TransGuard® Automotive Series

Multilayer Varistors for Automotive Applications

LEAD-FREE

LEAD-FREE COMPATIBLE COMPONENT

RoHS COMPLIANT

GENERAL DESCRIPTION

The TransGuard Automotive Series are zinc oxide (ZnO) based ceramic semiconductor devices with non-linear, bi-directional voltage-current characteristics.

They have the advantage of offering bi-directional overvoltage protection as well as EMI/RFI attenuation in a single SMT package. The Automotive Series high current and high energy handling capability make them well suited for protection against automotive related transients.

AVX VG series parts (large case size, high energy) are glass encapsulated. These parts provide the same high reliability as traditional VC series parts. The glass encapsulation provides also enhanced resistance against harsh environment or process such as acids, salts, chlorite flux.

Operating Temperature: -55ºC to +125ºC

FEATURES

- High Reliability
- High Energy Absorption (Load Dump)
- High Current Handling
- AEC Q200 Qualified
- Bi-Directional protection
- EMI/RFI attenuation
- Multi-strike capability
- Sub 1nS response to ESD strike

APPLICATIONS

- Internal Combustion Engine (ICE) Vehicles
- Hybrid Electric Vehicles (HEV)
- Plug-in Hybrid Electric Vehicles (PHEV)
- Commercial Vehicles
  - CAN, LIN, FLEXRAY based modules
  - Sensors
  - Module load dump protection
  - Motor/inductive load transient suppression

HOW TO ORDER

VC	AS	1206	18	D	400	R	P

Varistor Chip
VC = Varistor Chip
VG = Varistor Glass Encapsulated Chip

Automotive Series

Case Size
0402
0603
0805
1206
1210
1812
2220
3220

Working Voltage

03 = 3.3Vdc	31 = 31Vdc
05 = 5.6Vdc	34 = 34Vdc
09 = 9Vdc	38 = 38Vdc
12 = 12Vdc	42 = 42Vdc
14 = 14Vdc	45 = 45Vdc
16 = 16Vdc	48 = 48Vdc
18 = 18Vdc	56 = 56Vdc
22 = 22Vdc	60 = 60Vdc
26 = 26Vdc	65 = 65Vdc
30 = 30Vdc	85 = 85Vdc

Energy Rating

A = 0.1J	L = 0.8J
B = 0.2J	S = 1.9-2.0J
C = 0.3J	X = 0.05J
D = 0.4J	M = 1J
E = 0.5J	N = 1.1J
F = 0.7J	U = 4.0-5.0J
H = 1.2J	P = 2.5-3.7J
J = 1.5J	Y = 6.5-12J
K = 0.6J	

Clamping Voltage

140 = 14V	570 = 57V
150 = 18V	580 = 60V
220 = 22V	620 = 67V
250 = 27V	650 = 67V
300 = 32V	770 = 77V
380 = 38V	800 = 80V
390 = 42V	900 = 90V
400 = 42V	101 = 100V
440 = 44V	111 = 110V
490 = 49V	131 = 135V
540 = 54V	151 = 150V

Package
D = 7" (1000)*
R = 7" (4000)*
T = 13" (10,000)*
W = 7" (10,000)**
0402 only

*Not available for 0402
**Only available for 0402

Termination
P = Ni/Sn plated

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Multilayer Varistors for Automotive Applications

ELECTRICAL CHARACTERISTICS

AVX PN	V_W (DC)	V_W (AC)	V_B	V_C	I_{VC}	I_L	E_T	E_{LD}	I_P	Cap	Freq	V_{Jump}	$P_{Diss.\ Max}$
	Vdc	Vac	V	V	A	µA	J	J	A	pF	V	W	
VCAS060303A140	3.3	2.3	6.0±20%	14	1	50	0.1	-	30	1450	K	-	0.002
VCAS080503A140	3.3	2.3	6.0±20%	14	1	50	0.1	-	40	1000	K	-	0.002
VCAS080503C140	3.3	2.3	6.0±20%	14	1	50	0.3	-	120	4500	K	-	0.006
VCAS120603A140	3.3	2.3	6.0±20%	14	1	50	0.1	-	40	1500	K	-	0.002
VCAS120603D140	3.3	2.3	6.0±20%	14	1	50	0.4	-	150	4000	K	-	0.009
VCAS040205X150 _ _	5.6	4.0	8.5±20%	18	1	35	0.05	-	20	175	M	-	0.001
VCAS060305A150 _ _	5.6	4.0	8.5±20%	18	1	35	0.1	-	30	750	K	-	0.001
VCAS080505A150 _ _	5.6	4.0	8.5±20%	18	1	35	0.1	-	40	1100	K	-	0.001
VCAS080505C150 _ _	5.6	4.0	8.5±20%	18	1	35	0.3	-	120	3000	K	-	0.005
VCAS120605A150 _ _	5.6	4.0	8.5±20%	18	1	35	0.1	-	40	1200	K	-	0.002
VCAS120605D150 _ _	5.6	4.0	8.5±20%	18	1	35	0.4	-	150	3000	K	-	0.008
VCAS040209X200 _ _	9	6.4	12.7±15%	22	1	25	0.05	-	20	175	M	-	0.001
VCAS060309A200 _ _	9	6.4	12.7±15%	22	1	25	0.1	-	30	550	K	-	0.002
VCAS080509A200 _ _	9	6.4	12.7±15%	22	1	25	0.1	-	40	750	K	-	0.002
VCAS080512A250 _ _	12	8.5	16±15%	27	1	25	0.1	-	40	525	K	-	0.002
VCAS040214X300 _ _	14	10	18.5±12%	32	1	15	0.05	-	20	85	K	16	0.001
VCAS060314A300 _ _	14	10	18.5±12%	32	1	15	0.1	-	30	350	K	16	0.002
VCAS080514A300 _ _	14	10	18.5±12%	32	1	15	0.1	-	40	325	K	16	0.002
VCAS080514C300 _ _	14	10	18.5±12%	32	1	15	0.3	-	120	900	K	20	0.006
VCAS120614A300 _ _	14	10	18.5±12%	32	1	15	0.1	-	40	600	K	20	0.002
VCAS120614D300 _ _	14	10	18.5±12%	32	1	15	0.4	-	150	1050	K	20	0.008
VCAS060316B400 _ _	16	11	25.5±10%	42	1	10	0.2	0.25	30	150	K	27.5	0.003
VCAS120616K380 _ _	16	11	25.5±10%	38	1	10	0.6	1.5	200	930	K	27.5	0.010
VCAS121016J390 _ _	16	11	25.5±10%	42	5	10	1.6	3	500	3100	K	27.5	0.030
VGAS121016S390	16	14	24.5±10%	40	2.5	15	2	5	500	3000	K	27.5	0.01
VGAS181216P390	16	11	24.5±10%	40	5	15	2.9	10	1000	7000	K	27.5	0.07
VGAS222016Y390	16	11	24.5±10%	40	10	15	10.2	45	1500	20000	K	27.5	0.08
VGAS181216P400 _ _	16	11	24.5±10%	42	5	10	2.9	10	1000	5000	K	27.5	0.070
VGAS222016Y400	16	11	24.5±10%	42	10	10	7.2	25	1500	13000	K	25.5	0.100
VCAS040218X400 _ _	18	13	25.5±10%	42	1	10	0.05	0.05	20	65	M	27.5	0.001
VCAS060318A400 _ _	18	13	25.5±10%	42	1	10	0.1	0.25	30	150	K	27.5	0.003
VCAS080518A400 _ _	18	13	25.5±10%	42	1	10	0.1	0.1	30	225	K	27.5	0.002
VCAS080518C400 _ _	18	13	25.5±10%	42	1	10	0.3	1	120	550	K	27.5	0.007
VCAS120618A400 _ _	18	13	25.5±10%	42	1	10	0.1	0.5	30	350	K	27.5	0.002
VCAS120618D400 _ _	18	13	25.5±10%	42	1	10	0.4	1.5	150	900	K	27.5	0.008
VCAS120618E380 _ _	18	13	25.5±10%	38	1	10	0.5	1.5	200	930	K	27.5	0.010
VCAS121018J390 _ _	18	13	25.5±10%	42	5	10	1.6	3	500	3100	K	27.5	0.030
VGAS181218P440	18	14	27.5±10%	44	5	15	2.9	6	800	5000	K	27.5	0.05
VGAS222022Y490	22	17	30±10%	49	10	15	6.8	25	1200	12000	K	27.5	0.03
VCAS060326A580 _ _	26	18	34.5±10%	60	1	10	0.1	0.1	30	155	K	27.5	0.002
VCAS080526A580 _ _	26	18	34.5±10%	60	1	10	0.1	0.15	30	120	K	27.5	0.002
VCAS080526C580 _ _	26	18	34.5±10%	60	1	10	0.3	0.5	100	250	K	27.5	0.006
VCAS120626D580 _ _	26	18	34.5±10%	60	1	10	0.4	1	120	500	K	27.5	0.008
VCAS120626F540 _ _	26	18	33.0±10%	54	1	15	0.7	1.5	200	600	K	27.5	0.008
VCAS121026H560 _ _	26	18	34.5±10%	60	5	10	1.2	3	300	2150	K	27.5	0.018
VGAS181226P570	26	23	35.0±10%	57	5	15	2.5	8	600	3000	K	30	0.015
VGAS222026Y570	26	23	35±10%	57	10	15	6.8	25	1100	7000	K	30	0.030
VGAS322026Z570	26	23	35±10%	57	10	15	13	50	1800	15000	K	30	0.04
VCAS060330A650 _ _	30	21	41.0±10%	67	1	10	0.1	0.15	30	125	K	29	0.002
VCAS080530A650 _ _	30	21	41.0±10%	67	1	10	0.1	0.15	30	90	M	29	0.002
VCAS080530C650 _ _	30	21	41.0±10%	67	1	10	0.3	0.5	80	250	K	29	0.005
VCAS120630D650 _ _	30	21	41.0±10%	67	1	10	0.4	1	120	400	K	29	0.008
VCAS121030H620 _ _	30	21	41.0±10%	67	5	10	1.2	3	280	1850	K	30	0.018
VCAS121030S620 _ _	30	21	41.0±10%	67	5	10	1.9	3	300	1500	K	29	0.038
VCAS080531C650 _ _	31	25	39.0±10%	65	1	10	0.3	0.5	80	250	K	29	0.005
VCAS120631M650 _ _	31	25	39.0±10%	65	1	15	1	1.5	200	500	K	29	0.008
VGAS121031R650	31	25	39±10%	65	2.5	15	1.7	4.5	300	1200	K	30	0.05
VGAS181231P650	31	25	39.0±10%	65	5	15	3.7	8	800	2600	K	30	0.06
VGAS222031Y650	31	25	39±10%	65	10	15	9.6	23	1200	6100	K	30	0.03
VCAS120634N770 _ _	34	30	47.0±10%	77	1	15	1.1	1.5	200	400	K	48	0.008
VGAS121034S770 _ _	34	30	47.0±10%	77	2.5	15	2	3.0	400	1000	K	48	0.040
VGAS181234U770 _ _	34	30	47.0±10%	77	5	15	5	6.1	800	1500	K	48	0.080
VGAS222034Y770	34	30	47.0±10%	77	10	15	12	25	2000	6300	K	48	0.240
VCAS080538C770 _ _	38	30	47.0±10%	77	1	10	0.3	-	80	200	K	48	0.006
VCAS120642L800 _ _	42	32	51.0±10%	80	1	15	0.8	-	180	600	K	48	0.016

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ELECTRICAL CHARACTERISTICS

AVX PN	V_W (DC)	V_W (AC)	V_B	V_C	I_{VC}	I_L	E_T	E_{LD}	I_P	Cap	Freq	V_{Jump}	$P_{Diss.\ Max}$
	Vdc	Vac	V	V	A	µA	J	J	A	pF	V	W	
VCAS120642K900	42	32	56±10%	90	1	15	0.6		200	260	K	48	0.012
VGAS181242U900	42	35	56.0±10%	90	5	15	4.0	6	500	1200	K	48	0.015
VGAS222042Y900	42	37	56±10%	90	10	15	12	24	1000	5000	K	48	0.06
VCAS120645K900	45	35	56±10%	90	1	25	0.6		200	260	K	48	0.012N
VCAS120648D101 _ _	48	34	62.0±10%	100	1	10	0.4	-	100	225	K	48	0.008
VCAS121048H101 _ _	48	34	62.0±10%	100	1	10	1.2	-	250	500	K	48	0.022
VCAS120656F111 _ _	56	40	68.0±10%	110	1	15	0.7	-	100	180	K	48	0.014
VGAS181256U111	56	40	68±10%	110	5	15	4.8	-	500	1100	K	48	0.04
VCAS120660M131 _ _	60	50	82.0±10%	135	1	15	1	-	150	250	K	48	0.008
VCAS121060J121	60	42	76±10%	120	5	10	1.5		250	400	K	48	0.03
VGAS121065P131	65	50	82±10%	135	2.5	15	2.7		350	600	K	48	0.05
VGAS181265U131	65	50	82±10%	135	5	15	4.5	-	400	800	K	48	0.03
VGAS222065Y131	65	50	82±10%	135	10	15	6.5	-	1100	3000	K	48	0.06
VCAS121085S151 _ _	85	60	100.0±10%	150	1	35	2	-	250	275	K	48	0.040
VGAS181285U161	85	60	100±10%	165	5	15	4.5	-	400	500	K	48	0.04

V_W(DC) DC Working Voltage [V]
V_W(AC) AC Working Voltage [V]
V_B Typical Breakdown Votage [V @ 1mA$_{DC}$]
V_C Clamping Voltage [V @ I_M]
I_{VC} Test Current for V_C
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 0.5V_{RMS}
V_{Jump} Jump Start (V)
P. Power Dissipation (W)

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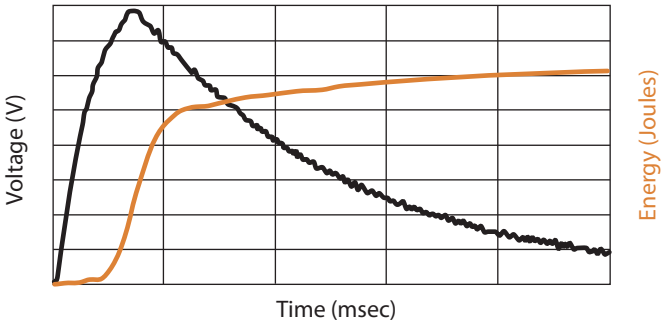
AUTOMOTIVE SERIES – LOAD DUMP TEST

According to ISO DP7637 rev 2 Pulse 5

Automotive Load Dump Pulse (According to ISO 7637 Pulse 5)



When using the test method indicated below, the amount of Energy dissipated by the varistor must not exceed the Load Dump Energy value specified in the product table.

LOAD DUMP LIBRARY

Typical max Vz versus Pulse duration and Ri

12V SYSTEMS

VCAS060316B400	0.5Ω	1Ω	4Ω
100ms	37	38	42
200ms	36	37	41
400ms	35	36	39
VCAS120616K380	0.5Ω	1Ω	4Ω
100ms	42	45	55
200ms	40	43	50
400ms	39	40	45
VCAS121016J390	0.5Ω	1Ω	4Ω
100ms	48	53	74
200ms	46	50	64
400ms	43	46	56
VGAS181216P400	0.5Ω	1Ω	4Ω
100ms	46	52	72
200ms	37	41	59
400ms	32	35	51
VGAS222016Y400	0.5Ω	1Ω	4Ω
100ms	53	60	77
200ms	50	55	73
400ms	47	50	66
VCAS040218X400	0.5Ω	1Ω	4Ω
100ms	38	39	40
200ms	37	37	38
400ms	34	35	36
VCAS060318A400	0.5Ω	1Ω	4Ω
100ms	37	38	42
200ms	36	37	41
400ms	35	36	39
VCAS080518A400	0.5Ω	1Ω	4Ω
100ms	37	39	40
200ms	35	38	39
400ms	33	37	38
VCAS080518C400	0.5Ω	1Ω	4Ω
100ms	40	41	48
200ms	39	40	45
400ms	38	39	42
VCAS120618A400	0.5Ω	1Ω	4Ω
100ms	43	45	55
200ms	41	43	48
400ms	40	41	45
VCAS120618D400	0.5Ω	1Ω	4Ω
100ms	42	45	55
200ms	40	42	50
400ms	39	40	45
VCAS120618E380	0.5Ω	1Ω	4Ω
100ms	42	45	55
200ms	40	43	50
400ms	39	40	45
VCAS121018J390	0.5Ω	1Ω	4Ω
100ms	48	53	74
200ms	46	50	64
400ms	43	46	56

24V SYSTEMS

VCAS060326A580	1Ω	4Ω	8Ω
100ms	51	56	58
200ms	50	54	56
400ms	49	51	53
VCAS080526A580	1Ω	4Ω	8Ω
100ms	51	53	59
200ms	49	51	57
400ms	48	50	51
VCAS080526C580	1Ω	4Ω	8Ω
100ms	51	54	62
200ms	49	51	56
400ms	48	49	51
VCAS120626D580	1Ω	4Ω	8Ω
100ms	52	60	68
200ms	50	57	65
400ms	47	54	61
VCAS121026H560	1Ω	4Ω	8Ω
100ms	61	74	91
200ms	59	69	82
400ms	55	64	70
VCAS060330A650	1Ω	4Ω	8Ω
100ms	57	59	63
200ms	56	58	61
400ms	54	57	58
VCAS080530A650	1Ω	4Ω	8Ω
100ms	58	62	66
200ms	56	61	64
400ms	53	57	61
VCAS080530C650	1Ω	4Ω	8Ω
100ms	58	61	63
200ms	57	58	62
400ms	55	56	59
VCAS120630D650	1Ω	4Ω	8Ω
100ms	61	70	75
200ms	57	66	69
400ms	56	62	64
VCAS121030H620	1Ω	4Ω	8Ω
100ms	70	77	98
200ms	64	70	89
400ms	56	65	70
VGAS181234U770	1Ω	4Ω	8Ω
100ms	87	110	125
200ms	82	97	114
400ms	75	85	95
VGAS222034Y770	1Ω	4Ω	8Ω
100ms	100	125	165
200ms	91	115	155
400ms	84	104	120

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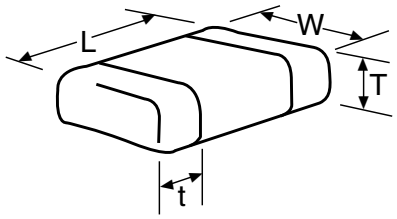
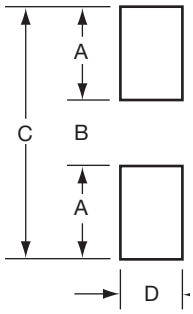


DIMENSIONS: mm (inches)

AVX 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: VCAS120618E380

2) Applicable for: VCAS120626F540, VCAS120631M650, VCAS120638N770, VCAS120642L800, VCAS120645K900, VCAS120656F111, VCAS120660M131

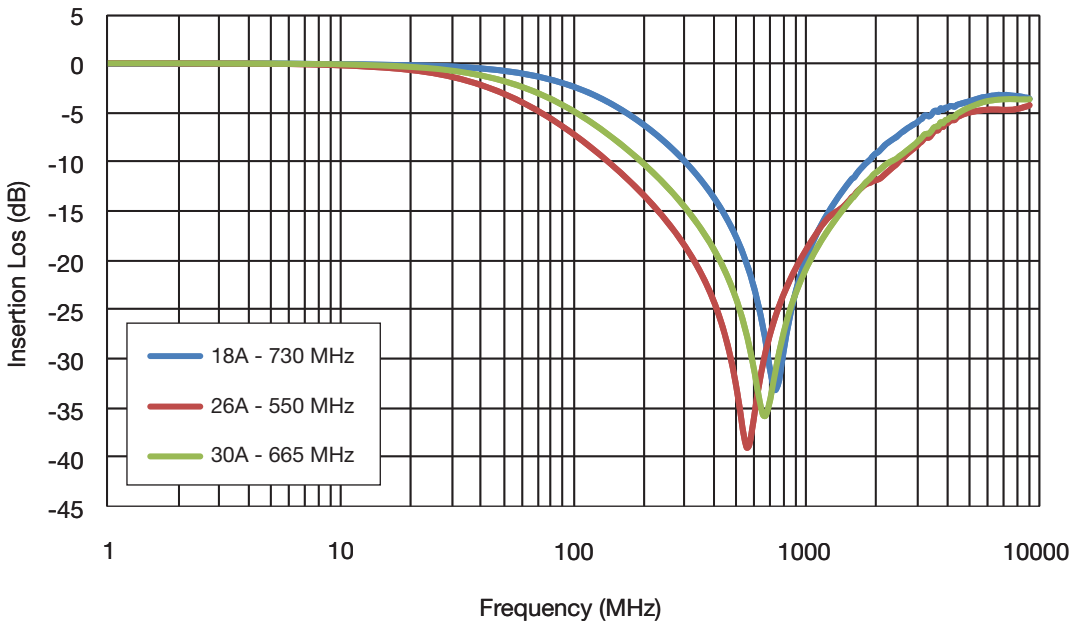


SOLDERING PAD: mm (inches)

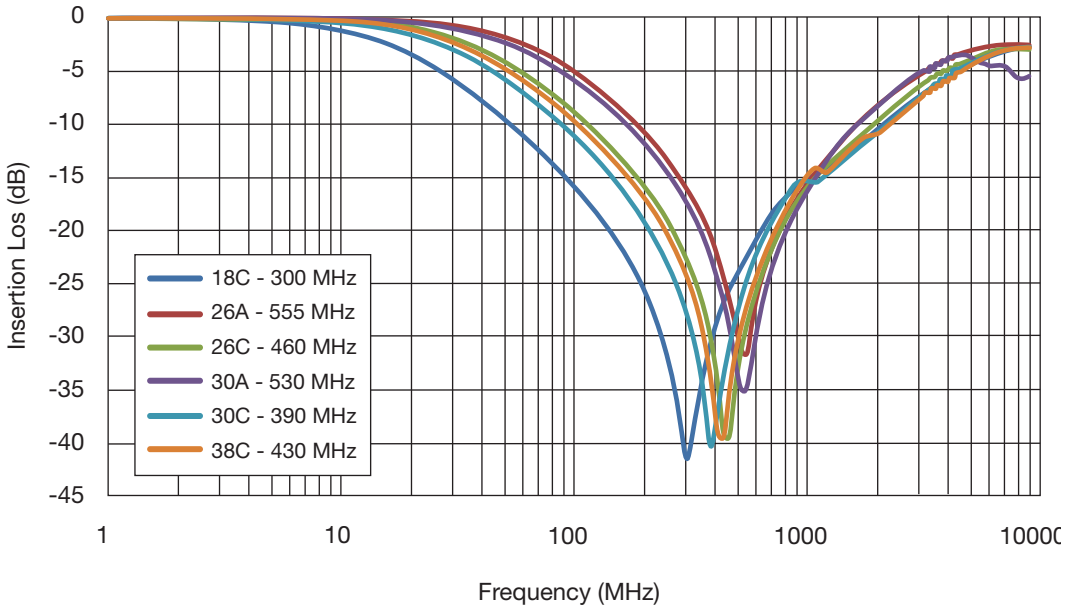
Pad Layout	0402	0603	0805	1206	1210	1812	2220	3220
A	1.61 (0.024)	0.89 (0.035)	1.02 (0.040)	1.02 (0.040)	1.02 (0.040)	1.00 (0.039)	1.00 (0.039)	2.21 (0.087)
B	1.51 (0.020)	0.76 (0.030)	1.02 (0.040)	2.03 (0.080)	2.03 (0.080)	3.60 (0.142)	4.60 (0.18)	5.79 (0.228)
C	1.70 (0.067)	2.54 (0.100)	3.05 (0.120)	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)

FORWARD TRANSMISSION CHARACTERISTICS (S21)

0603 Case Size

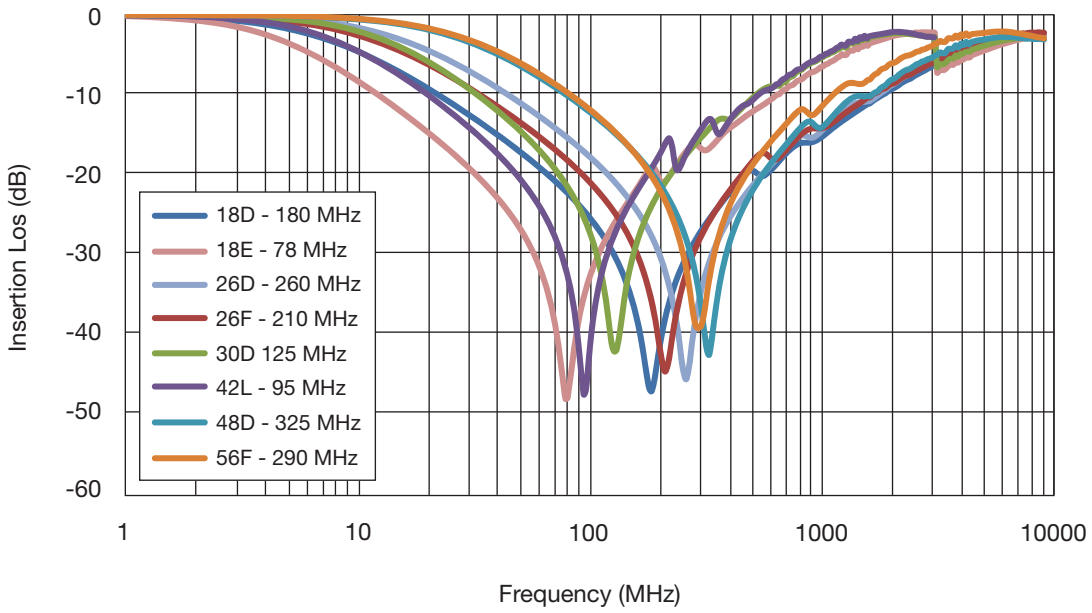


0805 Case Size

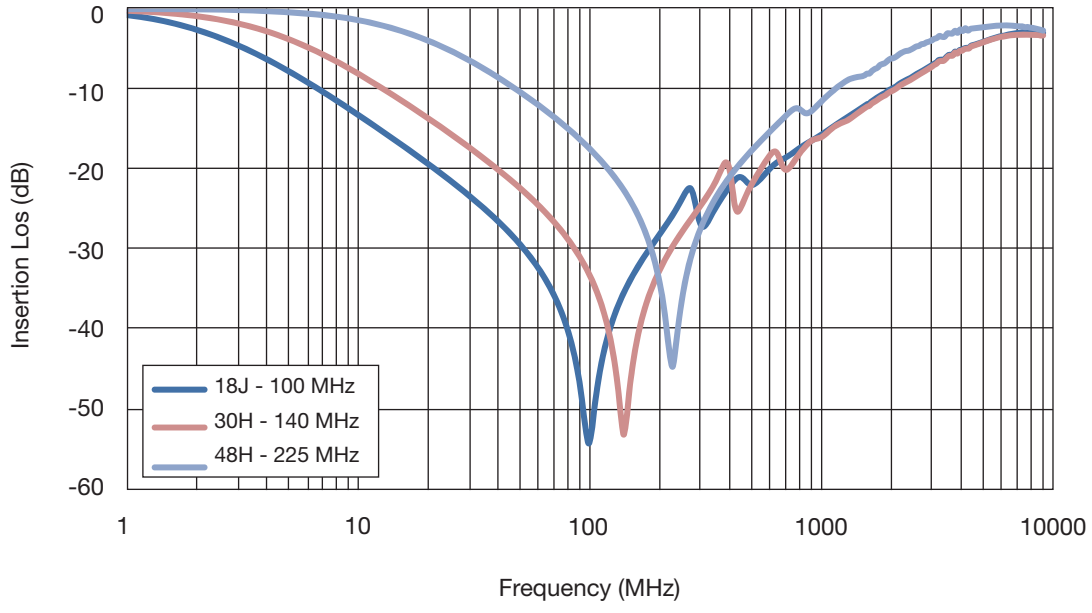


FORWARD TRANSMISSION CHARACTERISTICS (S21)

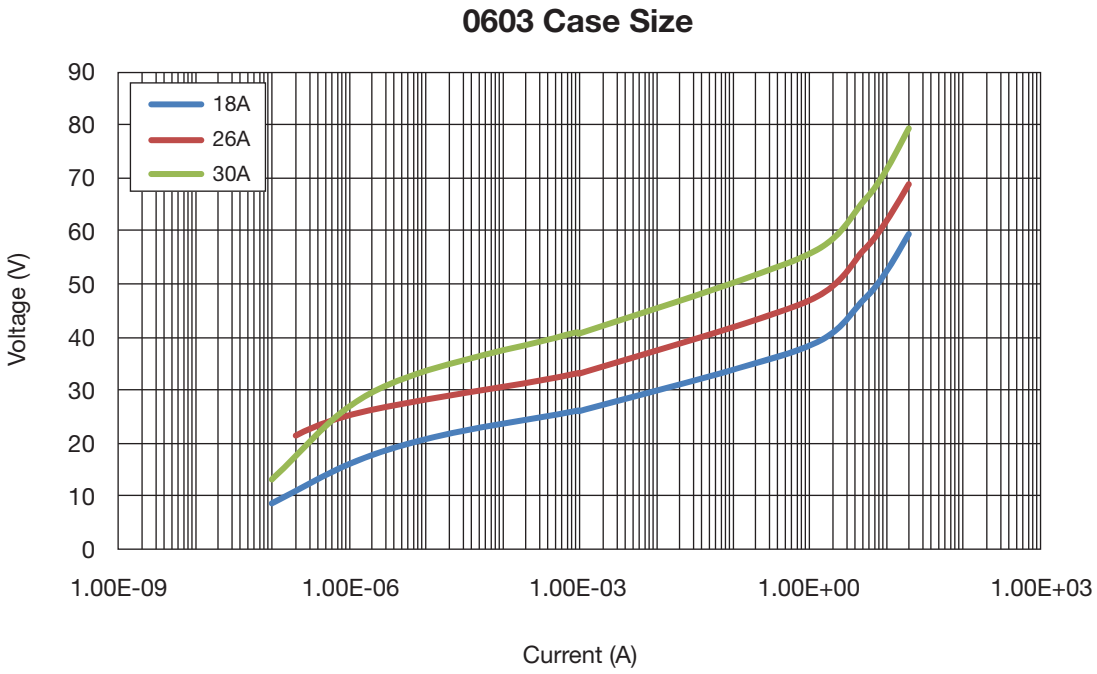
1206 Case Size

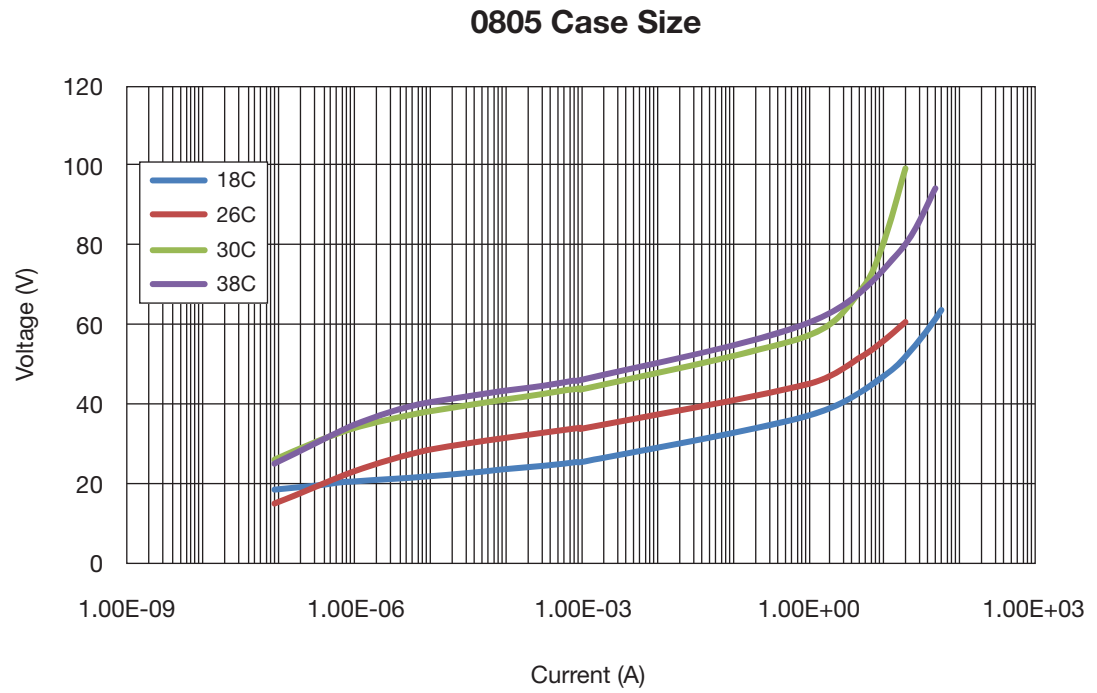


1210 Case Size



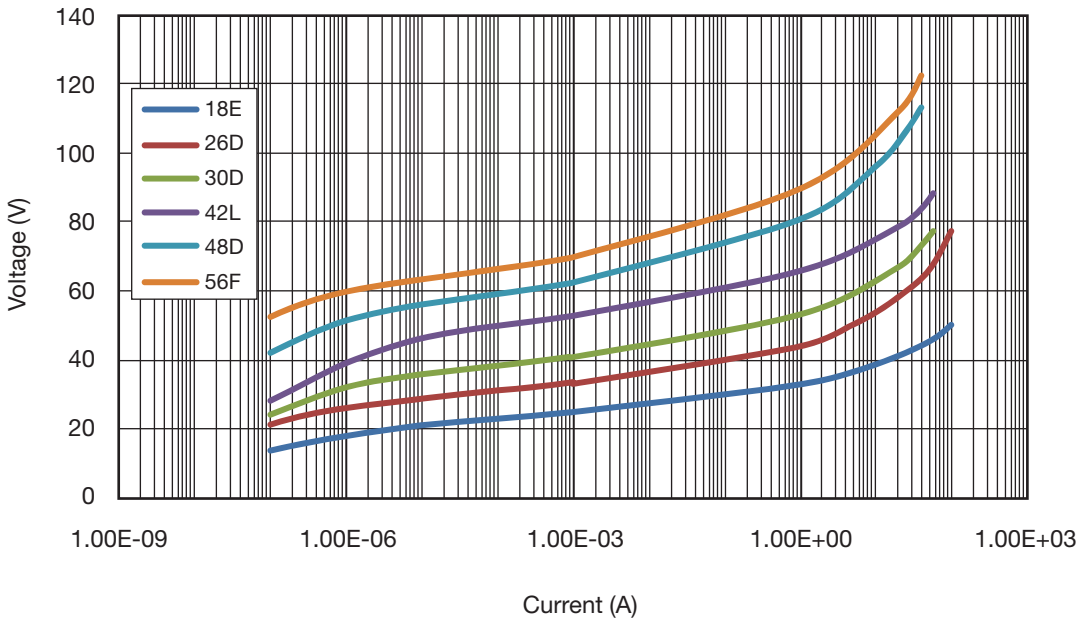
V-I CHARACTERISTICS



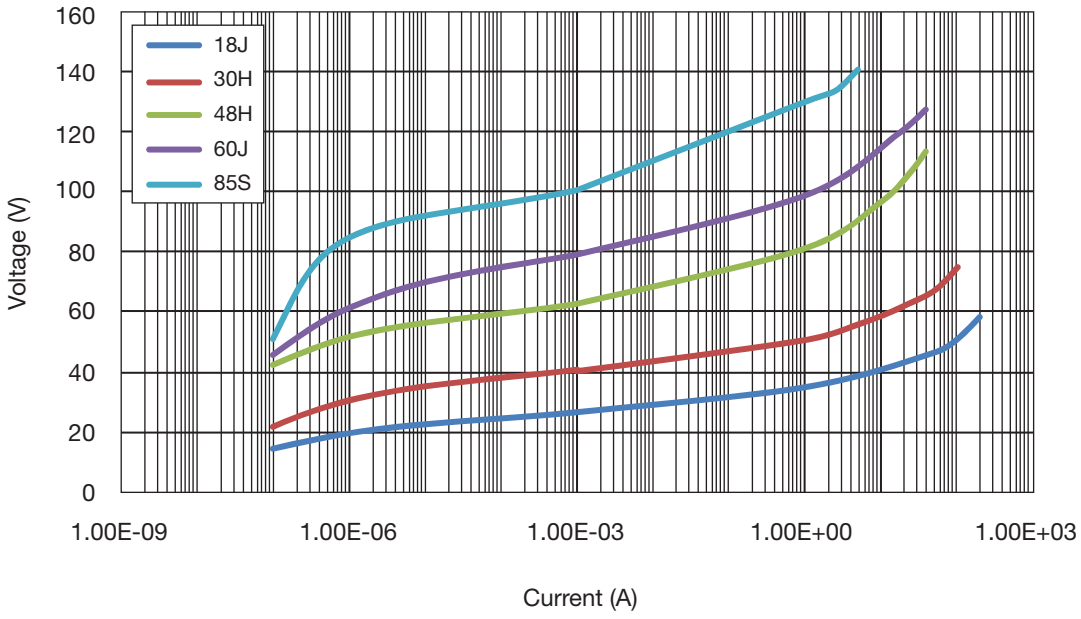


V-I CHARACTERISTICS

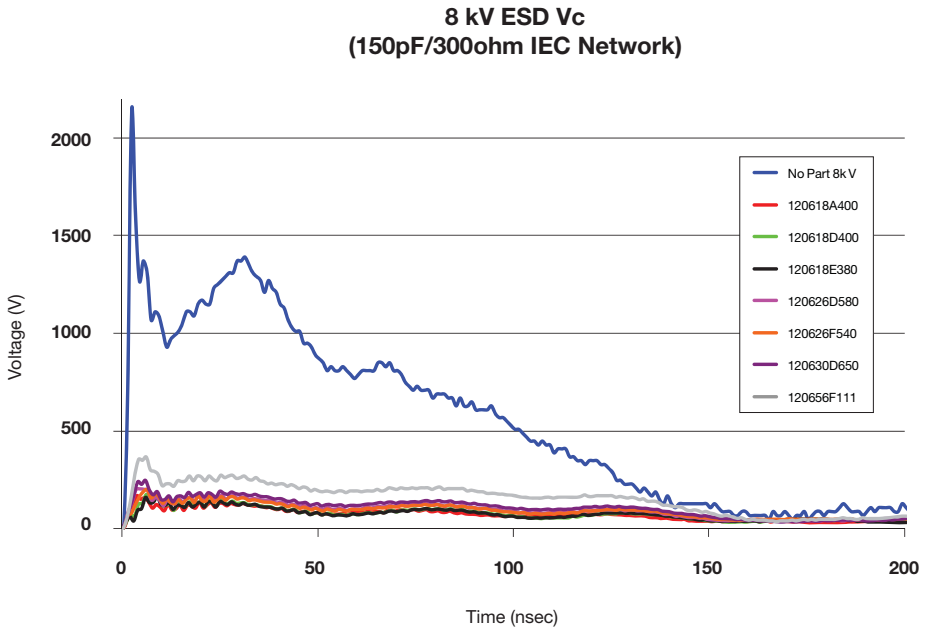
1206 Case Size



1210 Case Size



ESD V-I CHARACTERISTICS



TYPICAL VOLTAGE AT 8 KV PULSE

8kV Pulse	Peak Voltage (V)	30ns Voltage (V)	100ns Voltage (V)
No Part (No Suppression)	2130	1370	517
120618A400	171	123	65
120618D400	177	133	66
120618E380	161	121	63
120626D580	203	155	88
102626F540	201	159	84
120630D650	249	177	106
120656F111	366	262	169