

## Aluminum Capacitors Power Ultra Miniature Snap-In

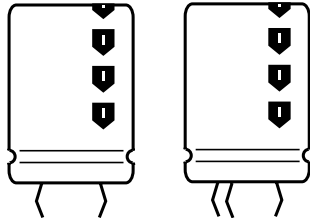
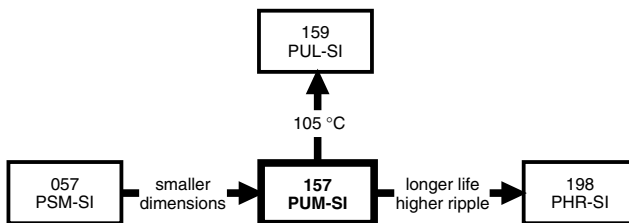


Fig.1 Component outlines


**FEATURES**

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Large types, very small dimensions, cylindrical aluminum case, insulated with a blue sleeve
- Useful life: 5000 hours at 85 °C
- Keyed polarity version available


**RoHS  
COMPLIANT**
**APPLICATIONS**

- General purpose, industrial and audio/video systems
- Smoothing and filtering
- Standard and switched mode power supplies
- Energy storage in pulse systems

**MARKING**

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

- Rated capacitance (in  $\mu\text{F}$ )
- Tolerance on rated capacitance, code letter in accordance with IEC 60062 (M for  $\pm 20\%$ )
- Rated voltage (in V)
- Date code (YYMM)
- Name of manufacturer
- Code for factory of origin
- '-' sign to identify the negative terminal, visible from the top and side of the capacitor
- Code number, all 12 or last 8 digits (2222) 157 xxxxx
- Climatic category in accordance with IEC 60068

**QUICK REFERENCE DATA**

DESCRIPTION	VALUE
Nominal case sizes ( $\varnothing$ D x L in mm)	22 x 25 to 35 x 60
Rated capacitance range (E6/E12 series), $C_R$	56 $\mu\text{F}$ to 2200 $\mu\text{F}$
Tolerance on $C_R$	$\pm 20\%$
Rated voltage range, $U_R$	200 V, 250 V   400 V, 450 V
Category temperature range	- 25 to + 85 °C
Endurance test at 85 °C	3000 hours
Load life at 85 °C	3000 hours
Useful life at 85 °C	5000 hours
Useful life at 40 °C, 1.4 x $I_R$ applied	90 000 hours
Shelf life at 0 V, 85 °C	1000 hours
Based on sectional specification	IEC 60384-4/EN130300
Climatic category IEC 60038	25/085/56

**SELECTION CHART FOR  $C_R$ ,  $U_R$  AND RELEVANT NOMINAL CASE SIZES ( $\varnothing$  D x L in mm)**

$C_R$ ( $\mu\text{F}$ )	$U_R$ (V)			
	200	250	400	450
56	-	-	-	22 x 25
68	-	-	22 x 25	22 x 30
82	-	-	22 x 25	22 x 30
	-	-	-	25 x 25
100	-	-	22 x 30	22 x 35
	-	-	-	25 x 30
120	-	-	22 x 30	22 x 40
	-	-	-	25 x 30
	-	-	-	30 x 25

<b>SELECTION CHART FOR C<sub>R</sub>, U<sub>R</sub> AND RELEVANT NOMINAL CASE SIZES (∅ D x L in mm)</b>				
C <sub>R</sub> (μF)	U <sub>R</sub> (V)			
	200	250	400	450
150	-	-	22 x 35	25 x 35
	-	-	25 x 30	25 x 40
	-	-	-	30 x 30
180	-	-	22 x 40	25 x 40
	-	-	25 x 35	30 x 35
	-	-	-	35 x 25
220	-	22 x 30	25 x 40	25 x 50
	-	-	30 x 30	30 x 40
	-	-	35 x 25	35 x 30
270	22 x 25	22 x 30	25 x 45	30 x 45
	-	25 x 25	30 x 35	35 x 35
	-	-	35 x 30	-
330	22 x 30	22 x 35	30 x 40	30 x 50
	-	25 x 30	35 x 30	35 x 40
390	22 x 30	22 x 40	30 x 45	35 x 45
	-	30 x 25	35 x 35	-
470	22 x 35	25 x 35	30 x 50	35 x 50
	25 x 30	30 x 30	35 x 40	-
560	22 x 40	25 x 40	35 x 45	-
	25 x 35	30 x 30	-	-
	30 x 25	35 x 25	-	-
680	25 x 40	25 x 45	35 x 50	35 x 60
	30 x 30	30 x 35	-	-
	35 x 25	35 x 30	-	-
820	25 x 45	30 x 40	35 x 60	-
	30 x 35	35 x 35	-	-
	35 x 30	-	-	-
1000	30 x 40	30 x 45	-	-
	35 x 30	35 x 40	-	-
1200	30 x 45	35 x 45	-	-
	35 x 35	-	-	-
1500	30 x 50	35 x 50	-	-
	35 x 40	-	-	-
1800	35 x 45	-	-	-
2200	35 x 50	-	-	-

## DIMENSIONS in millimeters AND AVAILABLE FORMS

### TWO TERMINAL SNAP-IN

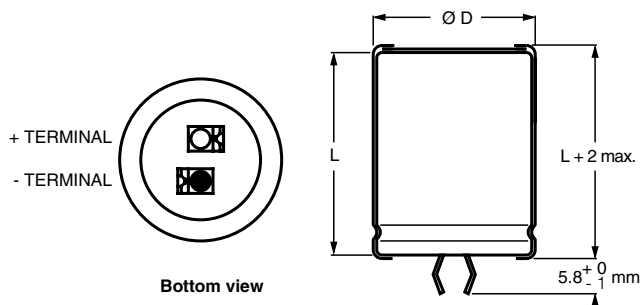


Fig.2 Two terminal snap-in

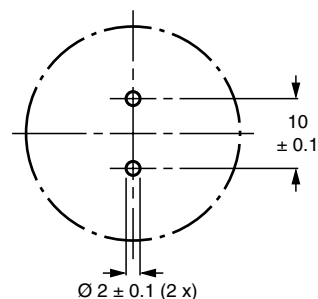
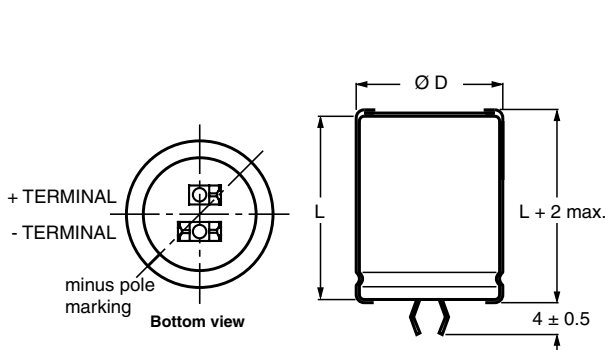


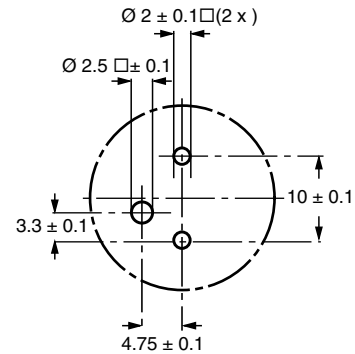
Fig.3 Mounting hole diagram

The minus terminal can be marked with a black dot or with an imprinted '-' sign.

**THREE TERMINAL SNAP-IN**


The negative terminal has **TWO** pins which are **BOTH** electrically connected.

Fig.4 Three terminal snap-in



The 10 mm spacing of the 2 pin snap-in is used as the base layout and a third hole is added.

The third hole is closer to the negative primary hole so that polarization is always maintained, together with added mechanical stability.

Fig.5 Mounting hole diagram

Table 1

<b>DIMENSIONS</b> in millimeters, <b>MASS AND PACKAGING QUANTITIES</b>				
<b>NOMINAL CASE SIZE</b> $\varnothing D \times L$	$\varnothing D_{\text{max.}}$	$L_{\text{max.}}$	<b>MASS (g)</b>	<b>PACKAGING QUANTITIES (units per box)</b>
22 x 25	23	27	≈ 12	100
22 x 30	23	32	≈ 16	100
22 x 35	23	37	≈ 20	100
22 x 40	23	42	≈ 23	100
25 x 25	26	27	≈ 20	100
25 x 30	26	32	≈ 22	100
25 x 35	26	37	≈ 24	100
25 x 40	26	42	≈ 27	100
25 x 45	26	47	≈ 32	100
25 x 50	26	52	≈ 38	100
30 x 25	31	27	≈ 25	100
30 x 30	31	32	≈ 30	100
30 x 35	31	37	≈ 35	100
30 x 40	31	42	≈ 40	100
30 x 45	31	47	≈ 45	100
30 x 50	31	52	≈ 50	100
35 x 25	36	27	≈ 33	50
35 x 30	36	32	≈ 40	50
35 x 35	36	37	≈ 48	50
35 x 40	36	42	≈ 55	50
35 x 45	36	47	≈ 63	50
35 x 50	36	52	≈ 72	50
35 x 60	36	62	≈ 82	50



ELECTRICAL DATA	
SYMBOL	DESCRIPTION
$C_R$	rated capacitance at 100/120 Hz
$I_R$	rated RMS ripple current at 120 Hz, 85 °C
$I_{L5}$	max. leakage current after 5 minutes at $U_R$
ESR	typ./max. equivalent series resistance at 100 Hz <sup>(1)</sup>
Z	typ./max. impedance at 10 kHz

**Notes**

- <sup>(1)</sup> ESR at 120 Hz is approximately 0.95 x ESR 100 Hz
- Unless otherwise specified, all electrical values in Table 2 apply at  $T_{amb} = 20\text{ °C}$ ,  $P = 86\text{ to }106\text{ kPa}$ ,  $RH = 45\text{ to }75\%$

**ORDERING EXAMPLE**

Electrolytic capacitor 157 series  
1000  $\mu\text{F}/200\text{ V}$ ;  $\pm 20\%$   
Nominal case size:  $\varnothing 30 \times 40\text{ mm}$   
2-terminal snap-in:  
Ordering code: MAL2 157 52102 E3  
Former 12NC: 2222 157 52102

3-terminal snap-in:  
Ordering code: MAL2 157 72102 E3  
Former 12NC: 2222 157 72102

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)	$I_R$ 120 Hz 85 °C (A)	$I_{L5}$ 5 min (mA)	TYP. ESR 100 Hz <sup>(1)</sup> (M $\Omega$ )	MAX. ESR 100 Hz <sup>(1)</sup> (M $\Omega$ )	TYP. Z 10 kHz (M $\Omega$ )	MAX. Z 10 kHz (M $\Omega$ )	ORDERING CODE MAL2157.....	
									2-TERM.	3-TERM.
200	270	22 x 25	1.15	0.54	550	880	420	700	52271E3	72271E3
	330	22 x 30	1.36	0.66	430	720	300	500	52331E3	72331E3
	390	22 x 30	1.46	0.78	390	650	295	490	52391E3	72391E3
	470	22 x 35	1.68	0.94	350	580	240	400	32471E3	12471E3
	470	25 x 30	1.67	0.94	350	580	240	400	52471E3	72471E3
	560	22 x 40	1.91	1.12	255	425	235	390	42561E3	22561E3
	560	25 x 35	1.91	1.12	255	425	235	390	32561E3	12561E3
	560	30 x 25	1.89	1.12	255	425	235	390	52561E3	72561E3
	680	25 x 40	2.18	1.36	210	350	205	340	42681E3	22681E3
	680	30 x 30	2.04	1.36	210	350	205	340	52681E3	72681E3
	680	35 x 25	2.06	1.36	210	350	205	340	62681E3	82681E3
	820	25 x 45	2.46	1.64	170	290	145	240	62821E3	82821E3
	820	30 x 35	2.35	1.64	170	290	145	240	32821E3	12821E3
	820	35 x 30	2.29	1.64	170	290	145	240	52821E3	72821E3
	1000	30 x 40	2.66	2.00	140	235	135	225	52102E3	72102E3
	1000	35 x 30	2.33	2.00	140	235	135	225	62102E3	82102E3
	1200	30 x 45	2.98	2.40	120	200	110	190	32122E3	12122E3
	1200	35 x 35	2.69	2.40	120	200	110	190	62122E3	82122E3
	1500	30 x 50	3.31	3.00	110	180	95	155	42152E3	22152E3
	1500	35 x 40	3.04	3.00	110	180	95	155	52152E3	72152E3
1800	35 x 45	3.36	3.60	100	160	80	130	42182E3	22182E3	
2200	35 x 50	3.68	4.40	90	150	65	105	52222E3	72222E3	
250	220	22 x 30	1.23	0.55	600	1080	420	700	53221E3	73221E3
	270	22 x 30	1.32	0.67	490	880	335	560	43271E3	23271E3
	270	25 x 25	1.23	0.67	490	880	335	560	53271E3	73271E3
	330	22 x 35	1.53	0.82	400	720	255	430	33331E3	13331E3
	330	25 x 30	1.56	0.82	400	720	255	430	53331E3	73331E3



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> 120 Hz 85 °C (A)	I <sub>L5</sub> 5 min (mA)	TYP. ESR 100 Hz <sup>(1)</sup> (MΩ)	MAX. ESR 100 Hz <sup>(1)</sup> (MΩ)	TYP. Z 10 kHz (MΩ)	MAX. Z 10 kHz (MΩ)	ORDERING CODE MAL2157.....	
									2-TERM.	3-TERM.
250	390	22 x 40	1.74	0.97	330	610	250	425	43391E3	23391E3
	390	30 x 25	1.58	0.97	330	610	250	425	53391E3	73391E3
	470	25 x 35	1.87	1.17	280	505	190	320	33471E3	13471E3
	470	30 x 30	1.89	1.17	280	505	190	320	53471E3	73471E3
	560	25 x 40	2.12	1.40	240	425	185	310	43561E3	23561E3
	560	30 x 30	1.97	1.40	240	425	185	310	53561E3	73561E3
	560	35 x 25	1.80	1.40	240	425	185	310	63561E3	83561E3
	680	25 x 45	2.29	1.70	200	350	155	260	63681E3	83681E3
	680	30 x 35	2.28	1.70	200	350	155	260	33681E3	13681E3
	680	35 x 30	2.20	1.70	200	350	155	260	53681E3	73681E3
	820	30 x 40	2.57	2.05	160	290	125	210	53821E3	73821E3
	820	35 x 35	2.54	2.05	160	290	125	210	63821E3	83821E3
	1000	30 x 45	2.88	2.50	140	235	105	180	33102E3	13102E3
	1000	35 x 40	2.86	2.50	140	235	105	180	53102E3	73102E3
	1200	35 x 45	3.17	3.00	120	200	95	160	43122E3	23122E3
	1500	35 x 50	3.49	3.75	90	160	85	140	53152E3	73152E3
400	68	22 x 25	0.71	0.27	1400	2800	1170	1950	56689E3	76689E3
	82	22 x 25	0.77	0.33	1250	2500	970	1620	56829E3	76829E3
	100	22 x 30	0.94	0.40	1125	2250	750	1220	56101E3	76101E3
	120	22 x 30	0.97	0.48	990	1980	700	1140	56121E3	76121E3
	150	22 x 35	1.13	0.60	750	1500	540	900	36151E3	16151E3
	150	25 x 30	1.16	0.60	750	1500	540	900	56151E3	76151E3
	180	22 x 40	1.29	0.72	630	1260	435	725	46181E3	26181E3
	180	25 x 35	1.35	0.72	630	1260	435	725	36181E3	16181E3
	220	25 x 40	1.54	0.88	520	1040	355	590	46221E3	26221E3
	220	30 x 30	1.50	0.88	520	1040	355	590	56221E3	76221E3
	220	35 x 25	1.42	0.88	520	1040	355	590	66221E3	86221E3
	270	25 x 45	1.72	1.08	430	860	335	560	66271E3	86271E3
	270	30 x 35	1.74	1.08	430	860	335	560	36271E3	16271E3
	270	35 x 30	1.71	1.08	430	860	335	560	56271E3	76271E3
	330	30 x 40	1.97	1.32	350	700	315	525	56331E3	76331E3
	330	35 x 30	1.76	1.32	350	700	315	525	66331E3	86331E3
	390	30 x 45	2.19	1.56	300	610	250	420	56391E3	76391E3
	390	35 x 35	2.04	1.56	300	610	250	420	36391E3	16391E3
	470	30 x 50	2.40	1.88	250	505	210	350	46471E3	26471E3
	470	35 x 40	2.30	1.88	250	505	210	350	56471E3	76471E3
560	35 x 45	2.55	2.24	210	425	180	305	46561E3	26561E3	
680	35 x 50	2.79	2.72	190	380	160	265	56681E3	76681E3	
820	35 x 60	3.33	3.28	155	315	115	215	56821E3	76821E3	

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> 120 Hz 85 °C (A)	I <sub>L5</sub> 5 min (mA)	TYP. ESR 100 Hz <sup>(1)</sup> (MΩ)	MAX. ESR 100 Hz <sup>(1)</sup> (MΩ)	TYP. Z 10 kHz (MΩ)	MAX. Z 10 kHz (MΩ)	ORDERING CODE MAL2157.....	
									2-TERM.	3-TERM.
450	56	22 x 25	0.68	0.25	1650	3300	1120	1880	57569E3	77569E3
	68	22 x 30	0.80	0.30	1400	2800	920	1530	57689E3	77689E3
	82	22 x 30	0.87	0.36	1200	2400	780	1290	47829E3	27829E3
	82	25 x 25	0.85	0.36	1200	2400	780	1290	57829E3	77829E3
	100	22 x 35	1.00	0.45	1000	2000	630	1050	37101E3	17101E3
	100	25 x 30	1.02	0.45	1000	2000	630	1050	57101E3	77101E3
	120	22 x 40	1.15	0.54	800	1600	530	885	47121E3	27121E3
	120	25 x 30	1.09	0.54	800	1600	530	885	57121E3	77121E3
	120	30 x 25	1.10	0.54	800	1600	530	885	67121E3	87121E3
	150	25 x 40	1.35	0.67	650	1300	420	705	47151E3	27151E3
	150	25 x 35	1.27	0.67	650	1300	420	705	67151E3	87151E3
	150	30 x 30	1.32	0.67	650	1300	420	705	57151E3	77151E3
	180	25 x 40	1.45	0.81	570	1150	360	605	47181E3	27181E3
	180	30 x 35	1.49	0.81	570	1150	360	605	57181E3	77181E3
	180	35 x 25	1.35	0.81	570	1150	360	605	67181E3	87181E3
	220	25 x 50	1.73	0.99	450	900	315	525	47221E3	27221E3
	220	30 x 40	1.72	0.99	450	900	315	525	57221E3	77221E3
	220	35 x 30	1.61	0.99	450	900	315	525	67221E3	87221E3
	270	30 x 45	1.95	1.21	380	770	270	450	37271E3	17271E3
	270	35 x 35	1.86	1.21	380	770	270	450	67271E3	87271E3
330	30 x 50	2.19	1.48	300	600	230	390	47331E3	27331E3	
330	35 x 40	2.10	1.48	300	600	230	390	57331E3	77331E3	
390	35 x 45	2.34	1.75	250	500	190	340	47391E3	27391E3	
470	35 x 50	2.60	2.11	210	420	170	290	57471E3	77471E3	
680	35 x 60	3.15	3.06	150	300	110	200	57681E3	77681E3	

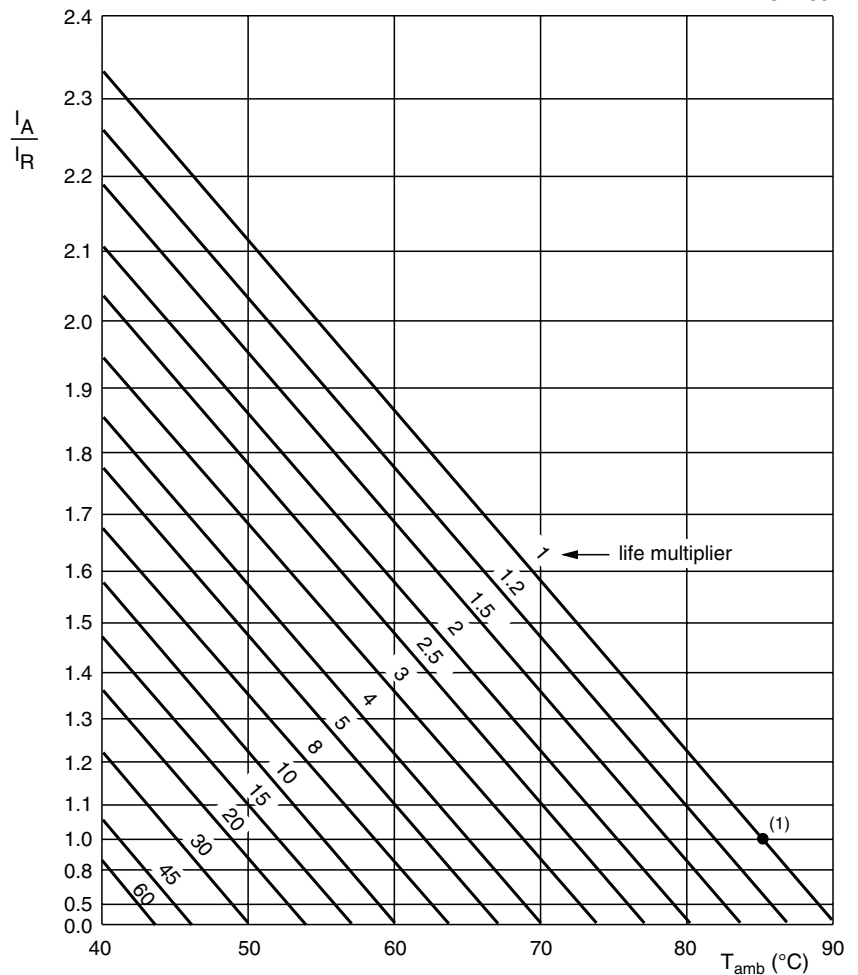
**Note**<sup>(1)</sup> ESR at 120 Hz is approximately 0.95 x ESR 100 Hz

ADDITIONAL ELECTRICAL DATA		
PARAMETER	CONDITIONS	VALUE
<b>Voltage</b>		
Surge voltage	≥ 400 V versions	U <sub>s</sub> = 1.1 x U <sub>R</sub>
	≤ 250 V versions	U <sub>s</sub> = 1.15 x U <sub>R</sub>
Reverse voltage		≤ 1 V
<b>Current</b>		
Leakage current	After 5 minutes at U <sub>R</sub>	I <sub>L5</sub> ≤ 0.01 C <sub>R</sub> x U <sub>R</sub>
<b>Inductance</b>		
Equivalent series inductance (ESL)	All case sizes	typ. 19 nH
		max. 25 nH



**RIPPLE CURRENT AND USEFUL LIFE**

MGA453



$I_A$  = actual ripple current at 120 Hz  
 $I_R$  = rated ripple current at 120 Hz and 85 °C  
 (1) Useful life at 85 °C and  $I_R$  applied: 5000 hours

Fig.6 Multiplier of useful life as a function of ambient temperature and ripple current load

Table 3

MULTIPLIER OF RIPPLE CURRENT ( $I_R$ ) AS A FUNCTION OF FREQUENCY	
FREQUENCY (Hz)	$I_R$ MULTIPLIER
50	0.90
100	0.95
120	1.00
200	1.15
1000	1.30
≥ 10 000	1.40

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	$T_{amb} = 85\text{ }^{\circ}\text{C}$ ; $U_R$ applied; 3000 hours	$\Delta C/C: \pm 10\%$ $ESR \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Load life		$T_{amb} = 85\text{ }^{\circ}\text{C}$ ; $U_R$ and $I_R$ applied; 3000 hours	$\Delta C/C: \pm 20\%$ $ESR \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 85\text{ }^{\circ}\text{C}$ ; $U_R$ and $I_R$ applied; 5000 hours	$\Delta C/C: \pm 30\%$ $ESR \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit, no visible damage total failure percentage: $\leq 3\%$
Shelf life (storage at high temperature)	IEC 60384-4/ EN130300 subclause 4.17	$T_{amb} = 85\text{ }^{\circ}\text{C}$ ; no voltage applied; 1000 hours  After test: $U_R$ to be applied for 30 minutes, 24 hours to 48 hours before measurement	$\Delta C/C: \pm 15\%$ $ESR \leq 1.5 \times \text{spec. limit}$ $I_{L5} \leq 1 \times \text{spec. limit}$





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