



Chipsmall Limited consists of a professional team with an average of over 10 year of expertise in the distribution of electronic components. Based in Hongkong, we have already established firm and mutual-benefit business relationships with customers from,Europe,America and south Asia,supplying obsolete and hard-to-find components to meet their specific needs.

With the principle of “Quality Parts,Customers Priority,Honest Operation,and Considerate Service”,our business mainly focus on the distribution of electronic components. Line cards we deal with include Microchip,ALPS,ROHM,Xilinx,Pulse,ON,Everlight and Freescale. Main products comprise IC,Modules,Potentiometer,IC Socket,Relay,Connector.Our parts cover such applications as commercial,industrial, and automotives areas.

We are looking forward to setting up business relationship with you and hope to provide you with the best service and solution. Let us make a better world for our industry!



## Contact us

Tel: +86-755-8981 8866 Fax: +86-755-8427 6832

Email & Skype: info@chipsmall.com Web: www.chipsmall.com

Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China



# Aluminum Capacitors

## Radial Standard Ultra Miniature

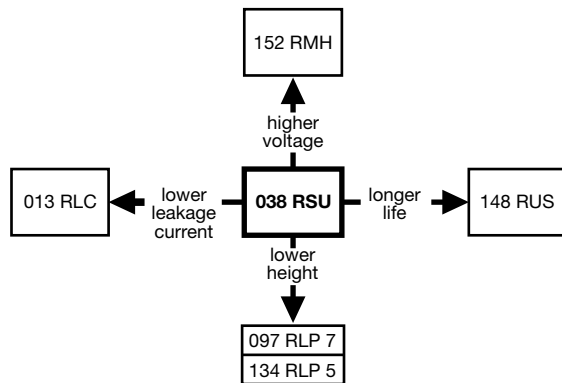
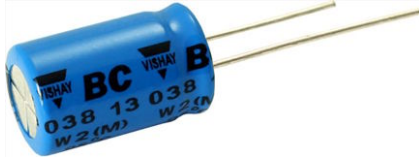


Fig. 1

QUICK REFERENCE DATA	
DESCRIPTION	VALUE
Nominal case sizes (Ø D x L in mm)	5 x 11 to 18 x 40
Rated capacitance range, C <sub>R</sub>	0.1 µF to 22 000 µF
Tolerance on C <sub>R</sub>	± 20 %
Rated voltage range, U <sub>R</sub>	6.3 V to 100 V
Category temperature range	- 40 °C to + 85 °C
Endurance test at 85 °C:	
Case size Ø D ≤ 8 mm	2000 h
Case size Ø D ≥ 10 mm	3000 h
Useful life at 85 °C:	
Case size Ø D ≤ 8 mm	2500 h
Case size Ø D ≥ 10 mm	3500 h
Useful life at 40 °C, 1.4 x I <sub>R</sub> applied:	
Case size Ø D ≤ 8 mm	60 000 h
Case size Ø D ≥ 10 mm	90 000 h
Shelf life at 0 V, 85 °C	1000 h
Based on sectional specification	IEC 60384-4/EN130300
Climatic category IEC 60068	40/085/56

### FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Radial leads, cylindrical aluminum case, insulated with a blue sleeve
- Pressure relief for case Ø D ≥ 6.3 mm
- Charge and discharge proof
- Miniaturized, high CV-product per unit volume
- Material categorization: For definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)


**RoHS**  
COMPLIANT

### APPLICATIONS

- General purpose, industrial, automotive, consumer, and audio-video
- Coupling, decoupling, timing, smoothing, filtering, buffering in SMPS
- Portable and mobile equipment (small size, low mass)

### MARKING

The capacitors are marked (where possible) with the following information:

- Rated capacitance (in µF)
- Tolerance on rated capacitance, code letter in accordance with IEC 60062 (M for ± 20 %)
- Rated voltage (in V)
- Date code, in accordance with IEC 60062
- Code indicating factory of origin
- Name of manufacturer
- Negative terminal identification
- Series number (038)

SELECTION CHART FOR $C_R$ , $U_R$ , AND RELEVANT NOMINAL CASE SIZES ( $\varnothing D \times L$ in mm)								
$C_R$ ( $\mu F$ )	$U_R$ (V)							
	6.3	10	16	25	35	50	63	100
0.10	–	–	–	–	–	–	5 x 11	–
0.22	–	–	–	–	–	–	5 x 11	–
0.33	–	–	–	–	–	–	5 x 11	–
0.47	–	–	–	–	–	–	5 x 11	5 x 11
1.0	–	–	–	–	–	–	5 x 11	5 x 11
2.2	–	–	–	–	–	–	5 x 11	5 x 11
3.3	–	–	–	–	–	–	5 x 11	5 x 11
4.7	–	–	–	–	–	–	5 x 11	5 x 11
10	–	–	–	–	–	–	5 x 11	6.3 x 11
22	–	–	–	–	–	5 x 11	5 x 11	6.3 x 11
33	–	–	–	–	–	5 x 11	6.3 x 11	8 x 11.5
47	–	–	–	–	5 x 11	6.3 x 11	6.3 x 11	10 x 12
100	–	5 x 11	5 x 11	6.3 x 11	6.3 x 11	8 x 11.5	10 x 12	10 x 20
220	5 x 11	5 x 11	6.3 x 11	8 x 11.5	8 x 11.5	10 x 12	10 x 16	13 x 25
330	6.3 x 11	6.3 x 11	8 x 11.5	8 x 11.5	10 x 12	10 x 16	10 x 20	13 x 25
470	6.3 x 11	6.3 x 11	8 x 11.5	10 x 12	10 x 16	10 x 20	13 x 20	16 x 25
1000	8 x 11.5	10 x 12	10 x 16	10 x 20	13 x 20	13 x 25	16 x 25	18 x 40
2200	10 x 16	10 x 20	13 x 20	13 x 25	6 x 25	16 x 31	18 x 35	–
3300	10 x 20	13 x 20	13 x 25	16 x 25	16 x 35	18 x 35	–	–
4700	13 x 20	13 x 25	16 x 25	16 x 31	18 x 35	–	–	–
6800	13 x 25	16 x 25	16 x 31	18 x 35	–	–	–	–
10 000	16 x 25	16 x 35	18 x 35	–	–	–	–	–
22 000	18 x 40	–	–	–	–	–	–	–

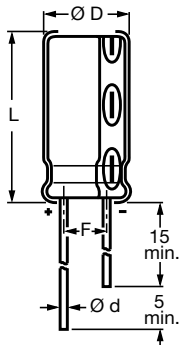
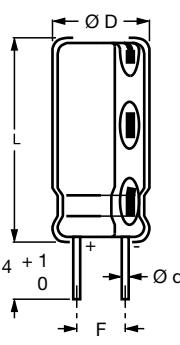
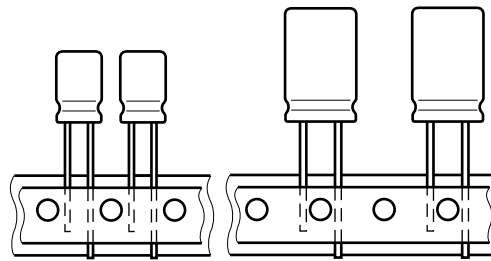
**DIMENSIONS in millimeters AND AVAILABLE FORMS**


Fig. 2 - Form CA


 Fig. 3 - Form CB:  
Cut leads


Dimensions of pitch F see Table 1 and Table 2

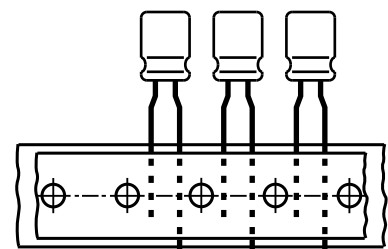
 Fig. 4 - Form TNA, Form TFA:  
Taped in box (ammopack), straight leads

 Case  $\varnothing D = 5$  mm to 8 mm; pitch F is 5 mm

 Fig. 5 - Form TFA:  
Taped in box (ammopack), formed leads

**Table 1**

DIMENSIONS in millimeters, MASS AND PACKAGING QUANTITIES									
NOMINAL CASE SIZE $\varnothing D \times L$	CASE CODE	$\varnothing d$	$\varnothing D_{max}$	$L_{max}$	F	MASS (g)	PACKAGING QUANTITIES		
							FORM CA	FORM CB	FORM TFA, TNA
5 x 11	11	0.5	5.5	12.5	$2.0 \pm 0.5$	$\approx 0.4$	5000	–	2000
6.3 x 11	12	0.5	6.8	12.5	$2.5 \pm 0.5$	$\approx 0.6$	5000	–	2000
8 x 11.5	13	0.6	8.5	12.5	$3.5 \pm 0.5$	$\approx 1.1$	5000	–	1000
10 x 12	14	0.6	10.5	13.5	$5.0 \pm 0.5$	$\approx 1.6$	3000	1000	500
10 x 16	15	0.6	10.5	17.5	$5.0 \pm 0.5$	$\approx 1.9$	2500	1000	500
10 x 20	16	0.6	10.5	22.0	$5.0 \pm 0.5$	$\approx 2.2$	2000	800	500
13 x 20	17	0.6	13.5	22.0	$5.0 \pm 0.5$	$\approx 4.0$	1500	400	300
13 x 25	18	0.6	13.5	27.0	$5.0 \pm 0.5$	$\approx 5.0$	1000	400	300
16 x 25	19	0.8	16.5	27.0	$7.5 \pm 0.5$	$\approx 8.0$	750	200	200
16 x 31	20	0.8	16.5	33.5	$7.5 \pm 0.5$	$\approx 9.0$	600	200	200
16 x 35	21	0.8	16.5	37.5	$7.5 \pm 0.5$	$\approx 11.0$	500	200	–
18 x 35	22	0.8	18.5	37.5	$7.5 \pm 0.5$	$\approx 14.5$	400	150	–
18 x 40	23	0.8	18.5	42.0	$7.5 \pm 0.5$	$\approx 16.0$	400	150	–

**Note**

- Detailed tape dimensions see section "Packaging".



ELECTRICAL DATA	
SYMBOL	DESCRIPTION
$C_R$	Rated capacitance at 100 Hz, tolerance $\pm 20\%$
$I_R$	Rated RMS ripple current at 100 Hz, 85 °C
$I_{L2}$	Max. leakage current after 2 min at $U_R$
$\tan \delta$	Max. dissipation factor at 100 Hz

**ORDERING EXAMPLE**

Electrolytic capacitor 038 series

470  $\mu\text{F}/25\text{ V}; \pm 20\%$

Nominal case size:  $\varnothing 10\text{ mm} \times 12\text{ mm}$ ; form TFA

Ordering code: MAL2 038 36471 E3

Former 12NC: 2222 038 36471

**Note**

- Unless otherwise specified, all electrical values in Table 2 apply at  $T_{\text{amb}} = 20\text{ °C}$ ,  $P = 86\text{ kPa}$  to  $106\text{ kPa}$ ,  $\text{RH} = 45\%$  to  $75\%$ .

**Table 2**

ELECTRICAL DATA AND ORDERING INFORMATION													
$U_R$ (V)	$C_R$ 100 Hz ( $\mu\text{F}$ )	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	$I_R$ 100 Hz 85 °C (mA)	$I_{L2}$ 2 min ( $\mu\text{A}$ )	$\tan \delta$ 100 Hz	ORDERING CODE MAL2038 .....							
						BULK PACKAGING				TAPED AMMOPACK			
						LONG LEADS		CUT LEADS		FORM TFA		FORM TNA	
						FORM CA	F (mm)	FORM CB	F (mm)	FORM TFA	F (mm)	FORM TNA	F (mm)
6.3	220	5 x 11	200	14	0.23	53221E3	2.0	-	-	33221E3	5.0	73221E3	2.5
	330	6.3 x 11	270	21	0.23	53331E3	2.5	-	-	33331E3	5.0	73331E3	2.5
	470	6.3 x 11	320	30	0.23	53471E3	2.5	-	-	33471E3	5.0	73471E3	2.5
	1000	8 x 11.5	540	63	0.23	53102E3	3.5	-	-	33102E3	5.0	73102E3	3.5
	2200	10 x 16	785	139	0.25	53222E3	5.0	63222E3	5.0	33222E3	5.0	-	-
	3300	10 x 20	1185	208	0.27	53332E3	5.0	63332E3	5.0	33332E3	5.0	-	-
	4700	13 x 20	1545	296	0.29	53472E3	5.0	63472E3	5.0	33472E3	5.0	-	-
	6800	13 x 25	1880	428	0.33	53682E3	5.0	63682E3	5.0	33682E3	5.0	-	-
	10 000	16 x 25	2330	630	0.41	53103E3	7.5	63103E3	7.5	33103E3	7.5	-	-
	22 000	18 x 40	3320	1386	0.65	53223E3	7.5	63223E3	7.5	-	-	-	-
10	100	5 x 11	145	10	0.20	54101E3	2.0	-	-	34101E3	5.0	74101E3	2.5
	220	5 x 11	160	22	0.20	54221E3	2.0	-	-	34221E3	5.0	74221E3	2.5
	330	6.3 x 11	290	33	0.20	54331E3	2.5	-	-	34331E3	5.0	74331E3	2.5
	470	6.3 x 11	350	47	0.20	54471E3	2.5	-	-	34471E3	5.0	74471E3	2.5
	1000	10 x 12	650	100	0.20	54102E3	5.0	64102E3	5.0	34102E3	5.0	-	-
	2200	10 x 20	1070	220	0.22	54222E3	5.0	64222E3	5.0	34222E3	5.0	-	-
	3300	13 x 20	1420	330	0.24	54332E3	5.0	64332E3	5.0	34332E3	5.0	-	-
	4700	13 x 25	1780	470	0.26	54472E3	5.0	64472E3	5.0	34472E3	5.0	-	-
	6800	16 x 25	2220	680	0.30	54682E3	7.5	64682E3	7.5	34682E3	7.5	-	-
	10 000	16 x 35	2760	1000	0.38	54103E3	7.5	64103E3	7.5	-	-	-	-
16	100	5 x 11	160	16	0.16	55101E3	2.0	-	-	35101E3	5.0	75101E3	2.5
	220	6.3 x 11	260	35	0.16	55221E3	2.5	-	-	35221E3	5.0	75221E3	2.5
	330	8 x 11.5	370	53	0.16	55331E3	3.5	-	-	35331E3	5.0	75331E3	3.5
	470	8 x 11.5	440	75	0.16	55471E3	3.5	-	-	35471E3	5.0	75471E3	3.5
	1000	10 x 16	785	160	0.16	55102E3	5.0	65102E3	5.0	35102E3	5.0	-	-
	2200	13 x 20	1295	352	0.18	55222E3	5.0	65222E3	5.0	35222E3	5.0	-	-
	3300	13 x 25	1655	528	0.20	55332E3	5.0	65332E3	5.0	35332E3	5.0	-	-
	4700	16 x 25	2090	752	0.22	55472E3	7.5	65472E3	7.5	35472E3	7.5	-	-
	6800	16 x 31	2520	1088	0.26	55682E3	7.5	65682E3	7.5	35682E3	7.5	-	-
	10 000	18 x 35	2920	1600	0.34	55103E3	7.5	65103E3	7.5	-	-	-	-
25	100	6.3 x 11	190	25	0.14	56101E3	2.5	-	-	36101E3	5.0	76101E3	2.5
	220	8 x 11.5	320	55	0.14	56221E3	3.5	-	-	36221E3	5.0	76221E3	3.5
	330	8 x 11.5	440	83	0.14	56331E3	3.5	-	-	36331E3	5.0	76331E3	3.5
	470	10 x 12	545	118	0.14	56471E3	5.0	66471E3	5.0	36471E3	5.0	-	-
	1000	10 x 20	955	250	0.14	56102E3	5.0	66102E3	5.0	36102E3	5.0	-	-
	2200	13 x 25	1540	550	0.16	56222E3	5.0	66222E3	5.0	36222E3	5.0	-	-
	3300	16 x 25	1975	825	0.18	56332E3	7.5	66332E3	7.5	36332E3	7.5	-	-
	4700	16 x 31	2420	1175	0.20	56472E3	7.5	66472E3	7.5	36472E3	7.5	-	-
	6800	18 x 35	2880	1700	0.24	56682E3	7.5	66682E3	7.5	-	-	-	-



ELECTRICAL DATA AND ORDERING INFORMATION													
U <sub>R</sub> (V)	C <sub>R</sub> 100 Hz (μF)	NOMINAL CASE SIZE Ø D x L (mm)	I <sub>R</sub> 100 Hz 85 °C (mA)	I <sub>L2</sub> 2 min (μA)	tan δ 100 Hz	ORDERING CODE MAL2038 .....							
						BULK PACKAGING				TAPED AMMOPACK			
						LONG LEADS		CUT LEADS		FORM TFA		FORM TNA	
						FORM CA	F (mm)	FORM CB	F (mm)	FORM TFA	F (mm)	FORM TNA	F (mm)
35	47	5 x 11	130	17	0.12	50479E3	2.0	-	-	30479E3	5.0	70479E3	2.5
	100	6.3 x 11	210	35	0.12	50101E3	2.5	-	-	30101E3	5.0	70101E3	2.5
	220	8 x 11.5	385	77	0.12	50221E3	3.5	-	-	30221E3	5.0	70221E3	3.5
	330	10 x 12	490	116	0.12	50331E3	5.0	60331E3	5.0	30331E3	5.0	-	-
	470	10 x 16	740	165	0.12	50471E3	5.0	60471E3	5.0	30471E3	5.0	-	-
	1000	13 x 20	1145	350	0.12	50102E3	5.0	60102E3	5.0	30102E3	5.0	-	-
	2200	16 x 25	1785	770	0.14	50222E3	7.5	60222E3	7.5	30222E3	7.5	-	-
	3300	16 x 35	2275	1155	0.16	50332E3	7.5	60332E3	7.5	-	-	-	-
	4700	18 x 35	2700	1645	0.18	50472E3	7.5	60472E3	7.5	-	-	-	-
50	22	5 x 11	95	11	0.10	51229E3	2.0	-	-	31229E3	5.0	71229E3	2.5
	33	5 x 11	125	17	0.10	51339E3	2.0	-	-	31339E3	5.0	71339E3	2.5
	47	6.3 x 11	165	24	0.10	51479E3	2.5	-	-	31479E3	5.0	71479E3	2.5
	100	8 x 11.5	260	50	0.10	51101E3	3.5	-	-	31101E3	5.0	71101E3	3.5
	220	10 x 12	455	110	0.10	51221E3	5.0	61221E3	5.0	31221E3	5.0	-	-
	330	10 x 16	585	165	0.10	51331E3	5.0	61331E3	5.0	31331E3	5.0	-	-
	470	10 x 20	755	235	0.10	51471E3	5.0	61471E3	5.0	31471E3	5.0	-	-
	1000	13 x 25	1340	500	0.10	51102E3	5.0	61102E3	5.0	31102E3	5.0	-	-
	2200	16 x 31	1885	1100	0.12	51222E3	7.5	61222E3	7.5	31222E3	7.5	-	-
3300	18 x 35	2500	1650	0.14	51332E3	7.5	61332E3	7.5	-	-	-	-	
63	0.10	5 x 11	3.0	3.0	0.09	58107E3	2.0	-	-	38107E3	5.0	78107E3	2.5
	0.22	5 x 11	4.5	3.0	0.09	58227E3	2.0	-	-	38227E3	5.0	78227E3	2.5
	0.33	5 x 11	7.5	3.0	0.09	58337E3	2.0	-	-	38337E3	5.0	78337E3	2.5
	0.47	5 x 11	9.5	3.0	0.09	58477E3	2.0	-	-	38477E3	5.0	78477E3	2.5
	1.0	5 x 11	17	3.0	0.09	58108E3	2.0	-	-	38108E3	5.0	78108E3	2.5
	2.2	5 x 11	28	3.0	0.09	58228E3	2.0	-	-	38228E3	5.0	78228E3	2.5
	3.3	5 x 11	34	3.0	0.09	58338E3	2.0	-	-	38338E3	5.0	78338E3	2.5
	4.7	5 x 11	45	3.0	0.09	58478E3	2.0	-	-	38478E3	5.0	78478E3	2.5
	10	5 x 11	70	6.3	0.09	58109E3	2.0	-	-	38109E3	5.0	78109E3	2.5
	22	5 x 11	105	14	0.09	58229E3	2.0	-	-	38229E3	5.0	78229E3	2.5
	33	6.3 x 11	140	21	0.09	58339E3	2.5	-	-	38339E3	5.0	78339E3	2.5
	47	6.3 x 11	170	30	0.09	58479E3	2.5	-	-	38479E3	5.0	78479E3	2.5
	100	10 x 12	320	63	0.09	58101E3	5.0	68101E3	5.0	38101E3	5.0	-	-
	220	10 x 16	490	139	0.09	58221E3	5.0	68221E3	5.0	38221E3	5.0	-	-
	330	10 x 20	710	208	0.09	58331E3	5.0	68331E3	5.0	38331E3	5.0	-	-
	470	13 x 20	900	296	0.09	58471E3	5.0	68471E3	5.0	38471E3	5.0	-	-
1000	16 x 25	1560	630	0.09	58102E3	7.5	68102E3	7.5	38102E3	7.5	-	-	
2200	18 x 35	1950	1386	0.11	58222E3	7.5	68222E3	7.5	-	-	-	-	
100	0.47	5 x 11	12	3.0	0.08	59477E3	2.0	-	-	39477E3	5.0	79477E3	2.5
	1.0	5 x 11	22	3.0	0.08	59108E3	2.0	-	-	39108E3	5.0	79108E3	2.5
	2.2	5 x 11	33	3.0	0.08	59228E3	2.0	-	-	39228E3	5.0	79228E3	2.5
	3.3	5 x 11	40	3.3	0.08	59338E3	2.0	-	-	39338E3	5.0	79338E3	2.5
	4.7	5 x 11	48	4.7	0.08	59478E3	2.0	-	-	39478E3	5.0	79478E3	2.5
	10	6.3 x 11	80	10	0.08	59109E3	2.5	-	-	39109E3	5.0	79109E3	2.5
	22	6.3 x 11	115	22	0.08	59229E3	2.5	-	-	39229E3	5.0	79229E3	2.5
	33	8 x 11.5	145	33	0.08	59339E3	3.5	-	-	39339E3	5.0	79339E3	3.5
	47	10 x 12	235	47	0.08	59479E3	5.0	69479E3	5.0	39479E3	5.0	-	-
	100	10 x 20	370	100	0.08	59101E3	5.0	69101E3	5.0	39101E3	5.0	-	-
	220	13 x 25	675	220	0.08	59221E3	5.0	69221E3	5.0	39221E3	5.0	-	-
	330	13 x 25	825	330	0.08	59331E3	5.0	69331E3	5.0	39331E3	5.0	-	-
470	16 x 25	1070	470	0.08	59471E3	7.5	69471E3	7.5	39471E3	7.5	-	-	
1000	18 x 40	2410	1000	0.08	59102E3	7.5	69102E3	7.5	-	-	-	-	



ADDITIONAL ELECTRICAL DATA		
PARAMETER	CONDITIONS	VALUE
<b>Voltage</b>		
Surge voltage		$U_s \leq 1.15 \times U_R$
Reverse voltage		$U_{rev} \leq 1 V$
<b>Current</b>		
Leakage current	After 2 min at $U_R$	$I_{L2} \leq 0.01 C_R \times U_R$ or $3 \mu A$ , whichever is greater
	After 5 min at $U_R$	$I_{L5} \leq 0.002 C_R \times U_R + 3 \mu A$
<b>Inductance</b>		
Equivalent series inductance (ESL)	Case $\varnothing D \leq 8$ mm	Typ. 13 nH
	Case $\varnothing D = 10$ mm	Typ. 16 nH
	Case $\varnothing D \geq 12.5$ mm	Typ. 18 nH
<b>Resistance</b>		
Equivalent series resistance (ESR)	Calculated from $\tan \delta_{max}$ and $C_R$ (see Table 2)	$ESR = \tan \delta / 2 \pi f C_R$

**CAPACITANCE (C)**

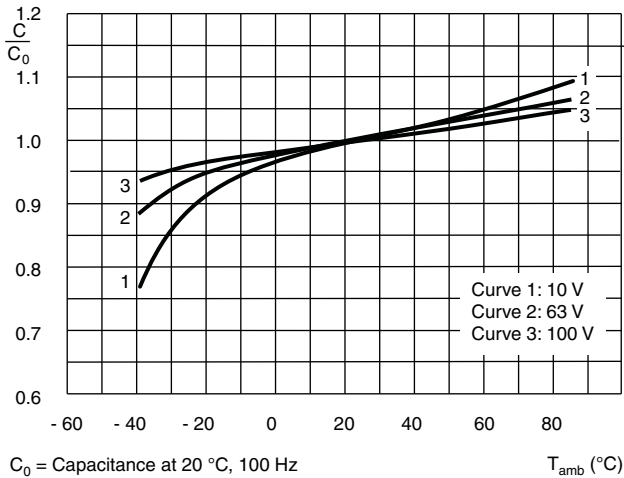


Fig. 6 - Typical multiplier of capacitance as a function of ambient temperature

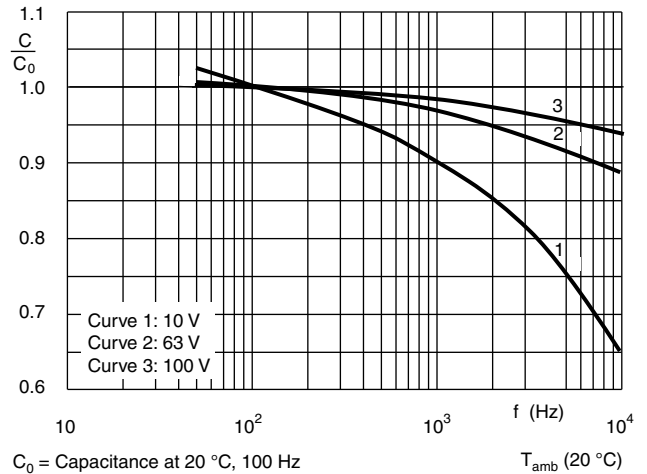
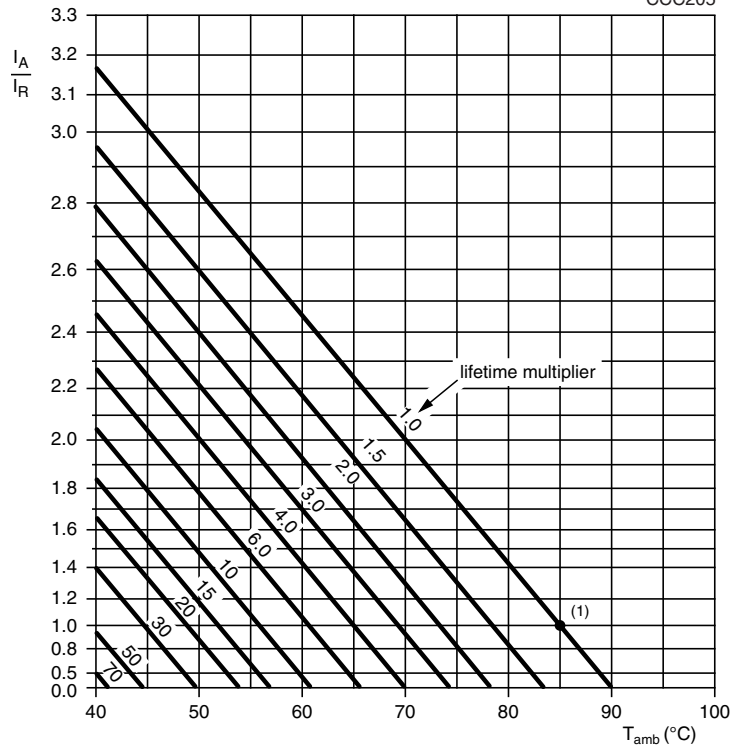


Fig. 7 - Typical multiplier of capacitance as a function of frequency

**RIPPLE CURRENT AND USEFUL LIFE**

CCC205



$I_A$  = Actual ripple current at 100 Hz  
 $I_R$  = Rated ripple current at 100 Hz, 85 °C  
 Useful life at 85 °C and  $I_R$  applied:  
 Case  $\varnothing D \leq 8$  mm: 2500 h  
 Case  $\varnothing D \geq 10$  mm: 3500 h

Fig. 8 - Multiplier of useful life as a function of ambient temperature and ripple current load

**Table 3**

<b>MULTIPLIER OF RIPPLE CURRENT (<math>I_R</math>) AS A FUNCTION OF FREQUENCY</b>			
<b>FREQUENCY (Hz)</b>	<b><math>I_R</math> MULTIPLIER</b>		
	<b><math>C_R &lt; 100 \mu\text{F}</math></b>	<b><math>C_R = 100 \mu\text{F TO } 1000 \mu\text{F}</math></b>	<b><math>C_R &gt; 1000 \mu\text{F}</math></b>
50	0.70	0.75	0.80
100	1.00	1.00	1.00
500	1.30	1.20	1.10
1000	1.40	1.30	1.12
$\geq 10\,000$	1.50	1.35	1.15

**Table 4**

<b>TEST PROCEDURES AND REQUIREMENTS</b>			
<b>TEST</b>		<b>PROCEDURE (quick reference)</b>	<b>REQUIREMENTS</b>
<b>NAME OF TEST</b>	<b>REFERENCE</b>		
Endurance	IEC 60384-4/ EN130300 subclause 4.13	$T_{\text{amb}} = 85 \text{ °C}$ ; $U_R$ applied; Case $\varnothing \leq 8$ mm: 2000 h Case $\varnothing \geq 10$ mm: 3000 h	$\Delta C/C: \pm 20 \%$ $\tan \delta \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{\text{amb}} = 85 \text{ °C}$ ; $U_R$ and $I_R$ applied; Case $\varnothing \leq 8$ mm: 2500 h Case $\varnothing \geq 10$ mm: 3500 h	$\Delta C/C: \pm 50 \%$ $\tan \delta \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit total failure percentage: $\leq 1 \%$
Shelf life (storage at high temperature)	IEC 60384-4/ EN130300 subclause 4.17	$T_{\text{amb}} = 85 \text{ °C}$ ; no voltage applied; 1000 h after test: $U_R$ to be applied for 30 min, 24 h to 48 h before measurement	$\Delta C/C: \pm 20 \%$ $\tan \delta \leq 2 \times \text{spec. limit}$ $I_{L5} \leq 3 \times \text{spec. limit}$
Surge	IEC 60384-4/ EN130300 subclause 4.14	From source of $1.15 \times U_R$ ; $RC = 0.1 \text{ s} \pm 0.05 \text{ s}$ ; 1000 cycles of 30 s on, 330 s off, at 85 °C	$\Delta C/C: \pm 25 \%$ $\tan \delta \leq 1.5 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$



## Disclaimer

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, "Vishay"), disclaim any and all liability for any errors, inaccuracies or incompleteness contained in any datasheet or in any other disclosure relating to any product.

Vishay makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, Vishay disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.

Statements regarding the suitability of products for certain types of applications are based on Vishay's knowledge of typical requirements that are often placed on Vishay products in generic applications. Such statements are not binding statements about the suitability of products for a particular application. It is the customer's responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Parameters provided in datasheets and/or specifications may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated for each customer application by the customer's technical experts. Product specifications do not expand or otherwise modify Vishay's terms and conditions of purchase, including but not limited to the warranty expressed therein.

Except as expressly indicated in writing, Vishay products are not designed for use in medical, life-saving, or life-sustaining applications or for any other application in which the failure of the Vishay product could result in personal injury or death. Customers using or selling Vishay products not expressly indicated for use in such applications do so at their own risk. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay. Product names and markings noted herein may be trademarks of their respective owners.

## Material Category Policy

**Vishay Intertechnology, Inc. hereby certifies that all its products that are identified as RoHS-Compliant fulfill the definitions and restrictions defined under Directive 2011/65/EU of The European Parliament and of the Council of June 8, 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (EEE) - recast, unless otherwise specified as non-compliant.**

**Please note that some Vishay documentation may still make reference to RoHS Directive 2002/95/EC. We confirm that all the products identified as being compliant to Directive 2002/95/EC conform to Directive 2011/65/EU.**

**Vishay Intertechnology, Inc. hereby certifies that all its products that are identified as Halogen-Free follow Halogen-Free requirements as per JEDEC JS709A standards. Please note that some Vishay documentation may still make reference to the IEC 61249-2-21 definition. We confirm that all the products identified as being compliant to IEC 61249-2-21 conform to JEDEC JS709A standards.**