capacitance (pF) @ frequency specified and 0.5 V_{RMS}
Freq Frequency at which capacitance is measured (K = 1kHz, M = 1MHz)



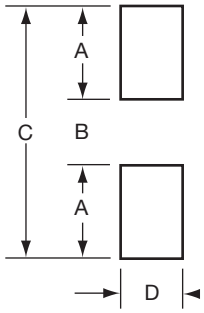
DIMENSIONS:

mm (inches)

Style		0402	0603	0805	1206	1210	1812	2220	3220
(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)	8.20±0.40 (0.323±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)	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) 1.27 (0.050)[1)] 1.70 (0.067)[2)]	1.70 (0.067)	2.00 (0.080)	2.50 (0.098)	2.50 max. (0.098 max.)
(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.)	1.30 max. (0.051 max.)

1) Applicable for: VC120618E380

2) Applicable for: VC120626F540, VC120631M650, VC120638N770, VC120642L800, VC120645K900, VC120656F111, VC120660M131



SOLDERING PAD:

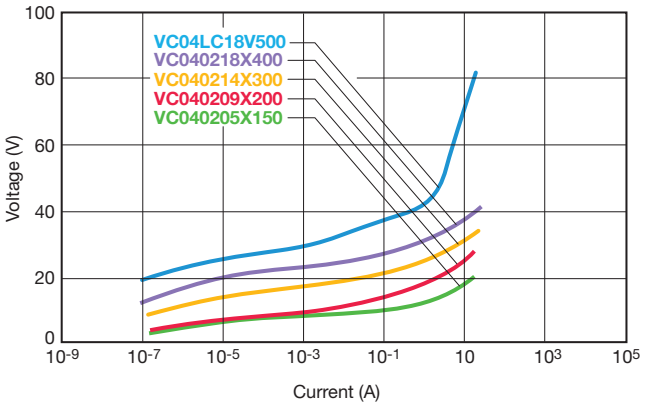
mm (inches)

Pad Layout	0402	0603	0805	1206	1210	1812	2220	3220
A	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)	2.21 (0.087)
B	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)	5.79 (0.228)
C	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)	10.21 (0.402)
D	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)	5.50 (0.217)

TYPICAL PERFORMANCE CURVES (0402 CHIP SIZE)

VOLTAGE/CURRENT CHARACTERISTICS

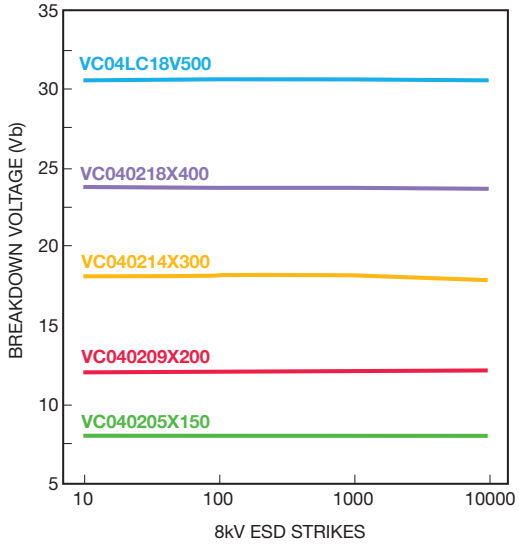
Multilayer construction and improved grain structure result in excellent transient clamping characteristics up to 20 amps peak current, while maintaining very low leakage currents under DC operating conditions. The VI curves below show the voltage/current characteristics for the 5.6V, 9V, 14V, 18V and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



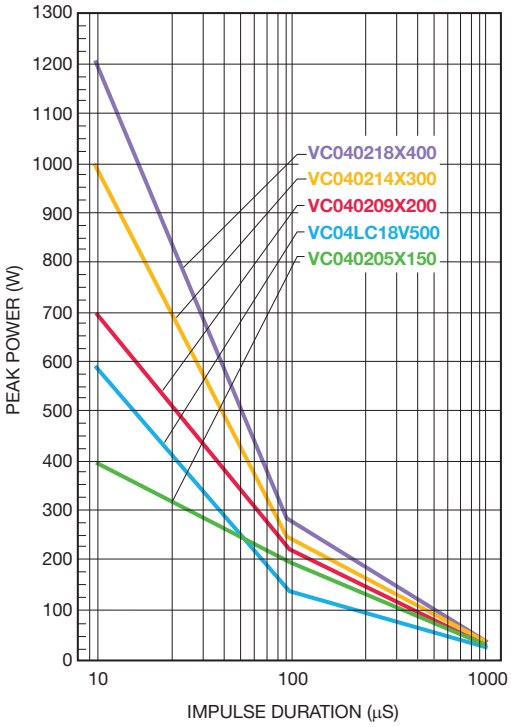
PULSE DEGRADATION

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.

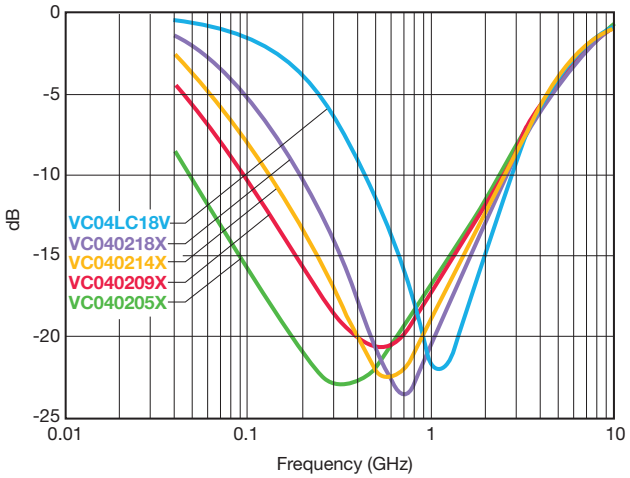
ESD TEST OF 0402 PARTS



PEAK POWER VS PULSE DURATION



INSERTION LOSS CHARACTERISTICS

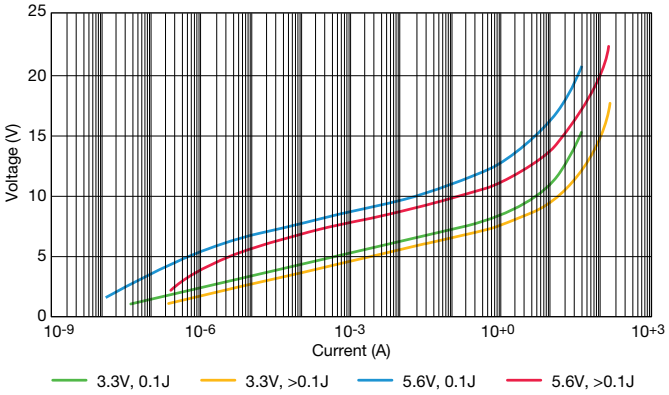


TYPICAL PERFORMANCE CURVES (0603, 0805, 1206 & 1210 CHIP SIZES)

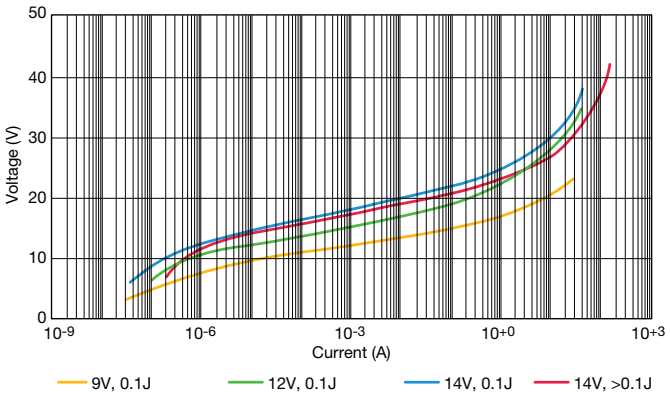
VOLTAGE/CURRENT CHARACTERISTICS

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.

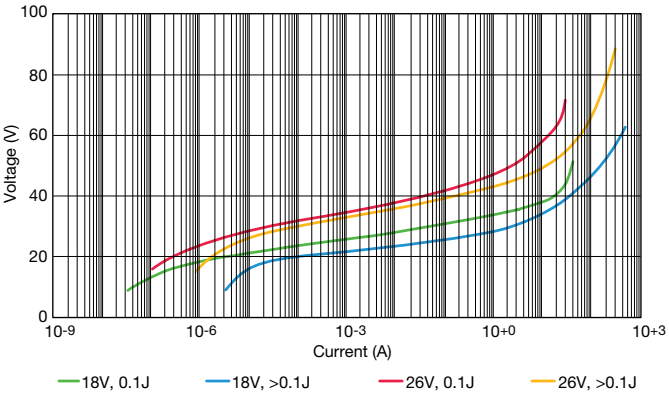
VI Curves - 3.3V and 5.6V Products



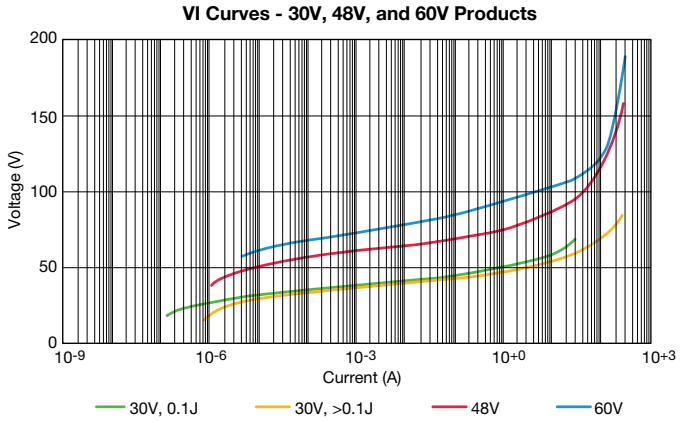
VI Curves - 9V, 12V, and 14V Products



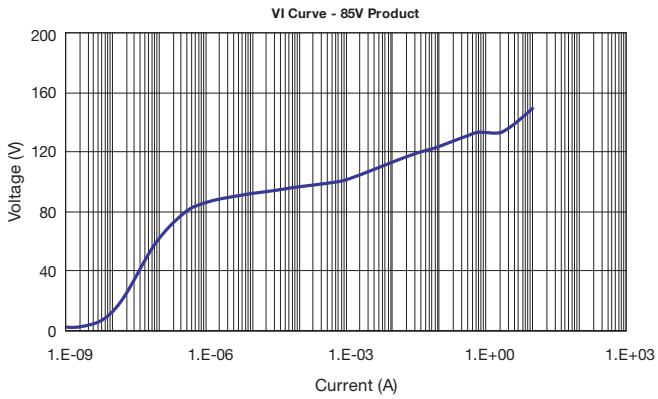
VI Curves - 18V and 26V Products



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

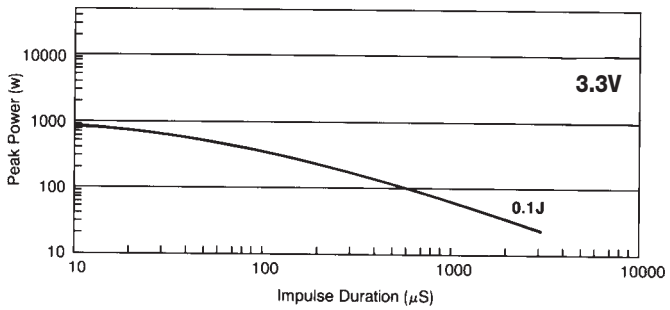


VI Curve - 85V Product

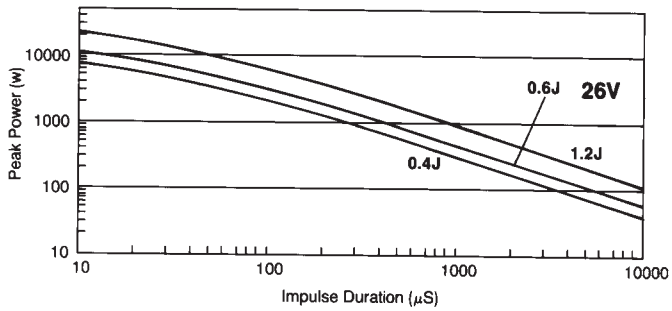


TYPICAL PERFORMANCE CURVES (0603, 0805, 1206 & 1210 CHIP SIZES)

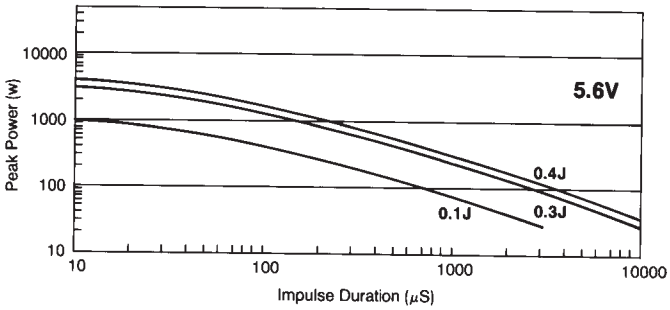
TYPICAL PULSE RATING CURVE
3.3V MULTILAYER TRANSGUARD®



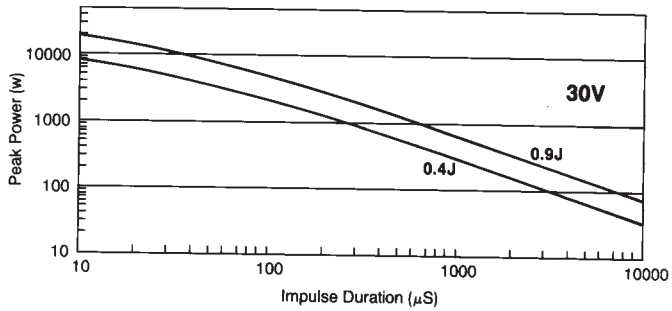
TYPICAL PULSE RATING CURVE
26V MULTILAYER TRANSGUARD®



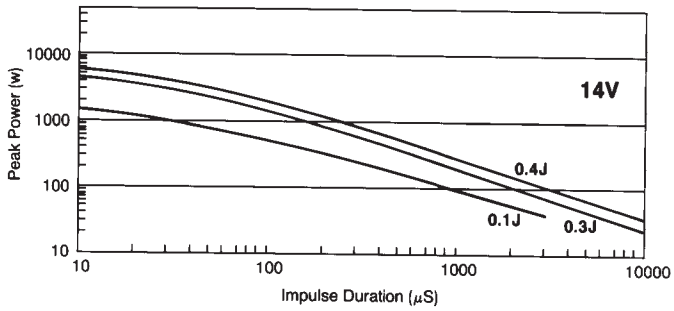
TYPICAL PULSE RATING CURVE
5.6V MULTILAYER TRANSGUARD®



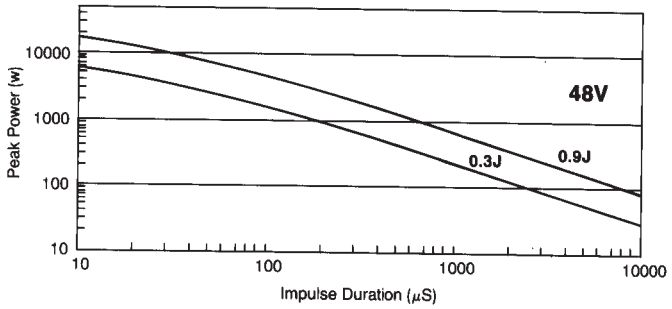
TYPICAL PULSE RATING CURVE
30V MULTILAYER TRANSGUARD®



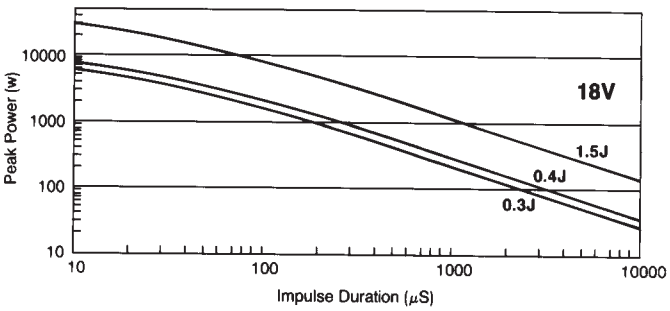
TYPICAL PULSE RATING CURVE
14V MULTILAYER TRANSGUARD®



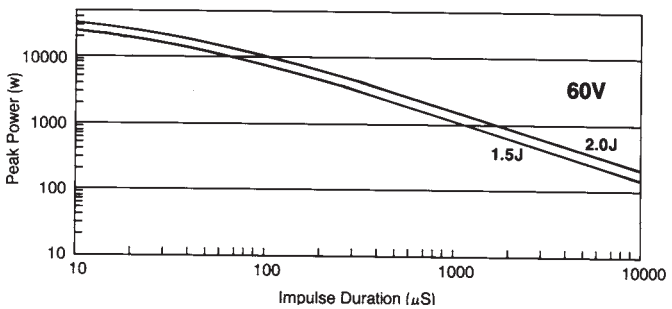
TYPICAL PULSE RATING CURVE
48V MULTILAYER TRANSGUARD®



TYPICAL PULSE RATING CURVE
18V MULTILAYER TRANSGUARD®



TYPICAL PULSE RATING CURVE
60V MULTILAYER TRANSGUARD®

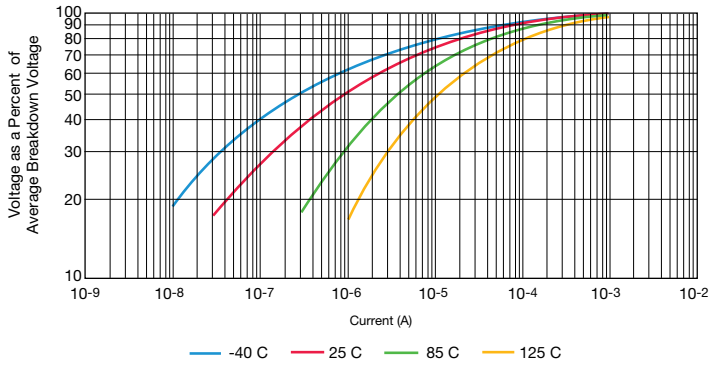


TYPICAL PERFORMANCE CURVES (0603, 0805, 1206 & 1210 CHIP SIZES)

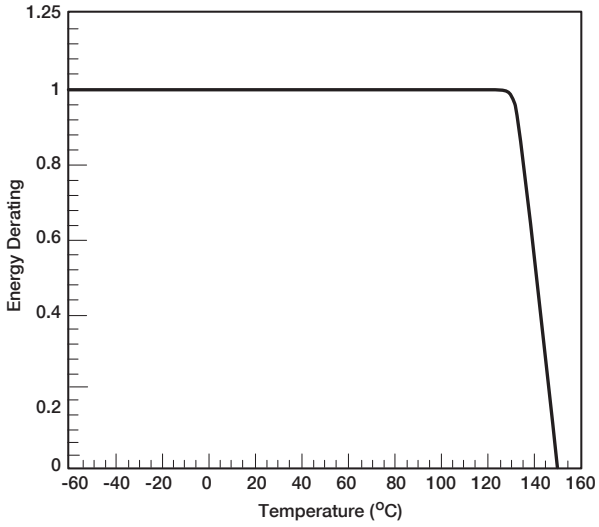
TEMPERATURE CHARACTERISTICS

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.

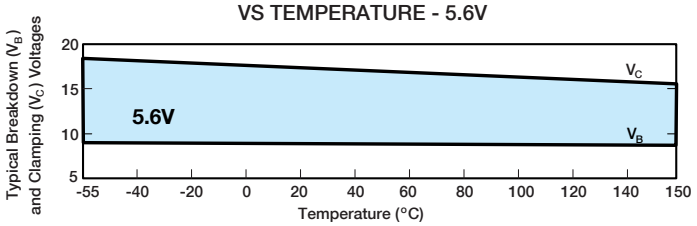
Temperature Dependence of Voltage



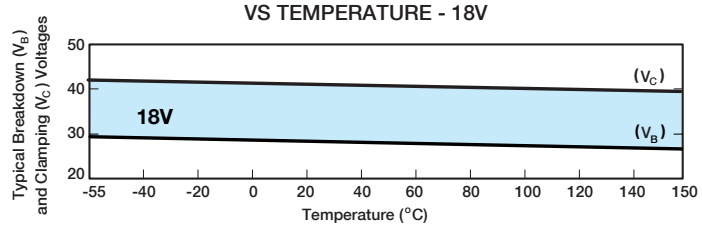
TYPICAL ENERGY DERATING VS TEMPERATURE



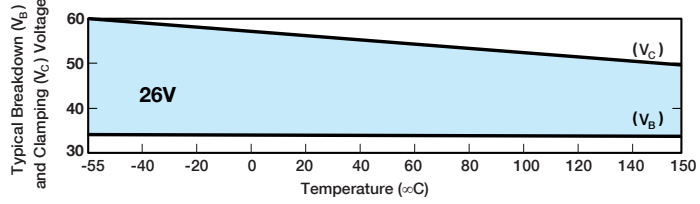
TYPICAL BREAKDOWN AND CLAMPING VOLTAGES VS TEMPERATURE - 5.6V



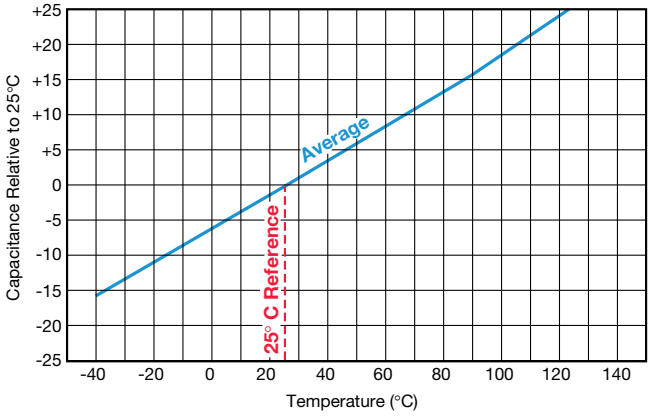
TYPICAL BREAKDOWN AND CLAMPING VOLTAGES VS TEMPERATURE - 18V



TYPICAL BREAKDOWN AND CLAMPING VOLTAGES VS TEMPERATURE - 26V



TYPICAL CAPACITANCE VS TEMPERATURE



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 x 20µS waveforms shows negligible degradation in breakdown voltage and minimal increases in leakage current. The plots of typical breakdown voltage vs number of 150A pulses are shown below.

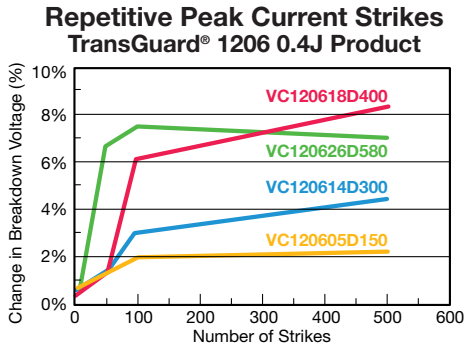


Figure 1

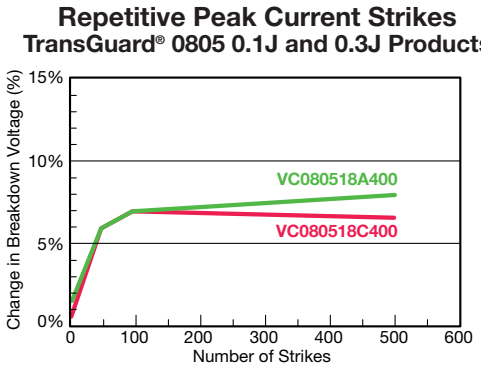


Figure 2

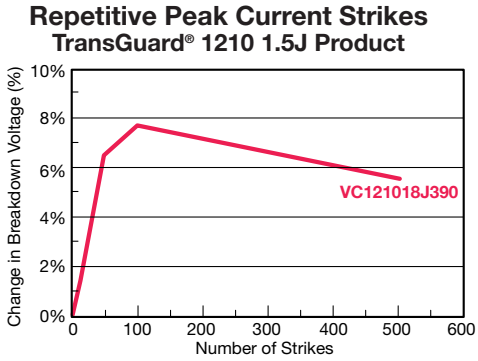


Figure 3

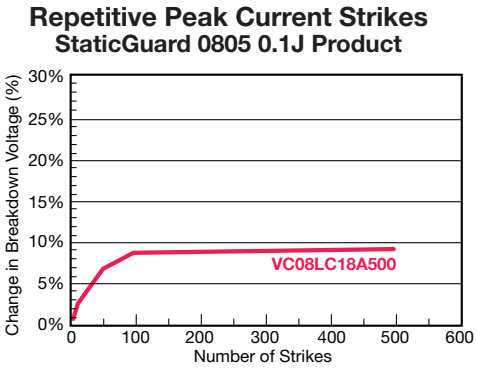
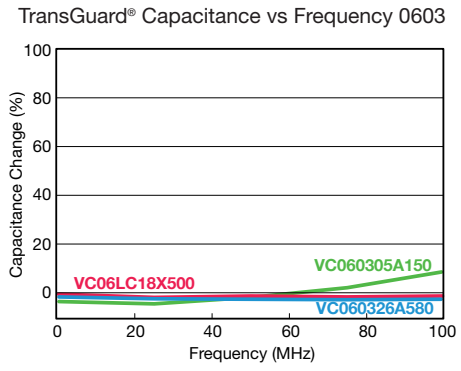
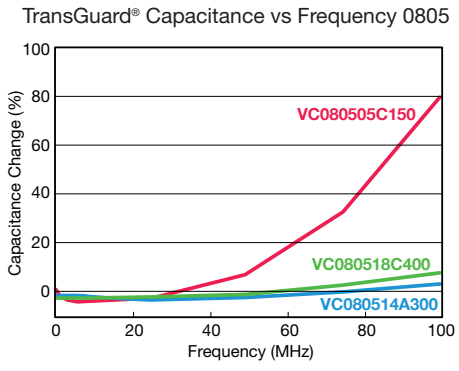
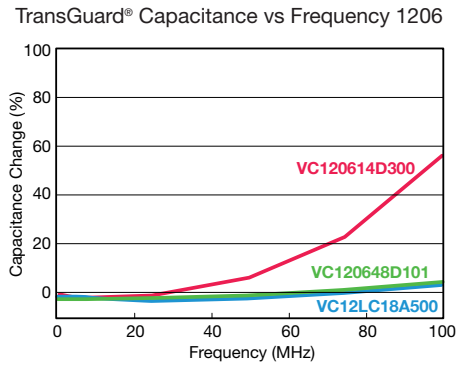


Figure 4

CAPACITANCE/FREQUENCY CHARACTERISTICS







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