

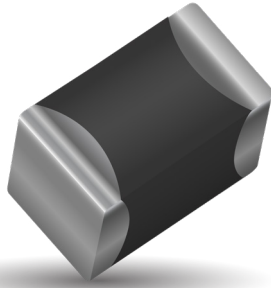


**THE DATASHEET OF
VCAS060330A650RP**



TransGuard® Automotive Series

Multilayer Varistors for Automotive Applications



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.

KYOCERA 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: -55°C to +125°C

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
- ISO 7637-2:2004
- JASO D001 1994

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	Automotive Series	Case Size	Working Voltage	Energy Rating	Clamping Voltage	Package	Termination			
VC = Varistor Chip VG = Varistor Glass Encapsulated Chip		0402 0603 0805 1206 1210 1812 2220 3220	03 = 3.3Vdc 05 = 5.6Vdc 09 = 9Vdc 12 = 12Vdc 14 = 14Vdc 16 = 16Vdc 18 = 18Vdc 22 = 22Vdc 26 = 26Vdc 30 = 30Vdc	31 = 31Vdc 34 = 34Vdc 38 = 38Vdc 42 = 42Vdc 45 = 45Vdc 48 = 48Vdc 56 = 56Vdc 60 = 60Vdc 65 = 65Vdc 85 = 85Vdc	A = 0.1J B = 0.2J C = 0.3J D = 0.4J E = 0.5J F = 0.7J H = 1.2J J = 1.5J K = 0.6J L = 0.8J	S = 1.9-2.0J X = 0.05J M = 1J N = 1.1J U = 4.0-5.0J P = 2.5-3.7J Y = 6.5-12J Z = 13J	140 = 14V 150 = 18V 220 = 22V 250 = 27V 300 = 32V 380 = 38V 390 = 42V 400 = 42V 440 = 44V 490 = 49V 540 = 54V 570 = 57V	580 = 60V 620 = 67V 650 = 67V 770 = 77V 800 = 80V 900 = 90V 101 = 100V 111 = 110V 131 = 135V 151 = 150V	D = 7" (1000)* R = 7" (4000)* T = 13" (10,000)* W = 7" (10,000)** 0402 only *Not available for 0402 **Only available for 0402	P = Ni/Sn plated Z = FLEXITERM®* *Only available for 0603-1210 case

TransGuard® Automotive Series

Multilayer Varistors for Automotive Applications



ELECTRICAL CHARACTERISTICS

Part Number	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	8.5±20%	18	1	35	0.05	-	20	175	M	-	0.001
VCAS060305A150 __	5.6	4	8.5±20%	18	1	35	0.1	-	30	750	K	-	0.001
VCAS080505A150 __	5.6	4	8.5±20%	18	1	35	0.1	-	40	1100	K	-	0.001
VCAS080505C150 __	5.6	4	8.5±20%	18	1	35	0.3	-	120	3000	K	-	0.005
VCAS120605A150 __	5.6	4	8.5±20%	18	1	35	0.1	-	40	1200	K	-	0.002
VCAS120605D150 __	5.6	4	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	0.01
VCAS121016J390 __	16	11	25.5±10%	42	5	10	1.6	3	500	3100	K	27.5	0.03
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
VCAS222016Y390	16	11	24.5±10%	40	10	15	10.2	37	2000	2500	K	27.5	10.2
VGAS222016Y390	16	11	24.5±10%	40	10	15	10.2	37	2000	2500	K	27.5	0.08
VGAS181216P400 __	16	11	24.5±10%	42	5	10	2.9	10	1000	5000	K	27.5	0.07
VCAS222016W400	16	11	24.5±10%	42	10	15	7.6	20	2000	2000	K	27.5	7.6
VGAS222016W400	16	11	24.5±10%	42	10	15	7.6	20	2000	2000	K	27.5	7.6
VGAS222016Y400	16	11	24.5±10%	42	10	10	7.2	25	1500	13000	K	25.5	0.1
VCAS222016Z400	16	11	24.5±10%	42	10	15	16	45	2000	2800	K	27.5	16
VGAS222016Z400	16	11	24.5±10%	42	10	15	16	45	2000	2800	K	27.5	16
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	0.01
VCAS121018J390 __	18	13	25.5±10%	42	5	10	1.6	3	500	3100	K	27.5	0.03
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	0.03
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

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ELECTRICAL CHARACTERISTICS

Part Number	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	
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	400	1000	K	48	0.04
VGAS181234U770 __	34	30	47.0±10%	77	5	15	5	6.1	800	1500	K	48	0.08
VGAS222034Y770	34	30	47.0±10%	77	10	15	12	25	2000	6300	K	48	0.240
VGAS322034Z770	34	30	47±10%	77	10	15	13	50	2000	18000	K	48	0.26
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
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 Voltage (V @ 1mA_{DC})

V_C Clamping Voltage [V @ I_{vc}]

I_{vc} Test Current for V_C

I_L Maximum Leakage Current at the working voltage, 25°C (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}, 25°C

V_{Jump} Jump Start (V)

P Power Dissipation (W)

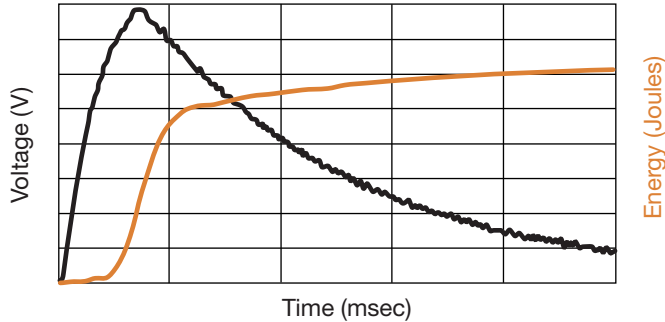
TransGuard® Automotive Series

Multilayer Varistors for Automotive Applications



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

Part Number	0.5Ω	1Ω	4Ω
VCAS060316B400			
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
VCAS222016W400	0.5Ω	1Ω	4Ω
100ms	62	80	172
400ms	48		90

12V SYSTEMS (continued)

Part Number	0.5Ω	1Ω	4Ω
VCAS222016Y390			
100ms	78	105	213
400ms	51		128
VCAS222016Z400	0.5Ω	1Ω	4Ω
100ms	82	110	213
400ms	55		134

24V SYSTEMS

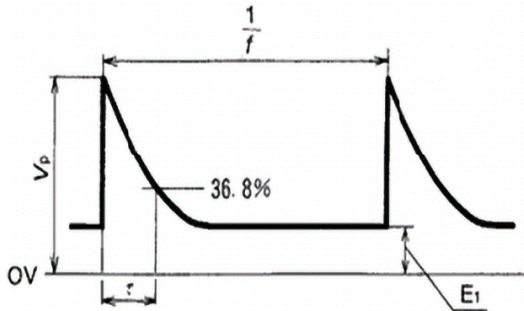
Part Number	1Ω	4Ω	8Ω
VCAS060326A580			
100ms	51	56	58
200ms	50	54	56
400ms	49	51	53
VCAS080526A580	1Ω	4Ω	8Ω
100ms	51	53	59
200ms	49	51	57
400ms	48	50	51
VCAS080526C580	1Ω	4Ω	8Ω
100ms	51	54	62
200ms	49	51	56
400ms	48	49	51
VCAS120626D580	1Ω	4Ω	8Ω
100ms	52	60	68
200ms	50	57	65
400ms	47	54	61
VCAS121026H560	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

TransGuard® Automotive Series

Multilayer Varistors for Automotive Applications



LOAD DUMP TEST – JASO D001-1994



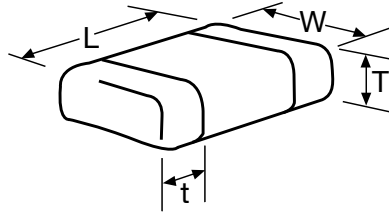
Type of Test		Test Conditions					Transient Voltage Generating Circuit	Number of Pulses
		V _p (V)	t (s)	f (Hz)	R _i (Ω)	Waveform		
TypeA	A-1	70	200,000	-	0.8	Fig. 4	Fig. 5 & Fig. 6	1
	A-2	110	2.5		0.4		Fig. 6	10
TypeB	B-1	80	60,000	1/30	8	Fig. 7	Fig. 8	100
	B-2	-260	2,000		80			

LOAD DUMP LIBRARY QUALIFIED TO JASO D001-1994

VCAS222016Z400	0.5Ω	1Ω	4Ω
100ms	82	110	213
400ms	55		134

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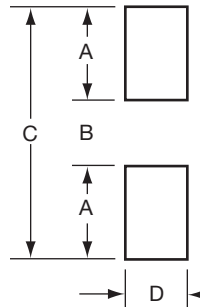


DIMENSIONS: MM (INCHES)

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: 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)

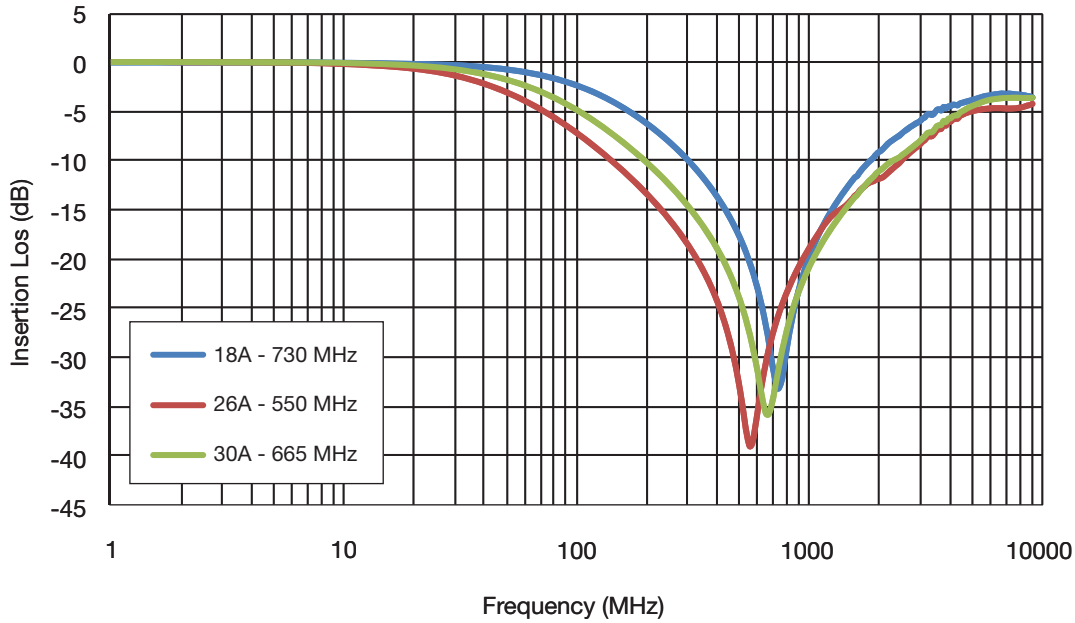
TransGuard® Automotive Series

Multilayer Varistors for Automotive Applications

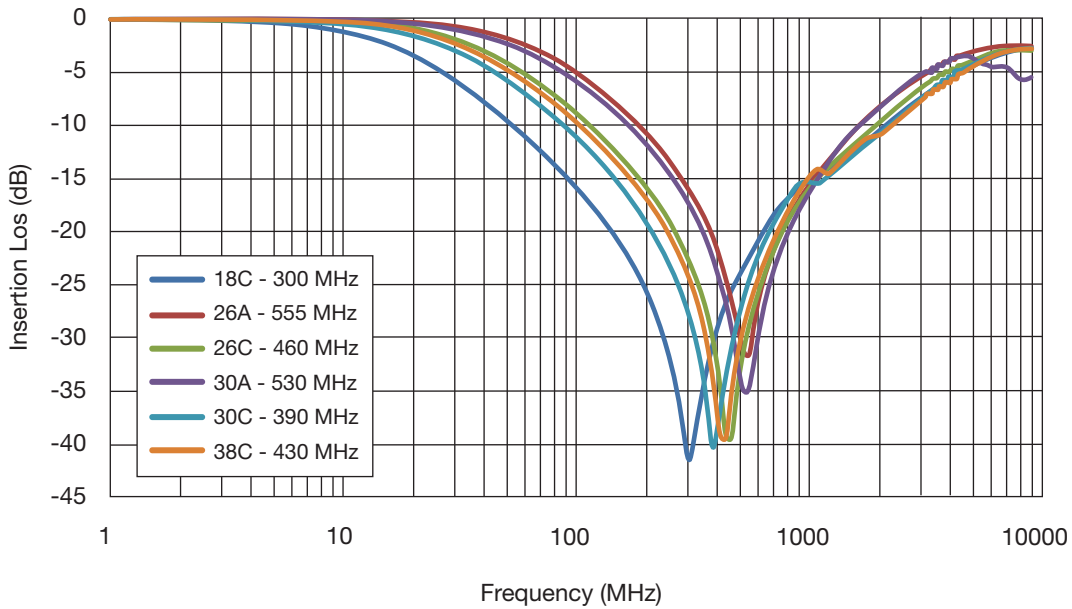


FORWARD TRANSMISSION CHARACTERISTICS (S21)

0603 Case Size

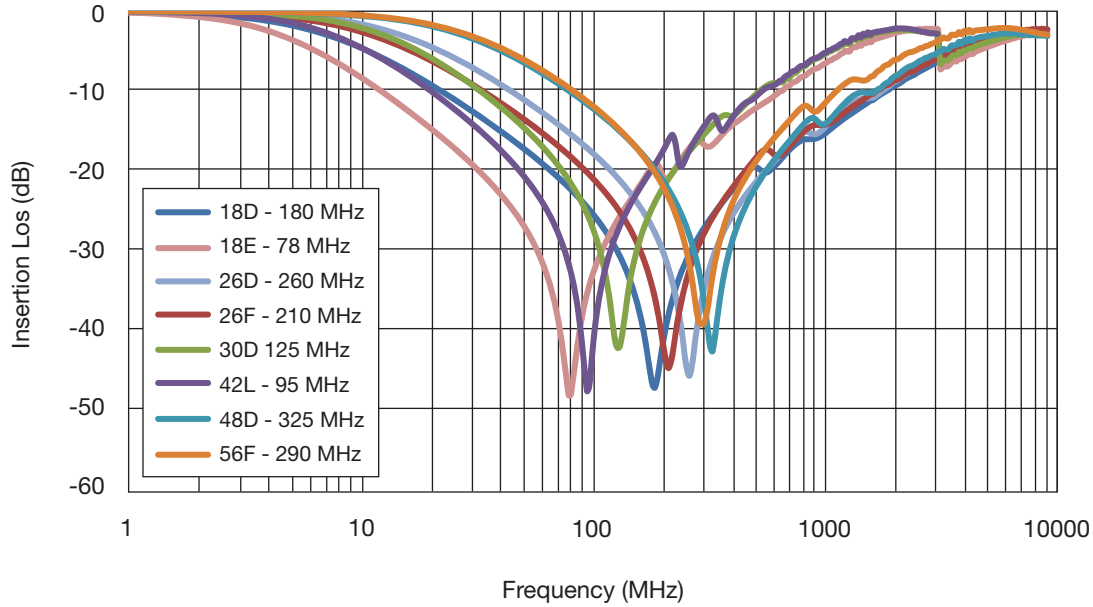


0805 Case Size

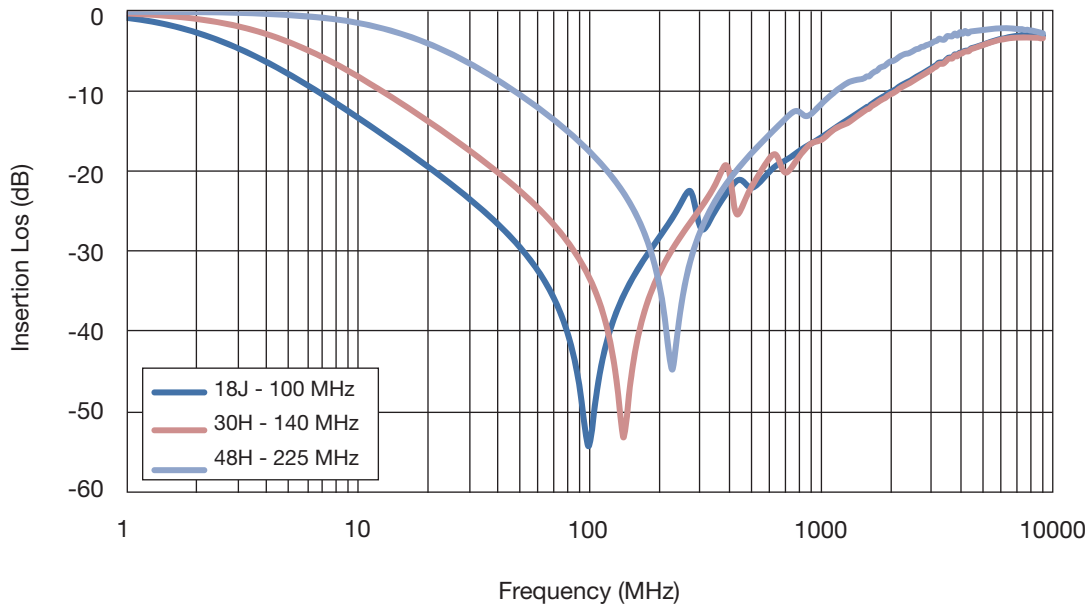


FORWARD TRANSMISSION CHARACTERISTICS (S21)

1206 Case Size



1210 Case Size



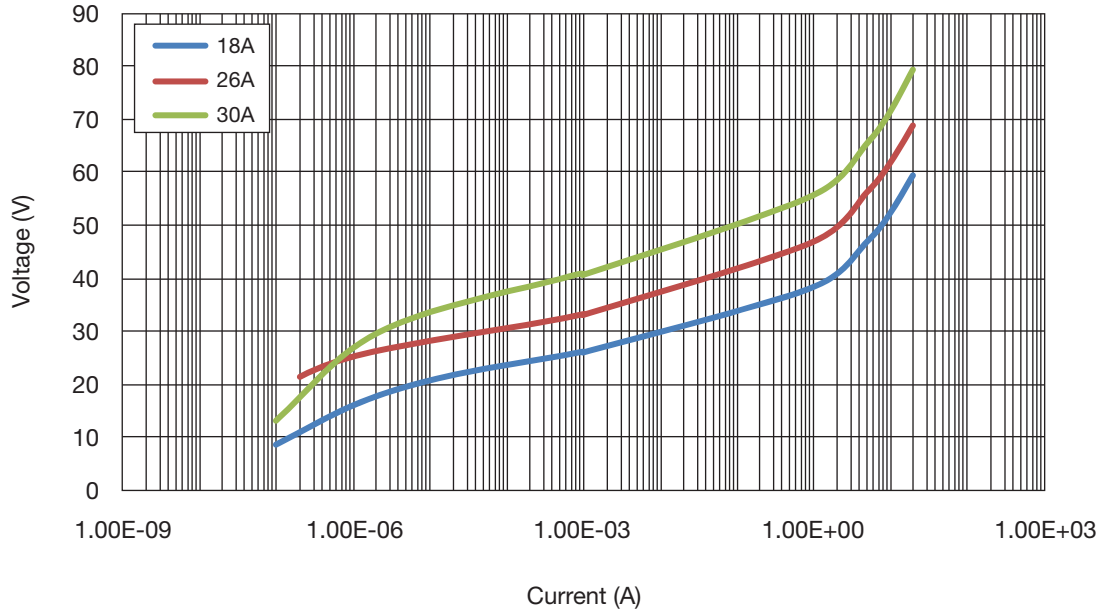
TransGuard® Automotive Series

Multilayer Varistors for Automotive Applications

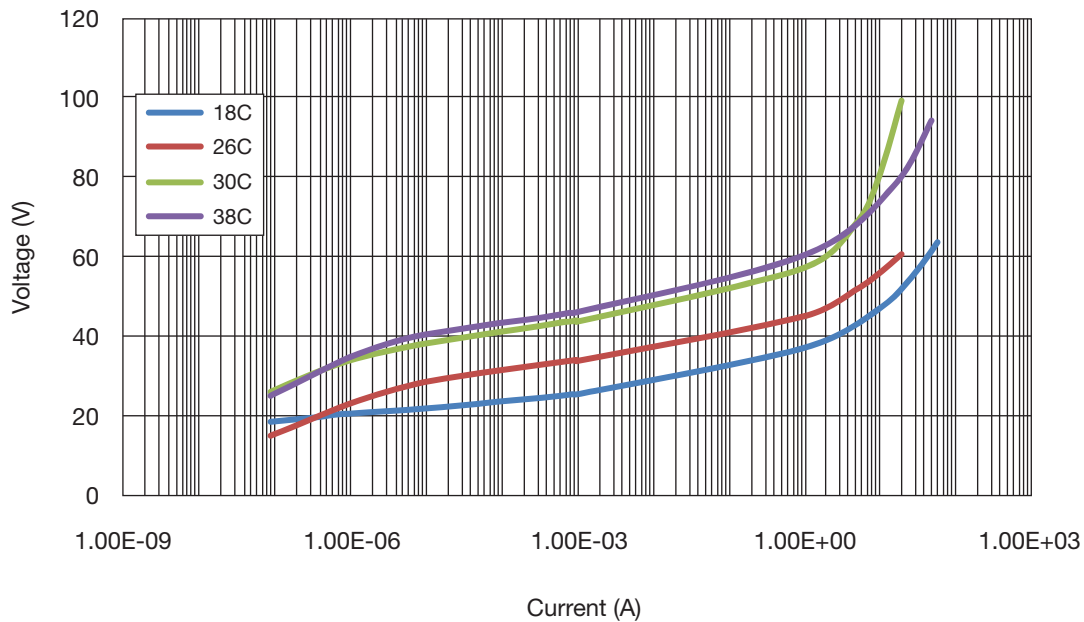


V-I CHARACTERISTICS

0603 Case Size

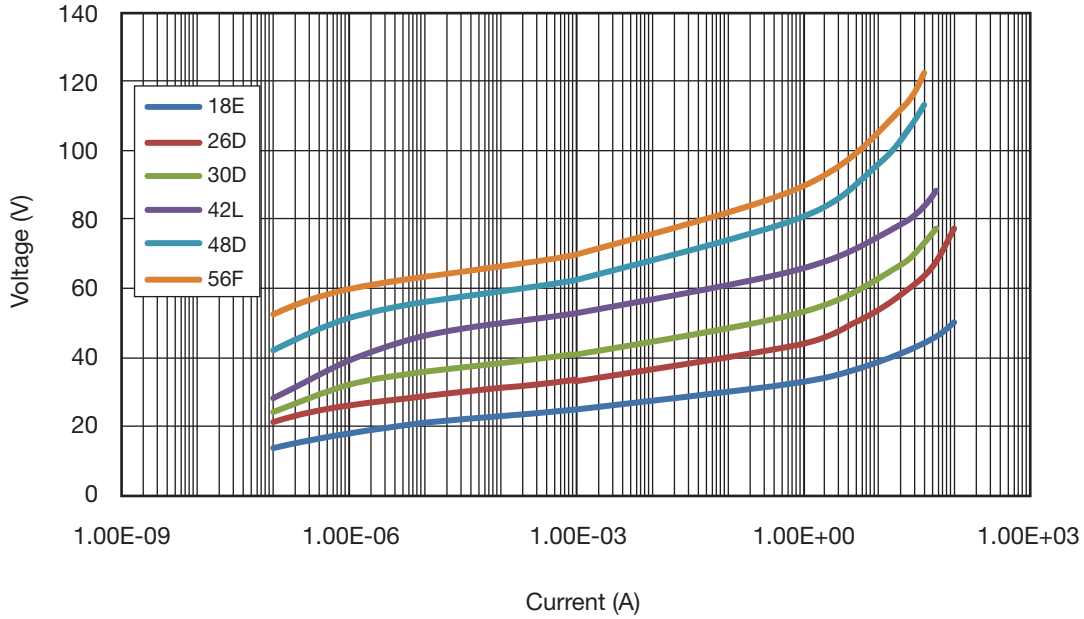


0805 Case Size

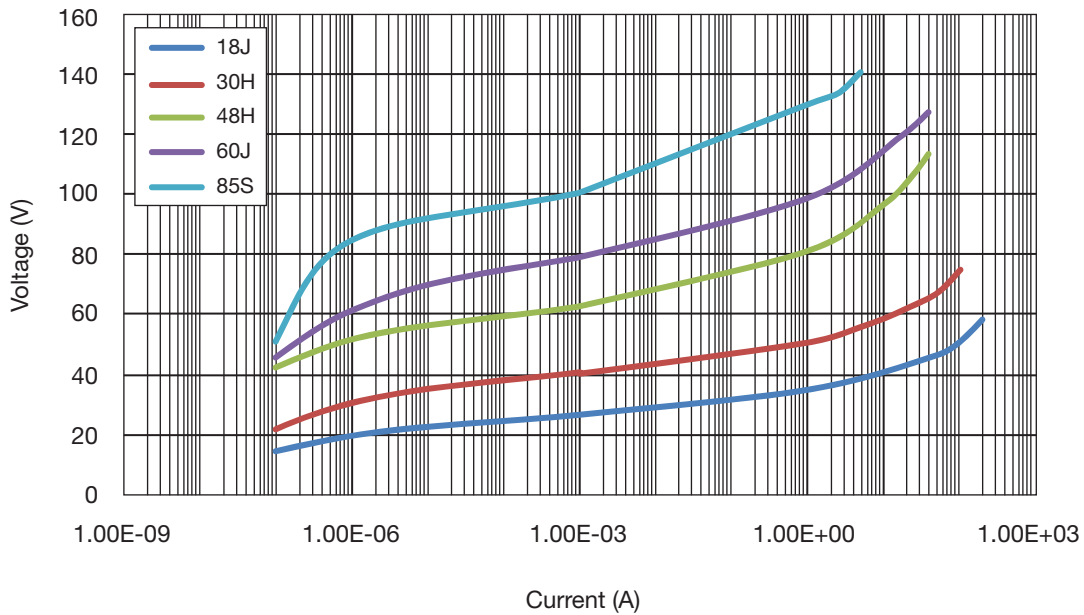


FORWARD TRANSMISSION CHARACTERISTICS (S21)

1206 Case Size



1210 Case Size



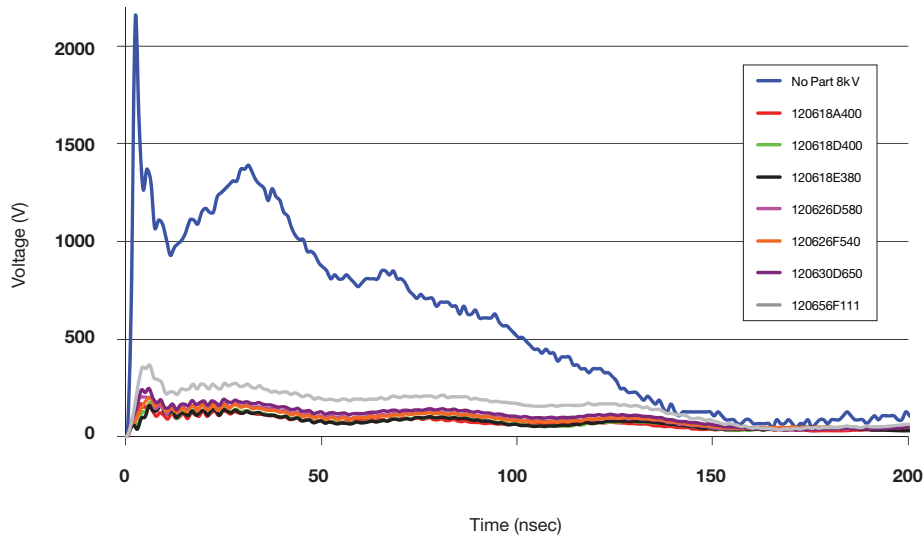
TransGuard® Automotive Series

Multilayer Varistors for Automotive Applications



ESD V-I CHARACTERISTICS

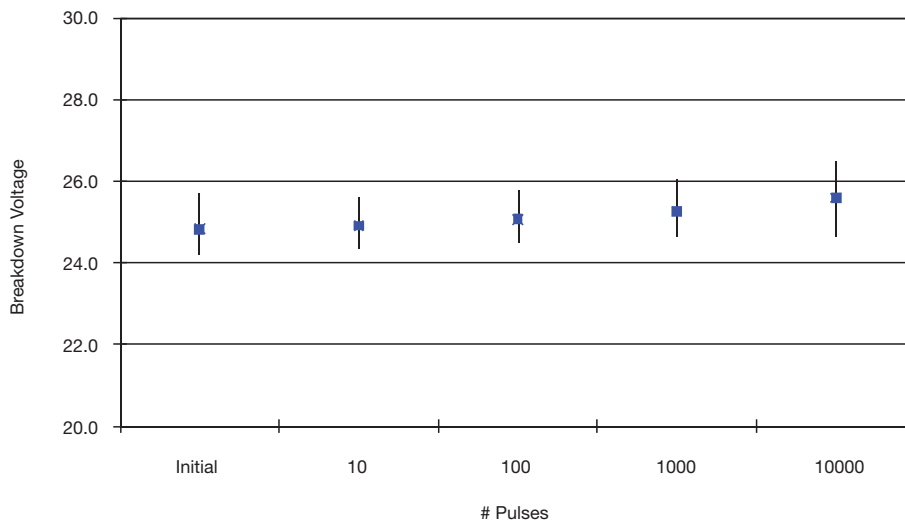
8 kV ESD Vc
(150pF/300ohm IEC Network)



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

ESD 8 kV IEC 61000-4-2 150pF / 330Ω Resistor
VC060318A400



Looking for pricing, stock, or lifecycle information?

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