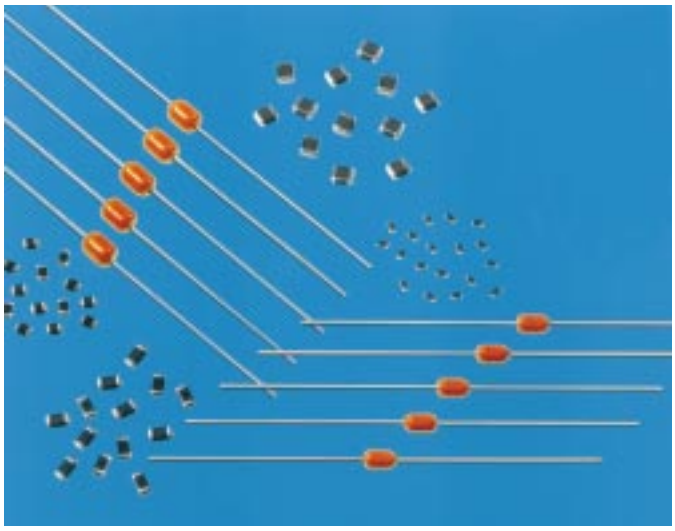
TransGuard®

AVX Multilayer Ceramic Transient Voltage Suppressors

GENERAL DESCRIPTION

The AVX TransGuard® Transient Voltage Suppressors (TVS) with unique high-energy multilayer construction represents state-of-the-art overvoltage circuit protection. Monolithic multilayer construction provides protection from voltage transients caused by ESD, lightning, NEMP, inductive switching, etc. True surface mount product is provided in EIA industry standard packages. Thru-hole components are supplied as conformally coated axial devices.



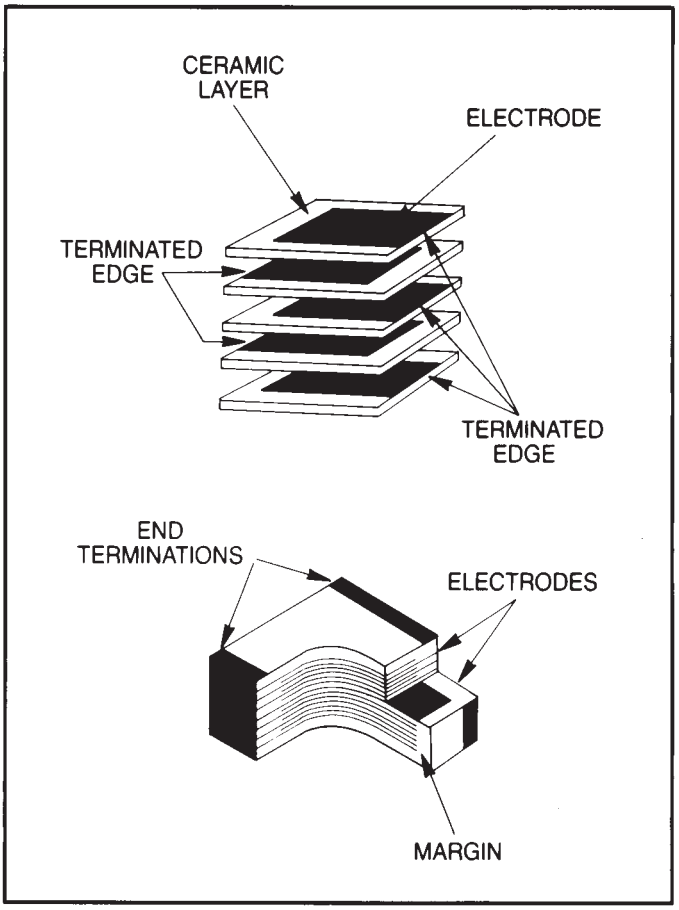
TRANSGUARD® DESCRIPTION

TransGuard® products 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. Devices are fabricated by a ceramic sintering process that yields a structure of conductive ZnO grains surrounded by electrically insulating barriers, creating varistor-like behavior.

The number of grain-boundary interfaces between conducting electrodes determines “Breakdown Voltage” of the device. High voltage applications such as AC line protection require many grains between electrodes while low voltage requires few grains to establish the appropriate breakdown voltage. Single layer ceramic disc processing proved to be a viable production method for thick cross section devices with many grains, but attempts to address low voltage suppression needs by processing single layer ceramic disc formulations with huge grain sites has had limited success.

AVX, the world leader in the manufacture of multilayer ceramic capacitors, now offers the low voltage transient protection marketplace a true multilayer, monolithic surface mount varistor. Technology leadership in processing thin dielectric materials and patented processes for precise ceramic grain growth have yielded superior energy dissipation in the smallest size. Now a varistor has voltage characteristics determined by design and not just cell sorting whatever falls out of the process.

Multilayer ceramic varistors are manufactured by mixing ceramic powder in an organic binder (slurry) and casting it into thin layers of precision thickness. Metal electrodes are deposited onto the green ceramic layers which are then stacked to form a laminated structure. The metal electrodes are arranged so that their terminations alternate from one end of the varistor to the other. The device becomes a monolithic block during the sintering (firing) cycle providing uniform energy dissipation in a small volume.



PART NUMBER IDENTIFICATION

Surface Mount Devices

Important: For part number identification only, not for construction of part numbers.
The information below only defines the numerical value of part number digits, and cannot be used to construct a desired set of electrical limits. Please refer to the TransGuard® part number data (blue section, pages 3-8) for the correct electrical ratings.

V C 1206 05 D 150 R

PACKAGING (Pcs/Reel):

STYLE	"D"	"R"	"T"
VC0402	N/A	4,000	10,000
VC0603	1,000	4,000	10,000
VC0805	1,000	4,000	10,000
VC1206	1,000	4,000	10,000
VC1210	1,000	2,000	10,000

CLAMPING VOLTAGE:

Where:

100 =	10.0V	500 =	50.0V
150 =	15.5V	560 =	56.0V
200 =	20.0V	580 =	58.0V
250 =	25.0V	620 =	62.0V
300 =	30.0V	650 =	65.0V
390 =	39.0V	101 =	100.0V
400 =	40.0V	121 =	120.0V

ENERGY:

Where:

A =	0.1J	H =	1.2J
C =	0.3J	J =	1.5J
D =	0.4J	P =	3.0J
F =	0.7J	V =	0.02J
G =	0.9J	X =	0.05J

WORKING VOLTAGE:

Where:

03 =	3.3 VDC	18 =	18.0 VDC
05 =	5.6 VDC	26 =	26.0 VDC
09 =	9.0 VDC	30 =	30.0 VDC
12 =	12.0 VDC	48 =	48.0 VDC
14 =	14.0 VDC	60 =	60.0 VDC

CASE SIZE DESIGNATOR:

SIZE	LENGTH		WIDTH	
0402	1.00±0.10mm	(0.040"±0.004")	0.5±0.10mm	(0.020"±0.004")
0603	1.60±0.15mm	(0.063"±0.006")	0.8±0.15mm	(0.032"±0.006")
0805	2.01±0.2mm	(0.079"±0.008")	1.25±0.2mm	(0.049"±0.008")
1206	3.20±0.2mm	(0.126"±0.008")	1.60±0.2mm	(0.063"±0.008")
1210	3.20±0.2mm	(0.126"±0.008")	2.49±0.2mm	(0.098"±0.008")

CASE STYLE:

C = Chip

PRODUCT DESIGNATOR:

V = Varistor

MARKING:
All standard surface mount TransGuard® chips will **not** be marked. Marked chips will be considered a special; contact factory for minimum order requirement and price adder.

Axial Leaded Devices

Important: For part number identification only, not for construction of part numbers.
The information below only defines the numerical value of part number digits, and cannot be used to construct a desired set of electrical limits. Please refer to the TransGuard® part number data (blue section, page 9) for the correct electrical ratings.

V A 1000 05 D 150 R

PACKAGING (Pcs/Reel):

STYLE	"D"	"R"	"T"
VA1000	1,000	3,000	7,500
VA2000	1,000	2,500	5,000

CLAMPING VOLTAGE:

Where:

100 =	10.0V	580 =	58.0V
150 =	15.5V	650 =	65.0V
300 =	30.0V	101 =	100.0V
400 =	40.0V	121 =	120.0V

ENERGY:

Where:

A =	0.1J
D =	0.4J
K =	2.0J

WORKING VOLTAGE:

Where:

03 =	3.3 VDC	26 =	26.0 VDC
05 =	5.6 VDC	30 =	30.0 VDC
14 =	14.0 VDC	48 =	48.0 VDC
18 =	18.0 VDC	60 =	60.0 VDC

CASE SIZE DESIGNATOR:

SIZE	LENGTH	DIAMETER
1000	4.32mm (0.170")	2.54mm (0.100")
2000	4.83mm (0.190")	3.56mm (0.140")

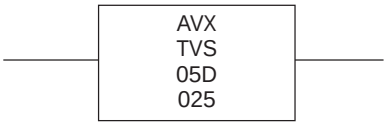
CASE STYLE:

A = Axial

PRODUCT DESIGNATOR:

V = Varistor

MARKING:
All axial TransGuards® are marked with vendor identification, product identification, voltage/energy rating code and date code (see example below):



Where: AVX = Always AVX (Vendor Identification)
TVS = Always TVS (Product Identification - Transient Voltage Suppressor)
05D = Working VDC and Energy Rating (Joules)
Where: 05 = 5.6 VDC, D = 0.4J
025 = Three Digit Date Code
Where: 0 = Last digit of year (2000)
25 = Week of year

TransGuard®

AVX Multilayer Ceramic Transient Voltage Suppressors

VOLTAGES = 5.6, 9, 14 OR 18 VDC
0402 SURFACE MOUNT

Dimensions:

Actual Size:	
Length	1.0 ± 0.10mm (0.040" ± 0.004")
Width	0.5 ± 0.10mm (0.020" ± 0.004")
Thickness	0.6mm Max. (0.024")
Termination Band Width	0.25 ± 0.15mm (0.010" ± 0.006")
Termination Separation	0.3mm Min. (0.012")
Termination Finish	Pt/Pd/Ag

AVX Part Number	Working Voltage	Breakdown Voltage	Clamping Voltage	Peak Current	Transient Energy	Capacitance	Inductance
Symbol	V_{WM}	V_B	V_C	I_{peak}	E_{trans}	C	L
Units	Volts (max.)	Volts	Volts (max.)	Amp (max.)	Joules (max.)	pF (typ.)	nH (typ.)
Test Condition	<50µA	1mA DC	8/20µS†	8/20µs	10/1000µS	0.5Vrms @: 1MHz	di/dt = 100mA/nS
VC040205X150	5.6	7.6 - 9.3	15.5	20	0.05	360	<1.0
VC040209X200	9.0	11.0 - 14.0	20.0	20	0.05	230	<1.0
VC040214X300	14.0	16.5 - 20.3	30.0	20	0.05	120	<1.0
VC040218X400	18.0	22.9 - 28.0	40.0	20	0.05	90	<1.0
VC04LC18V500	See pages 14-15 for specification and performance details.						

V_{WM}—Maximum steady-state DC operating voltage the varistor can maintain and not exceed 50µA leakage current
V_B—Voltage across the device measured at 1mA DC current
V_C—Maximum peak voltage across the varistor measured at a specified pulse current and waveform

†Transient Energy Rating <0.05 Joule — Pulse Current & Waveform 1A 8/20µS

I_{peak}—Maximum peak current which may be applied with the specified waveform without device failure

E_{tran}—Maximum energy which may be dissipated with the specified waveform without device failure

C—Device capacitance measured with zero volt bias 0.5Vrms and 1MHz

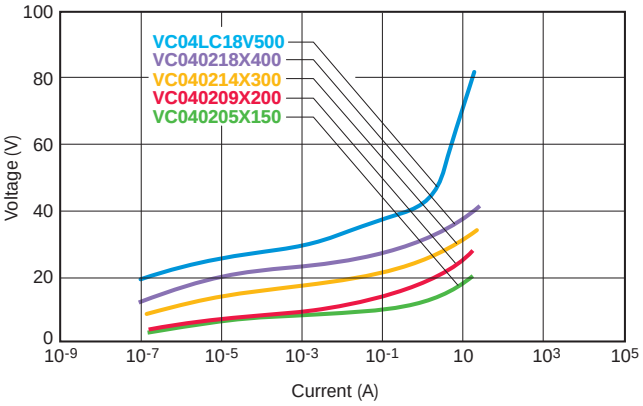
L—Device inductance measured with a current edge rate of 100 mA/nS

Dimensions: Millimeters (Inches)

TYPICAL PERFORMANCE CURVES (0402 CHIP SIZE)

VOLTAGE/CURRENT CHARACTERISTICS

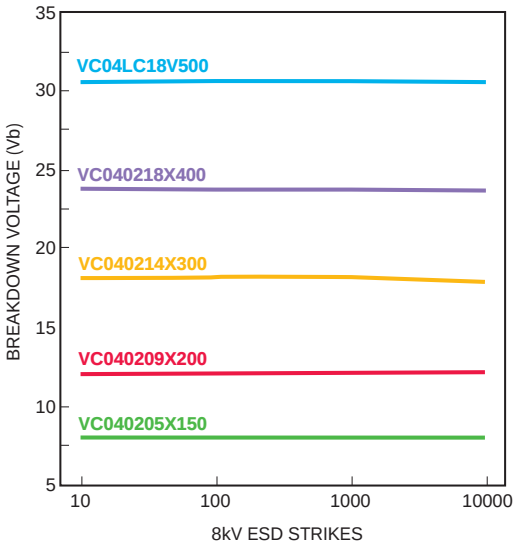
Multilayer construction and improved grain structure result in excellent transient clamping characteristics up to 20 amps peak current, while maintaining very low leakage currents under DC operating conditions. The VI curves below show the voltage/current characteristics for the 5.6V, 9V, 14V, 18V and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



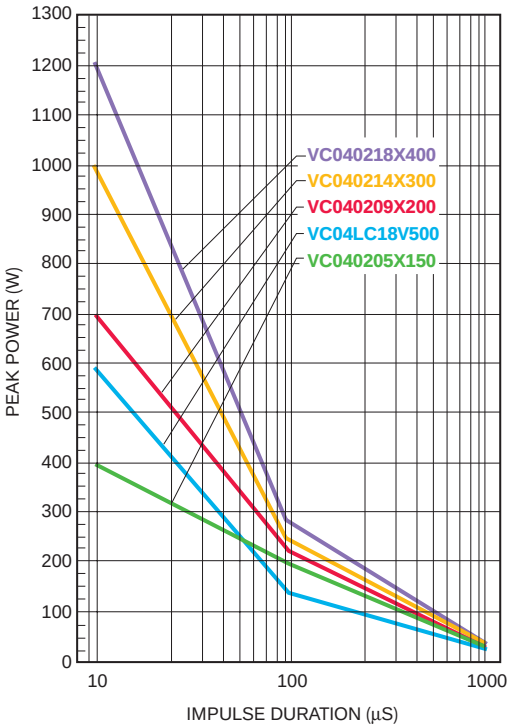
PULSE DEGRADATION

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.

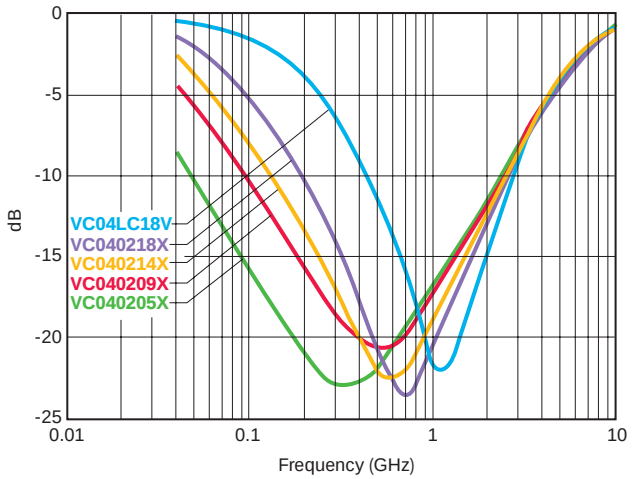
ESD TEST OF 0402 PARTS



PEAK POWER VS PULSE DURATION



INSERTION LOSS CHARACTERISTICS



VOLTAGES = 3.3, 5.6, 9, 14, 18, 26 OR 30 VDC
0603 SURFACE MOUNT

Dimensions:

Actual Size:

Length	1.6 ± 0.15mm (0.063" ± 0.006")
Width	0.50 ± 0.15mm (0.032" ± 0.006")
Thickness	0.9mm Max. (0.035")
Termination Band Width	0.35 ± 0.15mm (0.014" ± 0.006")
Termination Separation	0.7mm Min. (0.028")
Termination Finish	Pt/Pd/Ag

AVX Part Number	Working Voltage	Breakdown Voltage	Clamping Voltage	Peak Current	Transient Energy	Capacitance		Inductance
Symbol	V_{WM}	V_B	V_C	I_{peak}	E_{trans}	C		L
Units	Volts (max.)	Volts	Volts (max.)	Amp (max.)	Joules (max.)	pF (typ.)		nH (typ.)
Test Condition	<50µA	1mA DC	8/20µS†	8/20µs	10/1000µS	0.5Vrms @:		di/dt = 100mA/nS
						1kHz	1 MHz	
VC060303A100	3.3#	4.1 - 6.0	10	30	0.1	1800	1230	<1.0
VC060305A150	5.6	7.6 - 9.3	15.5	30	0.1	1000	825	<1.0
VC060309A200	9.0	11.0 - 15.0	20	30	0.1	650	550	<1.0
VC060314A300	14.0	16.5 - 20.3	30	30	0.1	500	424	<1.0
VC060318A400	18.0	22.9 - 28.0	40	30	0.1	275	225	<1.0
VC060326A580	26.0	31.0 - 38.0	58	30	0.1	200	160	<1.0
VC060330A650	30.0	37.0 - 46.0	65	30	0.1	175	150	<1.0
VC06LC18X500	See pages 14-15 for specification and performance details.							

V_{WM}—Maximum steady-state DC operating voltage the varistor can maintain and not exceed 50µA leakage current
V_B—Voltage across the device measured at 1mA DC current
V_C—Maximum peak voltage across the varistor measured at a specified pulse current and waveform

†Transient Energy Rating 0.1 Joule — Pulse Current & Waveform 2A 8/20µS

I_{peak}—Maximum peak current which may be applied with the specified waveform without device failure

E_{tran}—Maximum energy which may be dissipated with the specified waveform without device failure

C—Device capacitance measured with zero volt bias 0.5Vrms and 1kHz

L—Device inductance measured with a current edge rate of 100 mA/nS

Dimensions: Millimeters (Inches)

#Test condition <100µA

TransGuard®

AVX Multilayer Ceramic Transient Voltage Suppressors

VOLTAGES = 3.3, 5.6, 9, 12, 14, 18, 26 OR 30 VDC
0805 SURFACE MOUNT

Dimensions: **Actual Size:**

Length	2.01 ± 0.2mm (0.079" ± 0.008")
Width	1.25 ± 0.2mm (0.049" ± 0.008")
Thickness	1.02mm Max. (0.040")
Land Length	0.71mm Max. (0.028")
Termination Finish	Pt/Pd/Ag

AVX Part Number	Working Voltage	Breakdown Voltage	Clamping Voltage	Peak Current	Transient Energy	Capacitance		Inductance
Symbol	V_{WM}	V_B	V_C	I_{peak}	E_{trans}	C		L
Units	Volts (max.)	Volts	Volts (max.)	Amp (max.)	Joules (max.)	pF (typ.)		nH (typ.)
Test Condition	<50µA	1mA DC	8/20µS†	8/20µs	10/1000µS	0.5Vrms @:		di/dt = 100mA/nS
						1kHz	1 MHz	
VC080503A100	3.3#	4.1 - 6.0	10	40	0.1	1300	930	<1.5
VC080503C100	3.3#	3.7 - 5.6	10	120	0.3	5500	4000	1.5
VC080505A150	5.6	7.6 - 9.3	15.5	40	0.1	1250	860	<1.5
VC080505C150	5.6	7.1 - 8.7	15.5	120	0.3	3500	2400	1.5
VC080509A200	9	11.0 - 14.0	20	40	0.1	780	585	<1.5
VC080512A250	12	14.0 - 18.3	25	40	0.1	525	400	<1.5
VC080514A300	14	16.5 - 20.3	30	40	0.1	375	280	<1.5
VC080514C300	14	15.9 - 19.4	30	120	0.3	1100	820	1.5
VC080518A400	18*	22.9 - 28.0	40	30	0.1	350	275	<1.5
VC080518C400	18*	22.5 - 27.5	40	100	0.3	650	500	1.5
VC080526A580	26	31.0 - 37.9	58	30	0.1	140	110	<1.5
VC080526C580	26	30.5 - 37.3	58	100	0.3	250	190	1.5
VC080530A650	30	37.0 - 46.0	65	30	0.1	100	80	<1.5
VC08LC18A500	See pages 14-15 for specification and performance details.							

V_{WM}—Maximum steady-state DC operating voltage the varistor can maintain and not exceed 50µA leakage current
V_B—Voltage across the device measured at 1mA DC current
V_C—Maximum peak voltage across the varistor measured at a specified pulse current and waveform

†Transient Energy Rating	Pulse Current & Waveform
0.1 Joule	2A 8/20µS
0.2 - 0.3 Joules	5A 8/20µS

I_{peak}—Maximum peak current which may be applied with the specified waveform without device failure

E_{tran}—Maximum energy which may be dissipated with the specified waveform without device failure

C—Device capacitance measured with zero volt bias 0.5Vrms and 1kHz

L—Device inductance measured with a current edge rate of 100 mA/nS

*Withstands 24.5 VDC for 5 minutes (automotive applications)

Dimensions: Millimeters (Inches)

#Test condition <100µA

TransGuard®

AVX Multilayer Ceramic Transient Voltage Suppressors

VOLTAGES = 3.3, 5.6, 14, 18, 26, 30 OR 48 VDC
1206 SURFACE MOUNT

Dimensions:

Actual Size:

Length	3.20 ± 0.2mm (0.126" ± 0.008")
Width	1.60 ± 0.2mm (0.063" ± 0.008")
Thickness	1.02mm Max. (0.040")
Land Length	0.71mm Max. (0.028")
Termination Finish	Pt/Pd/Ag0

AVX Part Number	Working Voltage	Breakdown Voltage	Clamping Voltage	Peak Current	Transient Energy	Capacitance		Inductance
Symbol	V_{WM}	V_B	V_C	I_{peak}	E_{trans}	C		L
Units	Volts (max.)	Volts	Volts (max.)	Amp (max.)	Joules (max.)	pF (typ.)		nH (typ.)
Test Condition	<50µA	1mA DC	8/20µS†	8/20µs	10/1000µS	0.5Vrms @:		di/dt = 100mA/nS
						1kHz	1 MHz	
VC120603A100	3.3#	4.1 - 6.0	10	40	0.1	2000	1500	<1.7
VC120603D100	3.3#	3.7 - 5.6	10	150	0.4	4700	3800	1.7
VC120605A150	5.6	7.6 - 9.3	15.5	40	0.1	1200	870	<1.7
VC120605D150	5.6	7.1 - 8.7	15.5	150	0.4	3000	2300	1.7
VC120614A300	14	16.5 - 20.3	30	40	0.1	600	500	<1.7
VC120614D300	14	15.9 - 19.4	30	150	0.4	1200	900	1.7
VC120618A400	18*	22.9 - 28.0	40	30	0.1	350	270	<1.7
VC120618D400	18*	22.5 - 27.5	40	150	0.4	800	635	1.7
VC120626D580	26	30.5 - 37.3	58	120	0.4	550	450	1.7
VC120630D650	30	36.0 - 45.0	65	120	0.4	500	400	1.7
VC120648D101	48	56.0 - 68.0	100	100	0.4	225	185	1.7
VC12LC18A500	See pages 14-15 for specification and performance details.							

V_{WM}—Maximum steady-state DC operating voltage the varistor can maintain and not exceed 50µA leakage current
V_B—Voltage across the device measured at 1mA DC current
V_C—Maximum peak voltage across the varistor measured at a specified pulse current and waveform

†Transient Energy Rating	Pulse Current & Waveform
0.1 Joule	2A 8/20µS
≥0.4 Joules	10A 8/20µS

I_{peak}—Maximum peak current which may be applied with the specified waveform without excessive leakage
E_{tran}—Maximum energy which may be dissipated with the specified waveform without device failure
C—Device capacitance measured with zero volt bias 0.5Vrms and 1kHz
L—Device inductance measured with a current edge rate of 100 mA/nS
*Withstands 24.5 VDC for 5 minutes (automotive applications)

Dimensions: Millimeters (Inches)

#Test condition <100µA

TransGuard®

AVX Multilayer Ceramic Transient Voltage Suppressors

VOLTAGES = 18, 26, 30, 48 OR 60 VDC
1210 SURFACE MOUNT

Dimensions: **Actual Size:** 

Length	3.20 ± 0.2mm (0.126" ± 0.008")
Width	2.49 ± 0.2mm (0.098" ± 0.008")
Thickness	1.70mm Max. (0.067")
Land Length	0.71mm Max. (0.028")
Termination Finish	Pt/Pd/Ag

AVX Part Number	Working Voltage	Breakdown Voltage	Clamping Voltage	Peak Current	Transient Energy	Capacitance		Inductance
Symbol	V_{WM}	V_B	V_C	I_{peak}	E_{trans}	C		L
Units	Volts (max.)	Volts	Volts (max.)	Amp (max.)	Joules (max.)	pF (typ.)		nH (typ.)
Test Condition	<50µA	1mA DC	8/20µS†	8/20µs	10/1000µS	0.5Vrms @:		di/dt = 100mA/nS
						1kHz	1 MHz	
VC121018J390	18*	21.5 - 26.5	39	500	1.5	3100	2400	2.0
VC121026H560	26	29.7 - 36.3	56	300	1.2	2150	1675	2.0
VC121030G620	30	35.0 - 43.0	62	220	0.9	1900	1530	2.0
VC121030H620	30	35.0 - 43.0	62	280	1.2	1975	1575	2.0
VC121048G101	48	54.5 - 66.5	100	220	0.9	500	430	2.0
VC121048H101	48	54.5 - 66.5	100	250	1.2	525	450	2.0
VC121060J121	60	67.0 - 83.0	120	250	1.5	450	375	2.0

V_{WM}—Maximum steady-state DC operating voltage the varistor can maintain and not exceed 50µA leakage current
V_B—Voltage across the device measured at 1mA DC current
V_C—Maximum peak voltage across the varistor measured at a specified pulse current and waveform

†Transient Energy Rating ≥0.4 Joules — Pulse Current & Waveform 10A 8/20µS

I_{peak}—Maximum peak current which may be applied with the specified waveform without device failure

E_{tran}—Maximum energy which may be dissipated with the specified waveform without device failure

C—Device capacitance measured with zero volt bias 0.5Vrms and 1kHz

L—Device inductance measured with a current edge rate of 100 mA/nS

*Withstands 24.5 VDC for 5 minutes (automotive applications)

Dimensions: Millimeters (Inches)