

## Aluminum Electrolytic Capacitors Power Ultra Miniature Snap-In


**RoHS  
COMPLIANT**
**FEATURES**

- Up to 500 V
- Useful life: 5000 h at 85 °C
- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Large types, very small dimensions, cylindrical aluminum case, insulated with a blue sleeve
- Keyed polarity version available
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)

**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 or in 2 digits according to IEC 60062)
- 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, last 8 digits 157 xxxxx
- Climatic category in accordance with IEC 60068

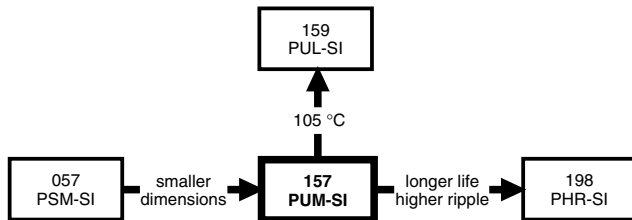


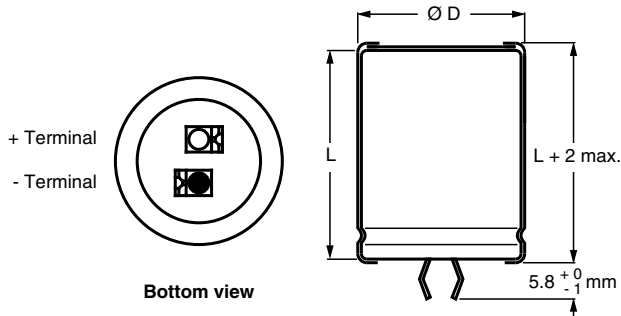
Fig. 1

QUICK REFERENCE DATA	
DESCRIPTION	VALUE
Nominal case sizes (Ø 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   500 V
Category temperature range	-25 °C to +85 °C
Endurance test at 85 °C	3000 h
Load life at 85 °C	3000 h
Useful life at 85 °C	5000 h
Useful life at 40 °C, 1.4 x $I_R$ applied	90 000 h
Shelf life at 0 V, 85 °C	1000 h
Max. RMS value of ripple voltage	12 V   n/a
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 (Ø D x L in mm)					
$C_R$ ( $\mu\text{F}$ )	$U_R$ (V)				
	200	250	400	450	500
47	-	-	-	-	22 x 25
56	-	-	-	22 x 25	-
68	-	-	22 x 25	22 x 30	22 x 30
	-	-	-	-	25 x 25
82	-	-	22 x 25	22 x 30	-
	-	-	-	25 x 25	-
100	-	-	22 x 30	22 x 35	22 x 35
	-	-	-	25 x 30	25 x 30
	-	-	-	-	30 x 25



SELECTION CHART FOR C <sub>R</sub> , U <sub>R</sub> , AND RELEVANT NOMINAL CASE SIZES (∅ D x L in mm)					
C <sub>R</sub> (μF)	U <sub>R</sub> (V)				
	200	250	400	450	500
120	-	-	22 x 30	22 x 40	22 x 40
	-	-	-	25 x 30	25 x 35
	-	-	-	30 x 25	-
150	-	-	22 x 35	25 x 35	25 x 40
	-	-	25 x 30	25 x 40	30 x 30
	-	-	-	30 x 30	-
180	-	-	22 x 40	25 x 40	25 x 45
	-	-	25 x 35	30 x 35	30 x 35
	-	-	-	35 x 25	-
220	-	22 x 30	25 x 40	25 x 50	30 x 40
	-	-	30 x 30	30 x 40	35 x 30
	-	-	35 x 25	35 x 30	-
270	22 x 25	22 x 30	25 x 45	30 x 45	30 x 45
	-	25 x 25	30 x 35	35 x 35	35 x 35
	-	-	35 x 30	-	-
330	22 x 30	22 x 35	30 x 40	30 x 50	30 x 50
	-	25 x 30	35 x 30	35 x 40	35 x 40
390	22 x 30	22 x 40	30 x 45	35 x 45	35 x 45
	-	30 x 25	35 x 35	-	-
470	22 x 35	25 x 35	30 x 50	35 x 50	35 x 50
	25 x 30	30 x 30	35 x 40	-	-
560	22 x 40	25 x 40	35 x 45	-	35 x 60
	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**


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

Fig. 2 - Two terminal snap-in

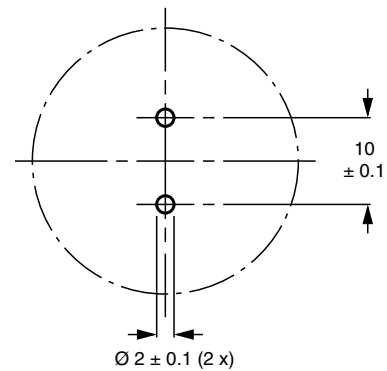
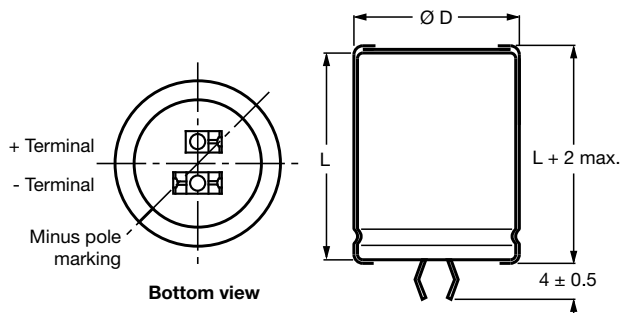
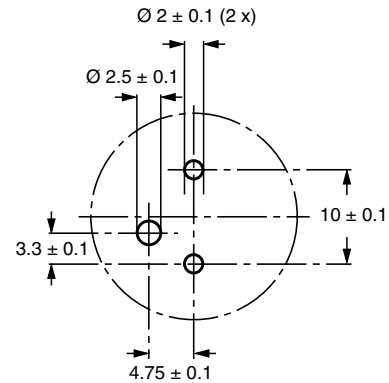


Fig. 3 - Mounting hole diagram

**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 in millimeters, MASS AND PACKAGING QUANTITIES</b>				
<b>NOMINAL CASE SIZE Ø D x L</b>	<b>Ø D<sub>max.</sub></b>	<b>L<sub>max.</sub></b>	<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



<b>DIMENSIONS</b> in millimeters, <b>MASS AND PACKAGING QUANTITIES</b>				
<b>NOMINAL CASE SIZE Ø D x L</b>	<b>Ø D<sub>max.</sub></b>	<b>L<sub>max.</sub></b>	<b>MASS (g)</b>	<b>PACKAGING QUANTITIES (units per box)</b>
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

<b>ELECTRICAL DATA</b>	
<b>SYMBOL</b>	<b>DESCRIPTION</b>
C <sub>R</sub>	Rated capacitance at 100 Hz / 120 Hz
I <sub>R</sub>	Rated RMS ripple current at 120 Hz, 85 °C
I <sub>L5</sub>	Max. leakage current after 5 min at U <sub>R</sub>
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<sub>amb</sub> = 20 °C, P = 86 kPa to 106 kPa, RH = 45 % to 75 %

**ORDERING EXAMPLE**

Electrolytic capacitor 157 series  
 1000 µF / 200 V; ± 20 %  
 Nominal case size: Ø 30 x 40 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 <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.
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
	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	



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.
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	
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	



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.
500	47	22 x 25	0.68	0.24	2834	3540	2095	2930	59479E3	79479E3
	68	22 x 30	0.85	0.34	1961	2450	1451	2030	59689E3	79689E3
	68	25 x 25	0.86	0.34	1979	2470	1469	2060	49689E3	29689E3
	100	22 x 35	1.07	0.50	1339	1670	992	1390	59101E3	79101E3
	100	25 x 30	1.08	0.50	1349	1690	1003	1400	49101E3	29101E3
	100	30 x 25	1.13	0.50	1375	1720	1030	1440	39101E3	19101E3
	120	22 x 40	1.24	0.60	1117	1400	828	1160	59121E3	79121E3
	120	25 x 35	1.23	0.60	1122	1400	833	1170	49121E3	29121E3
	150	25 x 40	1.43	0.75	901	1130	670	940	59151E3	79151E3
	150	30 x 30	1.42	0.75	922	1150	693	970	49151E3	29151E3
	180	25 x 45	1.65	0.90	752	940	560	780	59181E3	79181E3
	180	30 x 35	1.61	0.90	765	960	573	800	49181E3	29181E3
	220	30 x 40	1.84	1.10	629	790	472	660	59221E3	79221E3
	220	35 x 30	1.83	1.10	660	830	505	710	49221E3	29221E3
	270	30 x 45	2.11	1.35	515	640	387	540	59271E3	79271E3
	270	35 x 35	2.09	1.35	534	670	408	570	49271E3	29271E3
	330	30 x 50	2.40	1.65	426	530	322	450	59331E3	79331E3
	330	35 x 40	2.36	1.65	441	550	337	470	49331E3	29331E3
	390	35 x 45	2.63	1.95	374	470	286	400	59391E3	79391E3
	470	35 x 50	2.92	2.35	316	400	244	340	59471E3	79471E3
560	35 x 60	3.40	2.80	262	330	201	280	59561E3	79561E3	

**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 min 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**

Table 3

ENDURANCE TEST DURATION AND USEFUL LIFE	
ENDURANCE AT 85 °C (h)	USEFUL LIFE AT 85 °C (h)
3000	5000

**Note**

- Multiplier of useful life code: MGA453

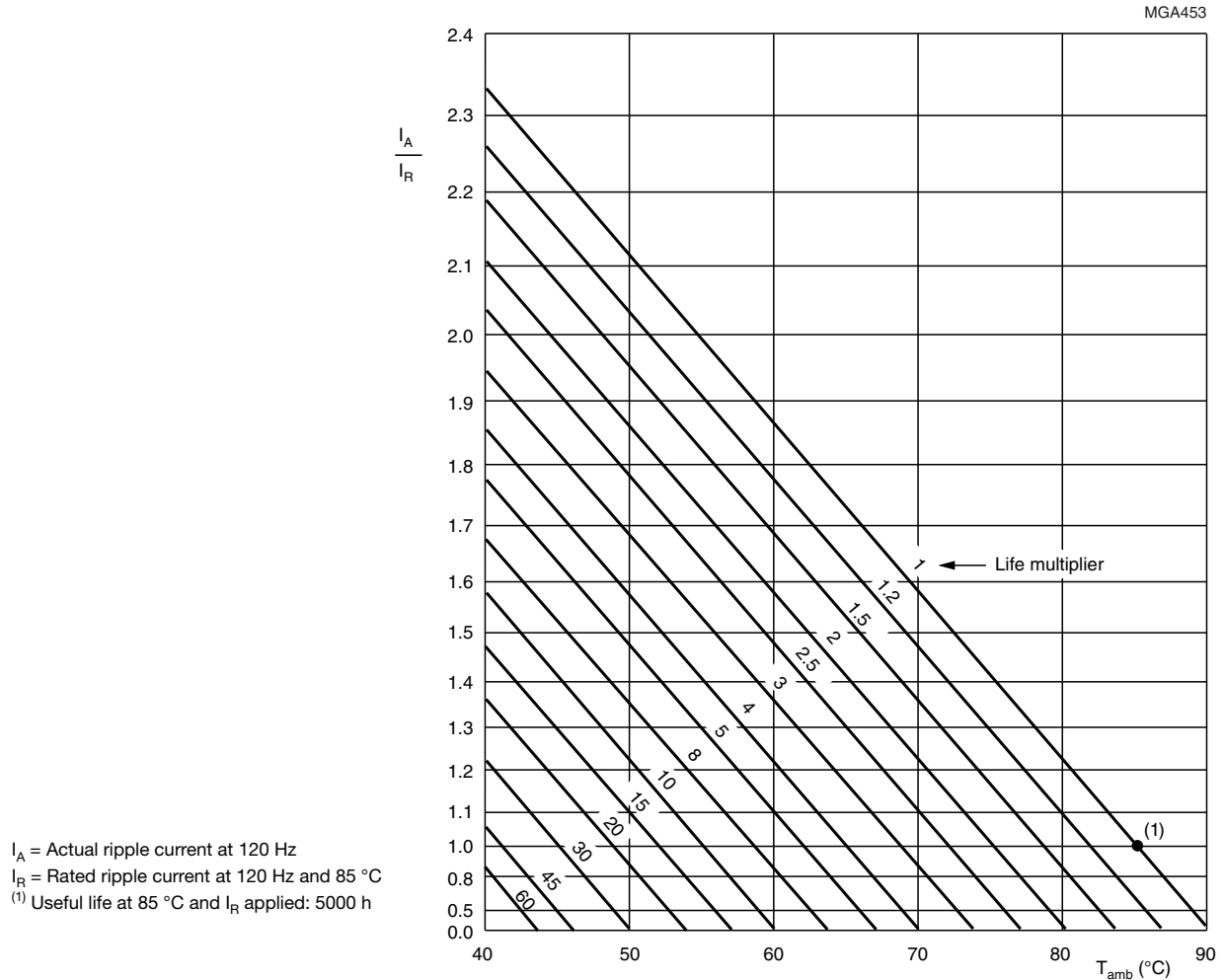


Fig. 6 - Multiplier of useful life as a function of ambient temperature and ripple current load

Table 4

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





Table 5

TEST PROCEDURES AND REQUIREMENTS			
TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4 / EN130300 subclause 4.13	T <sub>amb</sub> = 85 °C; U <sub>R</sub> applied; 3000 h	ΔC/C: ± 10 % ESR ≤ 2 x spec. limit I <sub>L5</sub> ≤ spec. limit
Load life		T <sub>amb</sub> = 85 °C; U <sub>R</sub> and I <sub>R</sub> applied; 3000 h	ΔC/C: ± 20 % ESR ≤ 2 x spec. limit I <sub>L5</sub> ≤ spec. limit
Useful life	CECC 30301 subclause 1.8.1	T <sub>amb</sub> = 85 °C; U <sub>R</sub> and I <sub>R</sub> applied; 5000 h	ΔC/C: ± 30 % ESR ≤ 3 x spec. limit I <sub>L5</sub> ≤ spec. limit no short or open circuit, no visible damage total failure percentage: ≤ 3 %
Shelf life (storage at high temperature)	IEC 60384-4 / EN130300 subclause 4.17	T <sub>amb</sub> = 85 °C; no voltage applied; 1000 h After test: U <sub>R</sub> to be applied for 30 min, 24 h to 48 h before measurement	ΔC/C: ± 15 % ESR ≤ 1.5 x spec. limit I <sub>L5</sub> ≤ 1 x spec. limit

Statements about product lifetime are based on calculations and internal testing. They should only be interpreted as estimations. Also due to external factors, the lifetime in the field application may deviate from the calculated lifetime. In general, nothing stated herein shall be construed as a guarantee of durability.



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