

Zinc Oxide Varistors

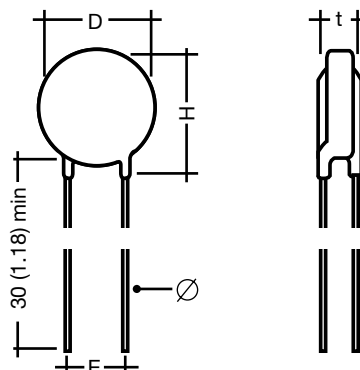


VE 07/09/13/17/24

VF 05/07/10/14/20

FEATURES

- Radial lead varistors
- Wide operating voltage range from 14 V to 625 V (V_{rms} for VE types) or 22 V to 1000 V (V_{1mA} for VF types)
- Available in tape and reel for use with automatic insertion equipment (see pages 31 to 33 for details).



PARTICULAR CHARACTERISTICS

UL (USA and Canadian Standards)	VE Series P/N codification using (D_{max} , V_{rms})	VF Series P/N codification using ($d_{ceramic}$, V_{1mA})	Maximum operating voltage		Nominal voltage at 1 mA dc		
			V_{rms}	V_{dc}	$V_{1mA\ mini}$	$V_{1mA\ nominal}$	$V_{1mA\ maxi}$
★	VE07M00140K _ _	VF05M10220K _ _	14	18	19.8	22	24.2
★	VE09M00140K _ _	VF07M10220K _ _					
★	VE13M00140K _ _	VF10M10220K _ _					
★	VE17M00140K _ _	VF14M10220K _ _					
★	VE07M00170K _ _	VF05M10270K _ _	17	22	24.0	27	30.0
★	VE09M00170K _ _	VF07M10270K _ _					
★	VE13M00170K _ _	VF10M10270K _ _					
★	VE17M00170K _ _	VF14M10270K _ _					
★	VE07M00200K _ _	VF05M10330K _ _	20	26	29.5	33	36.5
★	VE09M00200K _ _	VF07M10330K _ _					
★	VE13M00200K _ _	VF10M10330K _ _					
★	VE17M00200K _ _	VF14M10330K _ _					
★	VE07M00250K _ _	VF05M10390K _ _	25	31	35	39	43
★	VE09M00250K _ _	VF07M10390K _ _					
★	VE13M00250K _ _	VF10M10390K _ _					
★	VE17M00250K _ _	VF14M10390K _ _					
★	VE07M00300K _ _	VF05M10470K _ _	30	38	42	47	52
★	VE09M00300K _ _	VF07M10470K _ _					
★	VE13M00300K _ _	VF10M10470K _ _					
★	VE17M00300K _ _	VF14M10470K _ _					
★	VE07M00350K _ _	VF05M10560K _ _	35	45	50	56	62
★	VE09M00350K _ _	VF07M10560K _ _					
★	VE13M00350K _ _	VF10M10560K _ _					
★	VE17M00350K _ _	VF14M10560K _ _					
★	VE07M00400K _ _	VF05M10680K _ _	40	56	61	68	75
★	VE09M00400K _ _	VF07M10680K _ _					
★	VE13M00400K _ _	VF10M10680K _ _					
★	VE17M00400K _ _	VF14M10680K _ _					
★	VE07M00500K _ _	VF05M10820K _ _	50	65	73	82	91
★	VE09M00500K _ _	VF07M10820K _ _					
★	VE13M00500K _ _	VF10M10820K _ _					
★	VE17M00500K _ _	VF14M10820K _ _					

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DIMENSIONS millimeters (inches)

Type	Type	D		H max.	t max.	ϕ +10% -0.05 (.002)	E ± 0.8 (.031)
		Ceramic diameter	Maximum coated diameter				
VE07	VF05	5 (.196)	7 (.275)	10 (.394)	see table	0.6 (.024)	5.08 (0.20)
VE09	VF07	7 (.275)	9 (.354)	12 (.472)		0.6 (.024)	5.08 (0.20)
VE13*	VF10*	10 (.393)	13* (.512)	16 (.630)		0.8* (.031)	7.62* (0.30)
VE17	VF14	14 (.551)	17 (.669)	20 (.787)		0.8 (.031)	7.62 (0.30)
VE24**	VF20**	20 (.787)	24 (.945)	27 (1.06)		0.8** (.031)	7.62 (0.30)

* VE13 / VF10: For models with V_{RMS} 320 V
other version/suffixes available with:
E = 5.08 (0.20) Suffix:
 ϕ = 0.6 (.024) Bulk: HB
D = 12.5 (.492) max Tape: DA, DB, DC,
DD, DQ, ...

**VE24 / VF20: For lead diameter = 1.0 (.039),
please consult us.

GENERAL CHARACTERISTICS

Storage temperature: -40°C to +125°C
Max. operating temperature: +85°C
Response time: < 25 ns
Voltage coefficient temp.: $|K| < 0.09\%/^{\circ}\text{C}$
Voltage proof: 2500 V
Epoxy coating: Flame retardant
UL94-VO

MARKING

Type
AC nominal voltage (EIA coding) for VE types
 V_{1mA} varistor voltage (EIA coding) for VF types
Logo
UL logo (when approved)
Lot number (VE13/17/24 and VF10/14/20 only)

Max. clamping voltage (8 x 20 μs)		Max. energy absorption (10 x 1000 μs) W (J)		Max. permissible peak current (8 x 20 μs) Ip (A)		Typical capacitance $f = 1\text{kHz}$	Mean power dissipation	Maximum thickness t	V/I characteristic	Derating curves
Vp (V)	Ip (A)	Number of surges 1	10	1 surge	2 surges	pF	W	mm (inches)	Page	Page
43	1	0.4	0.2	100	50	1050	0.01	3.6 (.142)	22	24
43	2.5	0.9	0.6	250	125	1900	0.02	3.6 (.142)	22	25
43	5	2	1.3	500	250	4000	0.05	4.3 (.169)	22	26
43	10	4	2.6	1000	500	4000	0.10	4.3 (.169)	23	27
53	1	0.5	0.3	100	50	1050	0.01	3.7 (.146)	22	24
53	2.5	1.1	0.7	250	125	1900	0.02	3.7 (.146)	22	25
53	5	2.5	1.6	500	250	4000	0.05	4.3 (.169)	22	26
53	10	4.7	3.0	1000	500	6800	0.10	4.3 (.169)	23	27
65	1	0.6	0.3	100	50	750	0.01	3.9 (.154)	22	24
65	2.5	1.3	0.9	250	125	1500	0.02	3.9 (.154)	22	25
65	5	3.1	2.0	500	250	3100	0.05	4.5 (.177)	22	26
65	10	5.7	4.0	1000	500	5700	0.10	4.5 (.177)	23	27
77	1	0.7	0.4	100	50	660	0.01	3.6 (.142)	22	24
77	2.5	1.6	1.0	250	125	1250	0.02	3.6 (.142)	22	25
77	5	3.7	3	500	250	2800	0.05	4.4 (.173)	22	26
77	10	7	5	1000	500	4600	0.10	4.4 (.173)	23	27
93	1	0.9	0.4	100	50	580	0.01	3.8 (.150)	22	24
93	2.5	2.0	1	250	125	1050	0.02	3.8 (.150)	22	25
93	5	4.4	4	500	250	2150	0.05	4.4 (.173)	22	26
93	10	9.0	7	1000	500	3500	0.10	4.4 (.173)	23	27
110	1	1.1	0.4	100	50	460	0.01	3.9 (.154)	22	24
110	2.5	2.5	1	250	125	850	0.02	3.9 (.154)	22	25
110	5	5.4	4.4	500	250	1900	0.05	4.7 (.185)	22	26
110	10	10.0	8	1000	500	3100	0.10	4.7 (.185)	23	27
135	1	1.3	0.5	100	50	400	0.01	4.1 (.161)	22	24
135	2.5	3.0	1	250	125	720	0.02	4.1 (.161)	22	25
135	5	8.4	5.9	500	250	1700	0.05	4.9 (.193)	22	26
135	10	13.0	8.5	1000	500	2800	0.10	4.9 (.193)	23	27
135	5	1.8	0.6	400	200	300	0.1	3.5 (.138)	22	24
135	10	4.2	1.6	1200	600	530	0.2	3.5 (.138)	22	25
135	25	8.4	6	2500	1250	950	0.4	4.1 (.161)	22	26
135	50	15.0	11	4500	2500	1800	0.6	4.1 (.161)	23	27

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UL (USA and Canadian Standards)	VE Series P/N codification using (D _{max} , V _{rms})	VF Series P/N codification using (d _{ceramic} , V _{1mA})	Maximum operating voltage		Nominal voltage at 1 mA dc		
			V _{rms}	V _{DC}	V _{1mA mini}	V _{1mA nominal}	V _{1mA maxi}
★ ★ ★ ★	VE07M00600K __ VE09M00600K __ VE13M00600K __ VE17M00600K __	VF05M10101K __ VF07M10101K __ VF10M10101K __ VF14M10101K __	60	80	90	100	110
★ ★ ★ ★ ★	VE07M00750K __ VE09M00750K __ VE13M00750K __ VE17M00750K __ VE24M00750K __	VF05M10121K __ VF07M10121K __ VF10M10121K __ VF14M10121K __ VF20M10121K __	75	100	108	120	132
★ ★ ★ ★ ★	VE07M00950K __ VE09M00950K __ VE13M00950K __ VE17M00950K __ VE24M00950K __	VF05M10151K __ VF07M10151K __ VF10M10151K __ VF14M10151K __ VF20M10151K __	95	125	135	150	165
★ ★ ★ ★ ★	VE07M01150K __ VE09M01150K __ VE13M01150K __ VE17M01150K __ VE24M01150K __	VF05M10181K __ VF07M10181K __ VF10M10181K __ VF14M10181K __ VF20M10181K __	115	150	162	180	198
★ ★ ★ ★ ★	VE07M00131K __ VE09M00131K __ VE13M00131K __ VE17M00131K __ VE24M00131K __	VF05M12050K __ VF07M12050K __ VF10M12050K __ VF14M12050K __ VF20M12050K __	130	170	184	205	226
★ ★ ★ ★ ★	VE07M00141K __ VE09M00141K __ VE13M00141K __ VE17M00141K __ VE24M00141K __	VF05M10221K __ VF07M10221K __ VF10M10221K __ VF14M10221K __ VF20M10221K __	140	180	198	220	242
★ ★ ★ ★ ★	VE07M00151K __ VE09M00151K __ VE13M00151K __ VE17M00151K __ VE24M00151K __	VF05M10241K __ VF07M10241K __ VF10M10241K __ VF14M10241K __ VF20M10241K __	150	200	216	240	264
★ ★ ★ ★ ★	VE07M01750K __ VE09M01750K __ VE13M01750K __ VE17M01750K __ VE24M01750K __	VF05M10271K __ VF07M10271K __ VF10M10271K __ VF14M10271K __ VF20M10271K __	175	225	243	270	297
★ ★ ★ ★ ★	VE07M00211K __ VE09M00211K __ VE13M00211K __ VE17M00211K __ VE24M00211K __	VF05M10331K __ VF07M10331K __ VF10M10331K __ VF14M10331K __ VF20M10331K __	210	275	297	330	363
★ ★ ★ ★ ★	VE07M00231K __ VE09M00231K __ VE13M00231K __ VE17M00231K __ VE24M00231K __	VF05M10361K __ VF07M10361K __ VF10M10361K __ VF14M10361K __ VF20M10361K __	230	300	324	360	396

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Max. clamping voltage (8 x 20 μ s)		Max. energy absorption (10 x 1000 μ s) W (J)		Max. permissible peak current (8 x 20 μ s) Ip (A)		Typical capacitance f = 1kHz	Mean power dissipation	Maximum thickness t	V/I characteristic	Derating curves
Vp (V)	Ip (A)	Number of surges		1 surge	2 surges	pF	W	mm (inches)	Page	Page
165	5	2.2	0.7	400	200	165	0.1	3.8 (.150)	22	24
165	10	4.8	1.7	1200	600	440	0.2	3.8 (.150)	22	25
165	25	10	7	2500	1250	870	0.4	4.5 (.177)	22	26
165	50	17	14	4500	2500	2200	0.6	4.5 (.177)	23	27
200	5	2.5	0.8	400	200	150	0.1	4.0 (.157)	22	24
200	10	5.9	1.8	1200	600	400	0.2	4.0 (.157)	22	25
200	25	12	8	2500	1250	700	0.4	4.4 (.173)	22	26
200	50	20	15	4500	2500	1900	0.6	4.4 (.173)	23	27
200	100	40	30	6500	4000	4200	0.8	4.8 (.189)	23	28
250	5	3.4	1	400	200	110	0.1	4.4 (.173)	22	24
250	10	7.6	3	1200	600	310	0.2	4.4 (.173)	22	25
250	25	15	9	2500	1250	560	0.4	5.0 (.197)	22	26
250	50	25	20	4500	2500	1200	0.6	5.0 (.197)	23	27
250	100	50	33	6500	4000	3400	0.8	5.4 (.213)	23	28
300	5	3.6	1.3	400	200	100	0.1	4.5 (.177)	22	24
300	10	8.4	3.3	1200	600	280	0.2	4.5 (.177)	22	25
300	25	18	10.6	2500	1250	500	0.4	5.1 (.201)	22	26
300	50	30	22	4500	2500	1100	0.6	5.1 (.201)	23	27
300	100	60	40	6500	4000	3000	0.8	5.5 (.217)	23	28
340	5	4.2	1.5	400	200	90	0.1	4.1 (.161)	22	24
340	10	9.5	4	1200	600	250	0.2	4.1 (.161)	22	25
340	25	19	11	2500	1250	450	0.4	4.7 (.185)	22	26
340	50	34	25	4500	2500	1000	0.6	4.7 (.185)	23	27
340	100	74	46	6500	4000	2500	0.8	5.1 (.201)	23	28
360	5	4.5	1.5	400	200	85	0.1	4.2 (.165)	22	24
360	10	10	4	1200	600	235	0.2	4.2 (.165)	22	25
360	25	22	12.5	2500	1250	425	0.4	4.8 (.189)	22	26
360	50	36	26.5	4500	2500	930	0.6	4.8 (.189)	23	27
360	100	78	50	6500	4000	2250	0.8	5.2 (.205)	23	28
400	5	4.9	1.8	400	200	80	0.1	4.3 (.169)	22	24
400	10	11	4.1	1200	600	220	0.2	4.3 (.169)	22	25
400	25	24	13	2500	1250	400	0.4	4.9 (.193)	22	26
400	50	40	30	4500	2500	850	0.6	4.9 (.193)	23	27
400	100	85	56	6500	4000	2000	0.8	5.3 (.209)	23	28
445	5	5.6	1.9	400	200	70	0.1	4.5 (.177)	22	24
445	10	13	4.5	1200	600	190	0.2	4.5 (.177)	22	25
445	25	28	13.5	2500	1250	340	0.4	5.1 (.201)	22	26
445	50	46	31	4500	2500	750	0.6	5.1 (.201)	23	27
445	100	98	56	6500	4000	2000	0.8	5.5 (.217)	23	28
545	5	7.2	2.2	400	200	60	0.1	4.9 (.193)	22	24
545	10	15	5.4	1200	600	155	0.2	4.9 (.193)	22	25
545	25	31	14.0	2500	1250	275	0.4	5.5 (.217)	22	26
545	50	54	35	4500	2500	600	0.6	5.5 (.217)	23	27
545	100	115	70	6500	4000	1650	0.8	5.9 (.232)	23	28
595	5	7.2	2.4	400	200	55	0.1	5.1 (.201)	22	24
595	10	17	6	1200	600	140	0.2	5.1 (.201)	22	25
595	25	36	14.3	2500	1250	250	0.4	5.7 (.224)	22	26
595	50	60	38	4500	2500	550	0.6	5.7 (.224)	23	27
595	100	130	75	6500	4000	1500	0.8	6.1 (.240)	23	28



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UL (USA and Canadian Standards)	VE Series P/N codification using (D _{max} , V _{rms})	VF Series P/N codification using (d _{ceramic} V _{1mA})	Maximum operating voltage		Nominal voltage at 1 mA dc		
			V _{rms}	V _{DC}	V _{1mA mini}	V _{1mA nominal}	V _{1mA maxi}
★	VE07M00251K __	VF05M10391K __	250	320	351	390	429
★	VE09M00251K __	VF07M10391K __					
★	VE13M00251K __	VF10M10391K __					
★	VE17M00251K __	VF14M10391K __					
★	VE24M00251K __	VF20M10391K __					
★	VE07M02750K __	VF05M10431K __	275	350	387	430	473
★	VE09M02750K __	VF07M10431K __					
★	VE13M02750K __	VF10M10431K __					
★	VE17M02750K __	VF14M10431K __					
★	VE24M02750K __	VF20M10431K __					
★	VE07M00301K __	VF05M10471K __	300	385	423	470	517
★	VE09M00301K __	VF07M10471K __					
★	VE13M00301K __	VF10M10471K __					
★	VE17M00301K __	VF14M10471K __					
★	VE24M00301K __	VF20M10471K __					
★	VE09M00321K __	VF07M10511K __	320	420	459	510	561
★	VE13M00321K __	VF10M10511K __					
★	VE17M00321K __	VF14M10511K __					
★	VE24M00321K __	VF20M10511K __					
★	VE09M00351K __	VF07M10561K __	350	460	504	560	616
★	VE13M00351K __	VF10M10561K __					
★	VE17M00351K __	VF14M10561K __					
★	VE24M00351K __	VF20M10561K __					
★	VE09M03850K __	VF07M10621K __	385	505	558	620	682
★	VE13M03850K __	VF10M10621K __					
★	VE17M03850K __	VF14M10621K __					
★	VE24M03850K __	VF20M10621K __					
★	VE09M00421K __	VF07M10681K __	420	560	612	680	748
★	VE13M00421K __	VF10M10681K __					
★	VE17M00421K __	VF14M10681K __					
★	VE24M00421K __	VF20M10681K __					
★	VE13M00441K __	VF10M17150K __	440	585	643	715	787
★	VE17M00441K __	VF14M17150K __					
★	VE24M00441K __	VF20M17150K __					
★	VE13M00461K __	VF10M10751K __	460	615	675	750	825
★	VE17M00461K __	VF14M10751K __					
★	VE24M00461K __	VF20M10751K __					
★	VE13M00511K __	VF10M10821K __	510	670	738	820	902
★	VE17M00511K __	VF14M10821K __					
★	VE24M00511K __	VF20M10821K __					
★	VE13M00551K __	VF10M10861K __	550	715	774	860	946
★	VE17M00551K __	VF14M10861K __					
★	VE24M00551K __	VF20M10861K __					
★	VE13M05750K __	VF10M10911K __	575	730	819	910	1001
★	VE17M05750K __	VF14M10911K __					
★	VE24M05750K __	VF20M10911K __					
★	VE13M06250K __	VF10M10102K __	625	825	900	1000	1100
★	VE17M06250K __	VF14M10102K __					
★	VE24M06250K __	VF20M10102K __					

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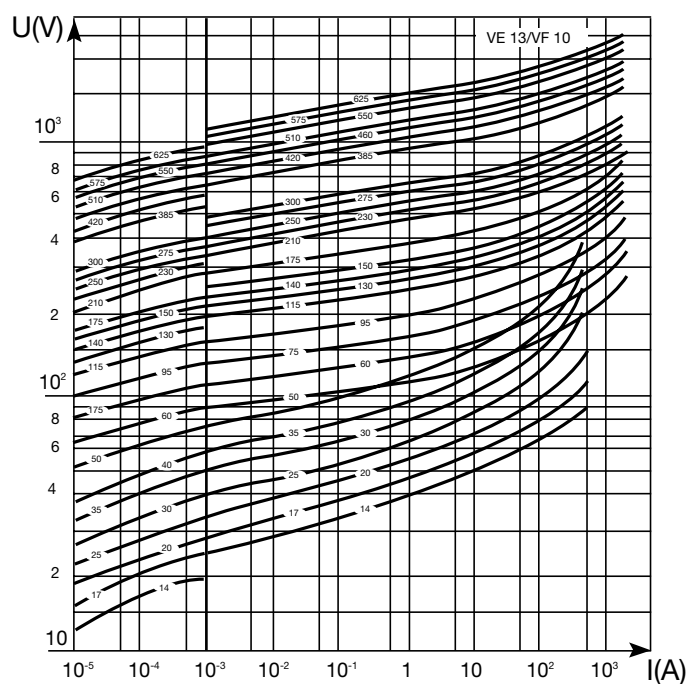
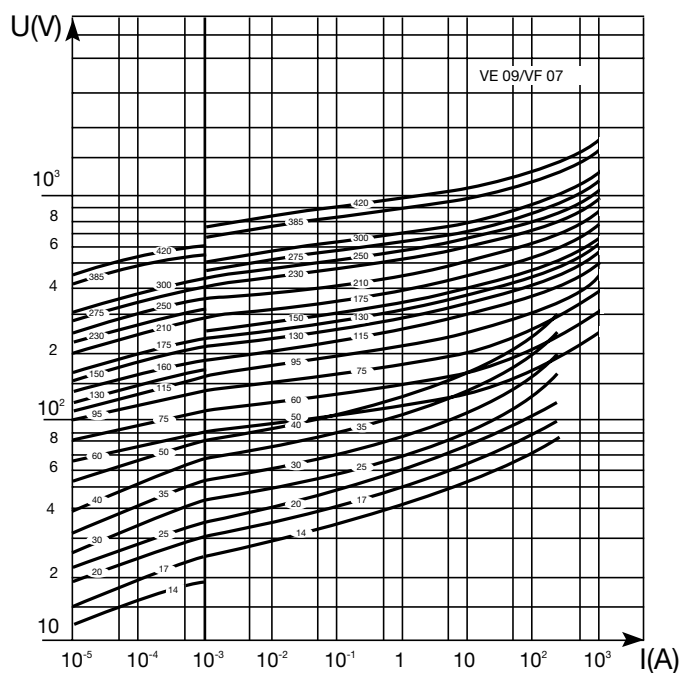
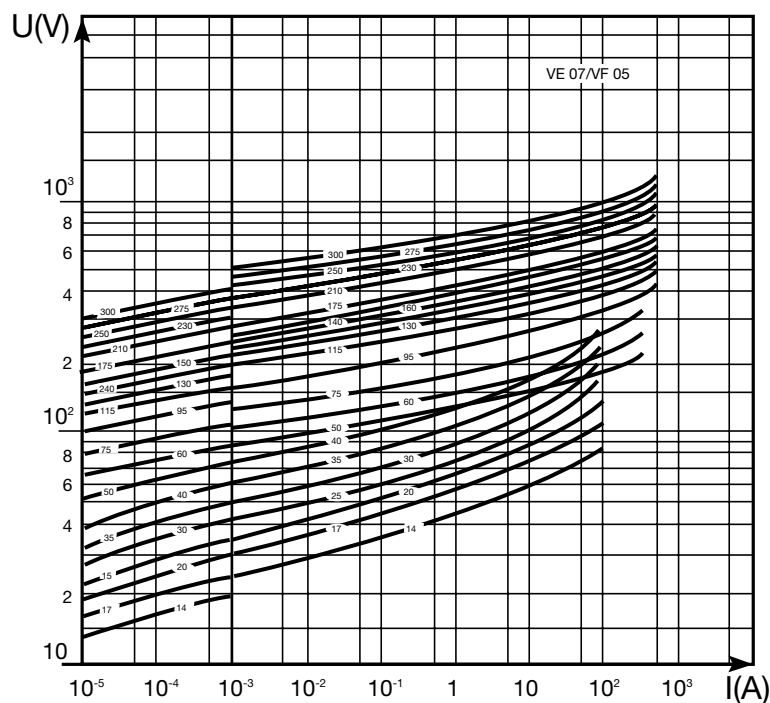
Max. clamping voltage (8 x 20 μ s)		Max. energy absorption (10 x 1000 μ s) W (J)		Max. permissible peak current (8 x 20 μ s) Ip (A)		Typical capacitance f = 1kHz	Mean power dissipation	Maximum thickness t	V/I characteristic	Derating curves
Vp (V)	Ip (A)	Number of surges		Ip (A)		pF	W	mm (inches)	Page	Page
		1	10	1 surge	2 surges					
645	5	8.2	2.8	400	200	50	0.1	5.4 (.213)	22	24
645	10	19	7.3	1200	600	130	0.2	5.4 (.213)	22	25
645	25	38	19	2500	1250	230	0.4	5.9 (.232)	22	26
645	50	65	39	4500	2500	500	0.6	5.9 (.232)	23	27
645	100	140	100	6500	4000	1300	0.8	6.3 (.248)	23	28
710	5	8.6	3	400	200	45	0.1	5.7 (.224)	22	24
710	10	21	7.4	1200	600	120	0.2	5.7 (.224)	22	25
710	25	43	20	2500	1250	210	0.4	6.3 (.248)	22	26
710	50	71	40	4500	2500	450	0.6	6.3 (.248)	23	27
710	100	151	105	6500	4000	1200	0.8	6.7 (.264)	23	28
775	5	9	3.3	400	200	40	0.1	6.0 (.236)	22	24
775	10	25	7.5	1200	600	100	0.2	6.0 (.236)	22	25
775	25	45	20	2500	1250	180	0.4	6.6 (.260)	22	26
775	50	80	42	4500	2500	400	0.6	6.6 (.260)	23	27
775	100	150	107	6500	4000	1000	0.8	7.0 (.276)	23	28
840	10	25	7.5	1200	600	100	0.2	6.4 (.252)	22	25
840	25	45	20	2500	1250	170	0.4	7.0 (.276)	22	26
840	50	82	42	4500	2500	380	0.6	7.0 (.276)	23	27
840	100	150	107	6500	4000	950	0.8	7.5 (.276)	23	28
910	10	25	7.5	1200	600	95	0.2	6.6 (.260)	22	25
910	25	45	20	2500	1250	160	0.4	7.3 (.287)	22	26
910	50	85	42	4500	2500	365	0.6	7.3 (.287)	23	27
910	100	155	107	6500	4000	900	0.8	7.8 (.307)	23	28
1025	10	25	7.5	1200	600	95	0.2	7.0 (.276)	22	25
1025	25	45	20	2500	1250	150	0.4	7.7 (.303)	22	26
1025	50	88	42	4500	2500	350	0.6	7.7 (.303)	23	27
1025	100	155	107	6500	4000	850	0.8	8.1 (.319)	23	28
1120	10	25	7.5	1200	600	80	0.2	7.4 (.291)	22	25
1120	25	45	20	2500	1250	120	0.4	8.2 (.323)	22	26
1120	50	90	42	4500	2500	300	0.6	8.2 (.323)	23	27
1120	100	160	107	6500	4000	700	0.8	8.6 (.339)	23	28
1180	25	45	20	2500	1250	115	0.4	8.4 (.331)	22	26
1180	50	95	44	4500	2500	275	0.6	8.4 (.331)	23	27
1180	100	165	115	6500	4000	650	0.8	8.8 (.346)	23	28
1240	25	45	20	2500	1250	110	0.4	8.5 (.335)	22	26
1240	50	100	47	4500	2500	250	0.6	8.5 (.335)	23	27
1240	100	175	120	6500	4000	600	0.8	9.0 (.354)	23	28
1350	25	55	22	2500	1250	100	0.4	9.0 (.354)	22	26
1350	50	110	57	4500	2500	220	0.6	9.0 (.354)	23	27
1350	100	190	150	6500	4000	550	0.8	9.4 (.370)	23	28
1420	25	57	24	2500	1250	90	0.4	9.3 (.366)	22	26
1420	50	113	57	4500	2500	200	0.6	9.3 (.366)	23	27
1420	100	200	150	6500	4000	500	0.8	9.7 (.382)	23	28
1500	25	60	25	2500	1250	80	0.4	9.7 (.382)	22	26
1500	50	120	60	4500	2500	180	0.6	9.7 (.382)	23	27
1500	100	210	160	6500	4000	450	0.8	10.1 (.398)	23	28
1650	25	68	25	2500	1250	74	0.4	10.5 (.413)	22	26
1650	50	130	60	4500	2500	165	0.6	10.5 (.413)	23	27
1650	100	230	160	6500	4000	410	0.8	11.0 (.433)	23	28



VOLTAGE-CURRENT CHARACTERISTICS

V/I characteristics give:

- for I below 1 mA the maximum leakage current under V_{dc}
- for I above 1 mA the maximum clamping voltage

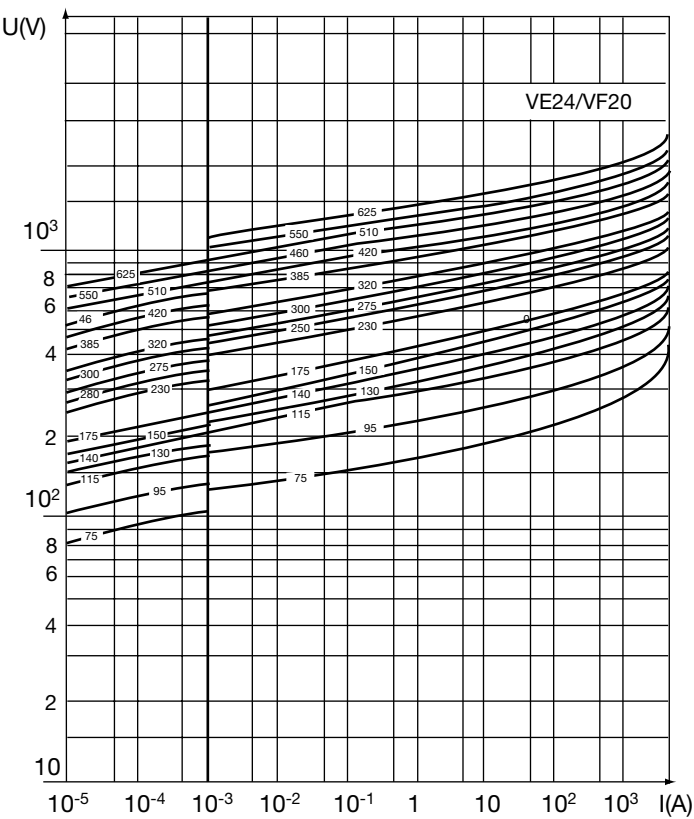
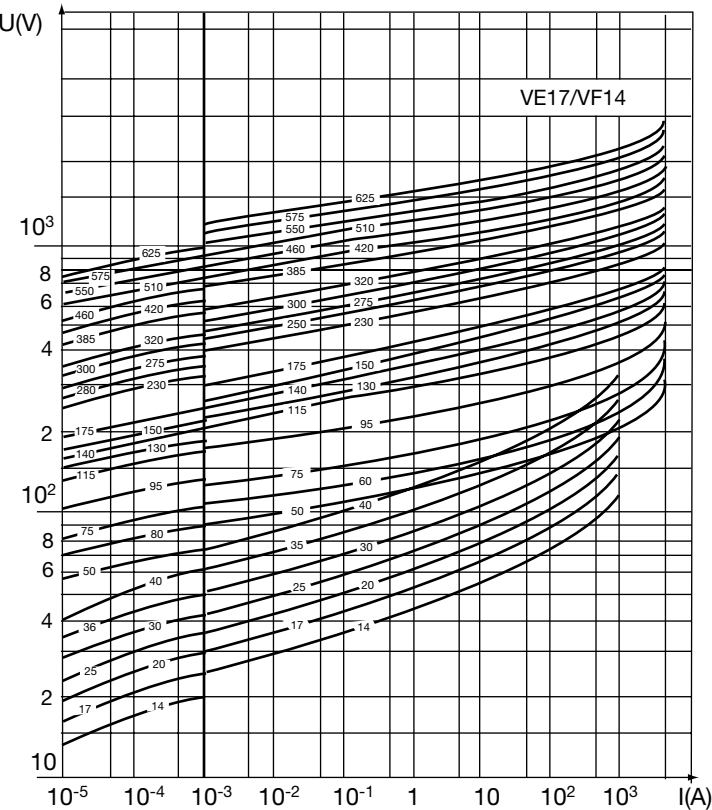


Zinc Oxide Varistors

Electrical Characteristics VE / VF Types



VOLTAGE-CURRENT CHARACTERISTICS

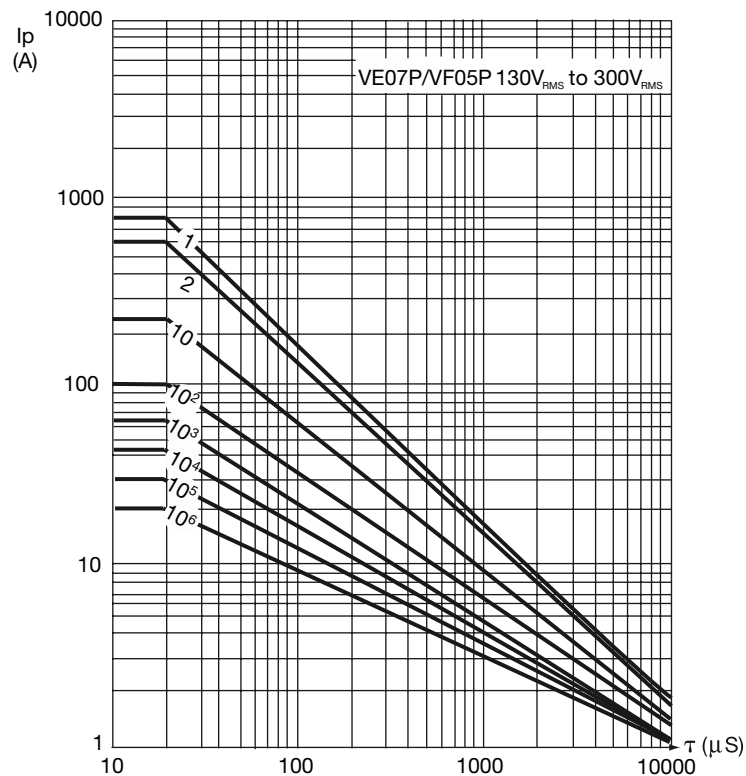
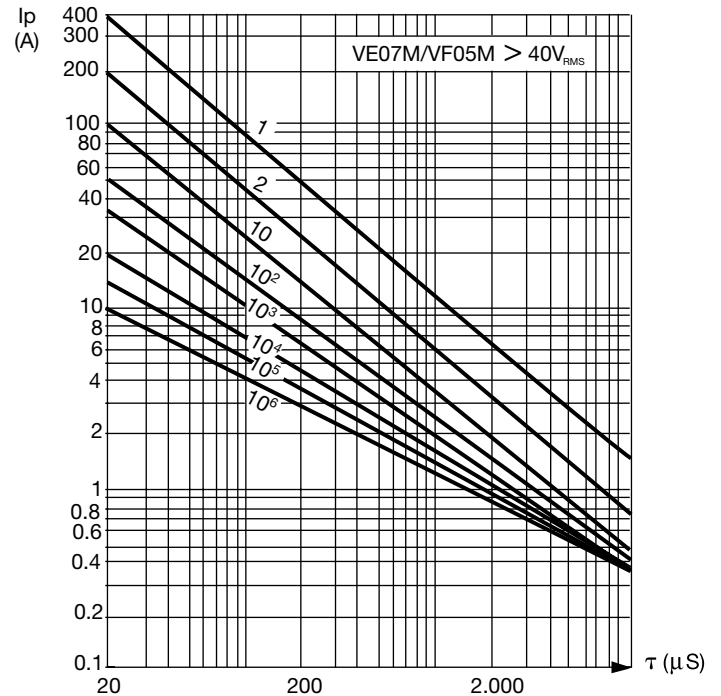
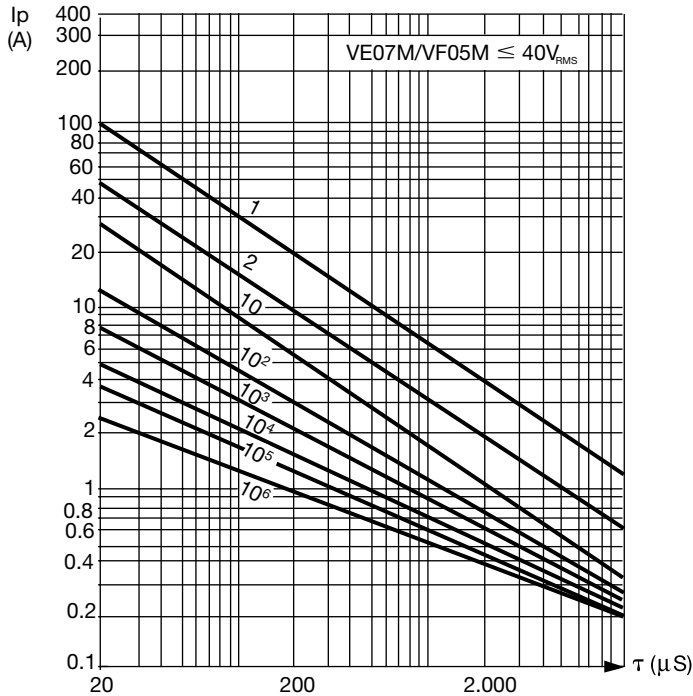


Zinc Oxide Varistors

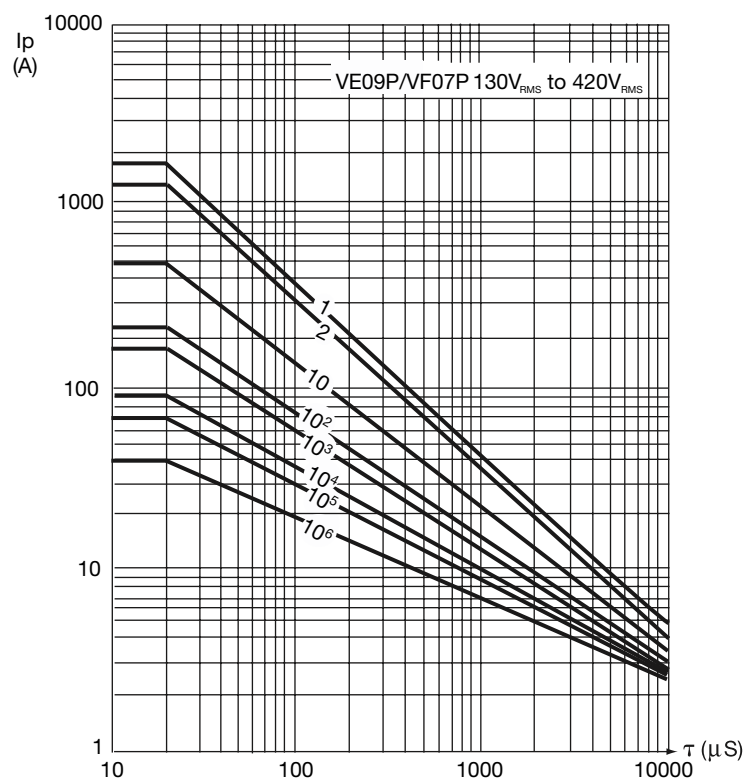
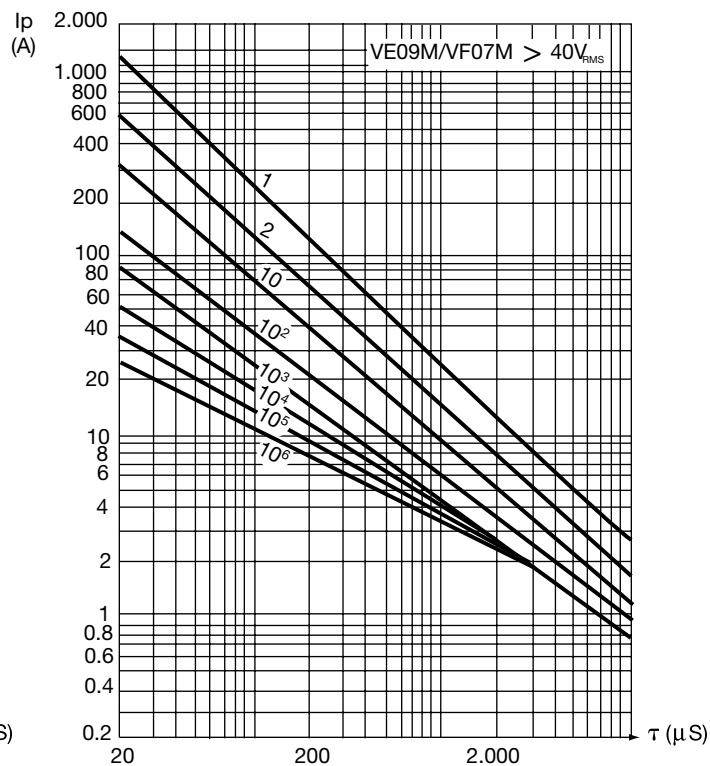
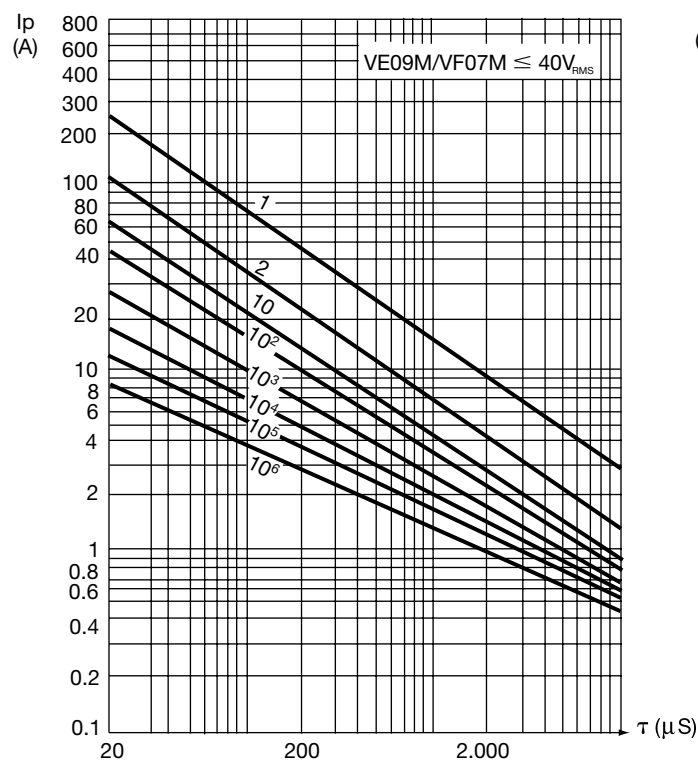
Electrical Characteristics VE / VF Types



MAXIMUM SURGE CURRENT (I_p) DERATING CURVES WITH PULSE WIDTH (τ) AND FREQUENCY



MAXIMUM SURGE CURRENT (I_p) DERATING CURVES WITH PULSE WIDTH (τ) AND FREQUENCY

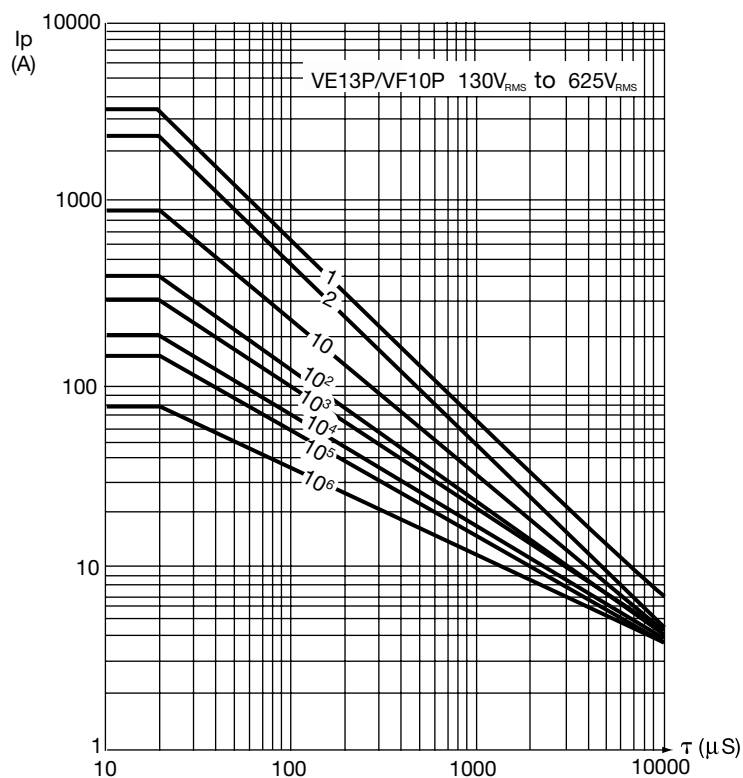
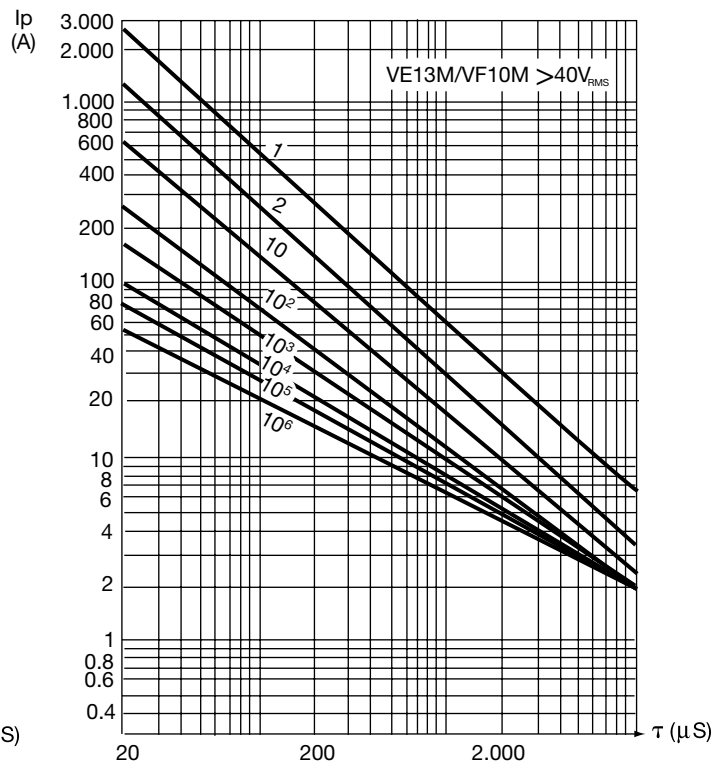
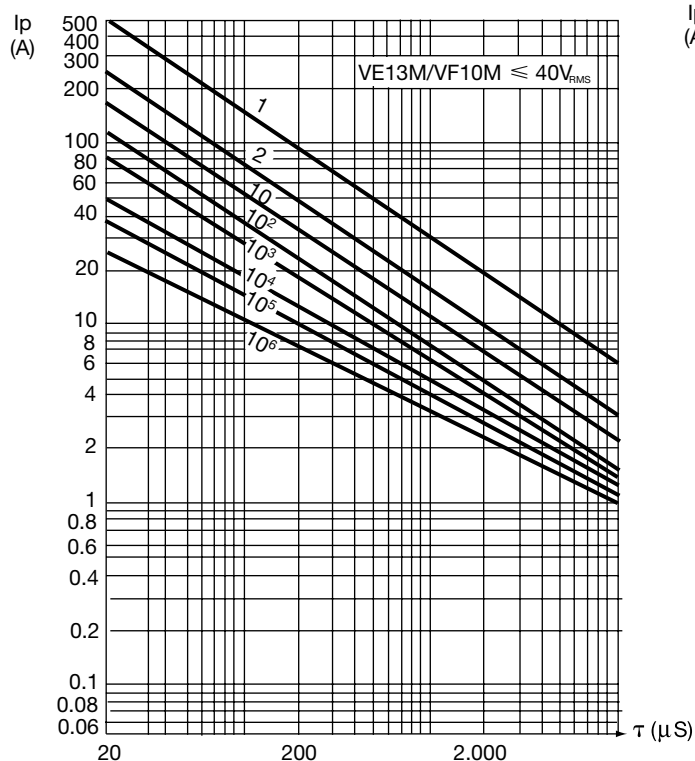


Zinc Oxide Varistors



Electrical Characteristics VE / VF Types

MAXIMUM SURGE CURRENT (I_p) DERATING CURVES WITH PULSE WIDTH (τ) AND FREQUENCY

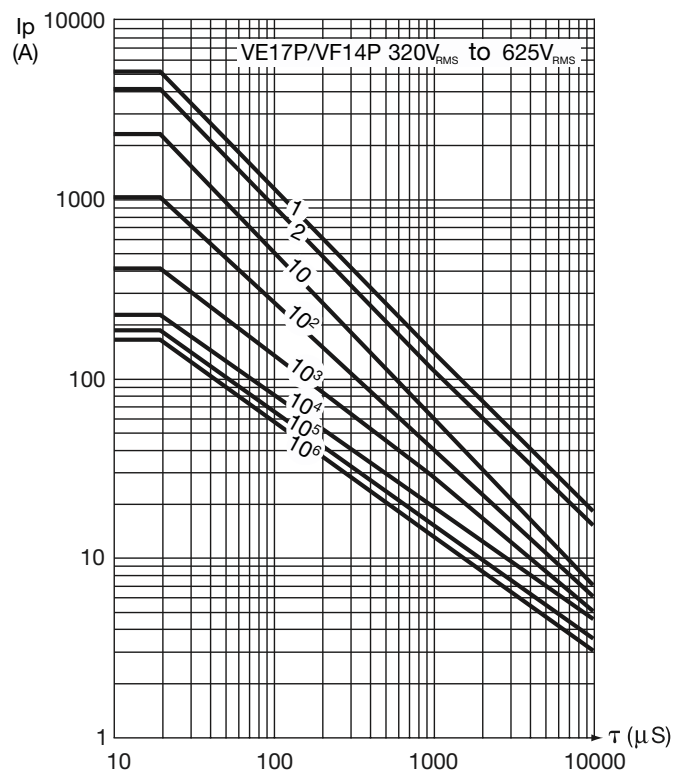
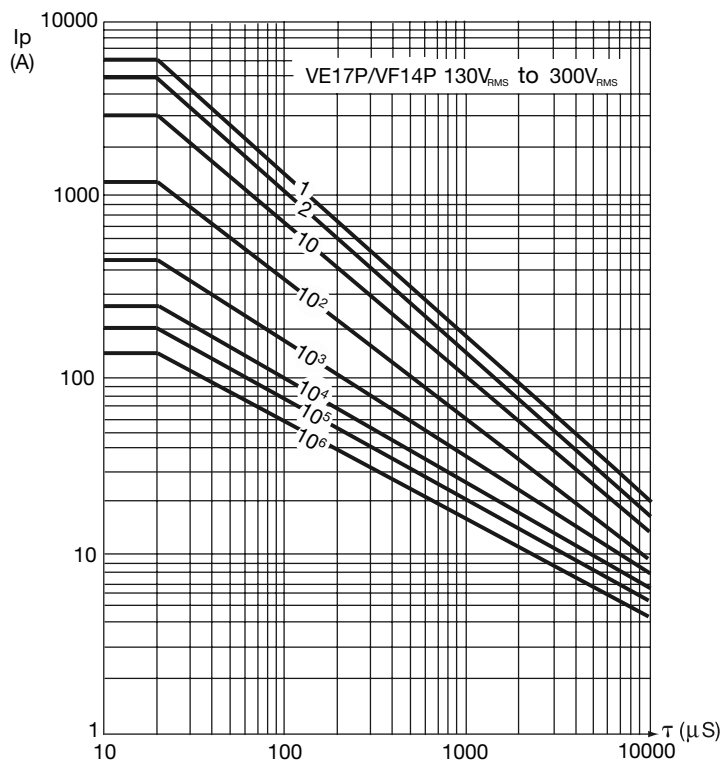
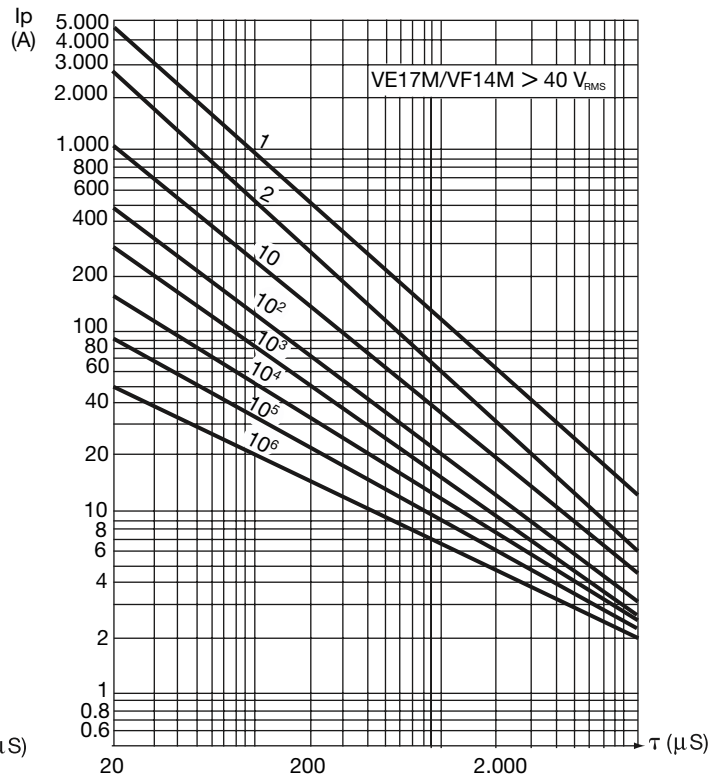
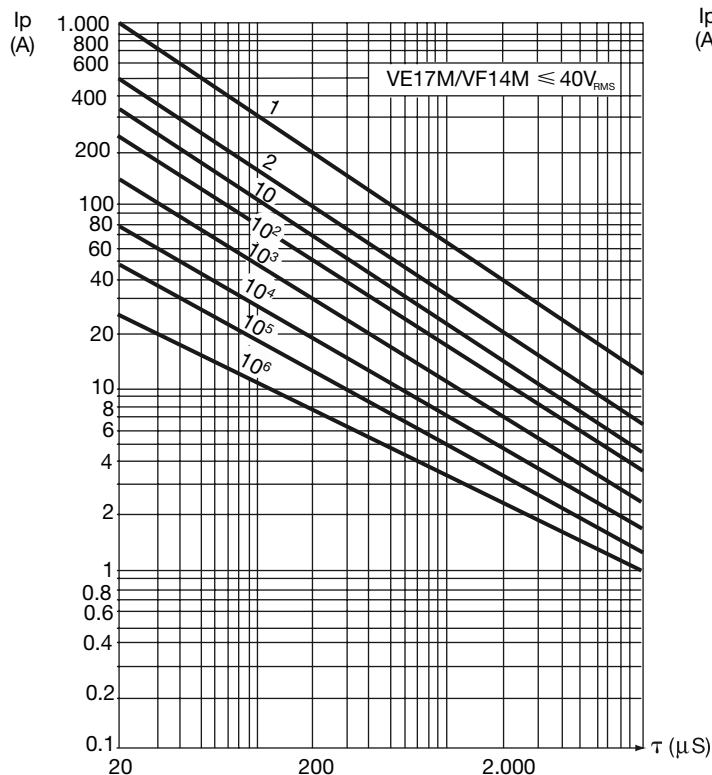


Zinc Oxide Varistors



Electrical Characteristics VE / VF Types

MAXIMUM SURGE CURRENT (I_p) DERATING CURVES WITH PULSE WIDTH (τ) AND FREQUENCY



Zinc Oxide Varistors



Electrical Characteristics VE / VF Types

MAXIMUM SURGE CURRENT (I_p) DERATING CURVES WITH PULSE WIDTH (τ) AND FREQUENCY

