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Aluminum Capacitors Power Economy Long Life Snap-In

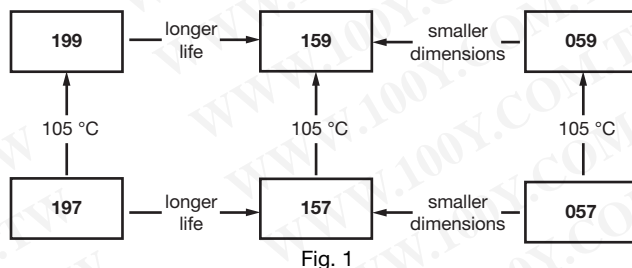


Fig. 1

QUICK REFERENCE DATA	
DESCRIPTION	VALUE
Nominal case size (∅ D x L in mm)	22 x 25 to 35 x 50
Rated capacitance range, C _R	47 µF to 2200 µF
Tolerance on C _R	± 20 %
Rated voltage range, U _R	160 V, 200 V, 250 V, 400 V, 450 V
Category temperature range	- 25 °C to + 105 °C
Endurance test at 105 °C	2000 h
Useful life at 105 °C	3000 h
Useful life at 40 °C and 1.6 x I _R applied	300 000 h
Shelf life at 0 V, 105 °C	500 h
Based on sectional specification	IEC 60384-4/EN130300/W of JISC5141

FEATURES

- Polarized aluminum capacitors, non-solid electrolyte
- Large types, very small dimensions, cylindrical aluminum case, insulated with a blue sleeve
- Useful life: 3000 h at 105 °C
- Compliant to RoHS Directive 2002/95/EC



RoHS COMPLIANT

APPLICATIONS

- Consumer and industrial electronics
- Whitegood motor control
- Electronic drives
- SMPS/UPS

MARKING

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

- Rated capacitance (in µF)
- Tolerance code on rated capacitance, code letter in accordance with IEC 60062 (M for ± 20 %)
- Rated voltage (in V)
- Name of manufacturer
- Date code
- “-” sign to identify the negative terminal, visible from the top and side of the capacitor
- Code number (last 8 digits)
- Maximum operating temperature

SELECTION CHART FOR C _R , U _R , AND RELEVANT NOMINAL CASE SIZES (∅ D x L in mm)					
C _R (µF)	U _R (V)				
	160	200	250	400	450
47	-	-	-	22 x 25	-
56	-	-	-	22 x 25	22 x 25
68	-	-	-	22 x 25	22 x 30
	-	-	-	-	22 x 25
82	-	-	-	22 x 30	22 x 35
	-	-	-	25 x 25	-
100	-	-	-	22 x 35	22 x 40
	-	-	-	25 x 30	25 x 30
	-	-	-	-	30 x 25
120	-	-	-	22 x 35	25 x 35
	-	-	-	25 x 30	-
	-	-	-	30 x 25	-
150	-	-	-	22 x 40	-
	-	-	-	25 x 35	25 x 40
	-	-	-	30 x 30	30 x 30
	-	-	-	-	35 x 25

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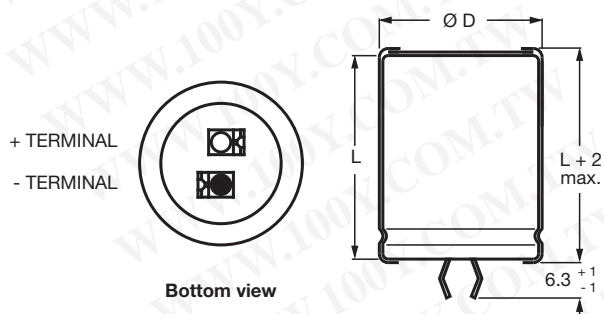


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SELECTION CHART FOR C _R , U _R , AND RELEVANT NOMINAL CASE SIZES (Ø D x L in mm)					
C _R (µF)	U _R (V)				
	160	200	250	400	450
180	-	-	-	25 x 40	-
	-	-	-	30 x 30	30 x 35
	-	-	-	35 x 25	-
220	-	-	22 x 30	-	-
	-	-	25 x 25	-	30 x 40
	-	-	-	30 x 35	35 x 30
270	-	-	-	35 x 30	-
	-	-	22 x 35	25 x 50	30 x 45
	-	-	25 x 30	30 x 40	35 x 35
330	-	-	30 x 25	35 x 30	-
	22 x 25	22 x 35	22 x 40	-	30 x 50
	-	-	25 x 30	30 x 45	35 x 40
390	-	-	30 x 25	35 x 35	-
	22 x 30	22 x 35	-	30 x 50	-
	-	25 x 30	25 x 35	35 x 40	35 x 45
470	-	-	30 x 30	-	-
	22 x 35	-	-	-	35 x 50
	-	30 x 25	25 x 40	35 x 50	-
560	-	-	30 x 30	-	-
	22 x 40	-	-	35 x 25	35 x 45
	25 x 30	-	-	-	-
680	-	-	30 x 35	-	-
	-	30 x 30	30 x 35	35 x 50	-
	25 x 35	-	35 x 30	-	-
820	-	-	30 x 40	-	-
	-	30 x 30	30 x 40	-	-
	-	-	35 x 35	-	-
1000	-	35 x 25	-	-	-
	25 x 40	25 x 50	30 x 45	-	-
	30 x 30	30 x 35	35 x 35	-	-
1200	-	-	35 x 30	-	-
	35 x 25	35 x 30	35 x 40	-	-
	30 x 35	30 x 45	-	-	-
1500	-	-	35 x 40	-	-
	35 x 30	35 x 35	35 x 40	-	-
	-	-	35 x 45	-	-
1800	25 x 50	30 x 50	35 x 45	-	-
	30 x 40	-	35 x 50	-	-
	35 x 30	-	-	-	-
2200	30 x 45	35 x 45	-	-	-
	35 x 35	-	-	-	-
1800	30 x 50	-	-	-	-
	35 x 45	35 x 50	-	-	-
2200	35 x 50	-	-	-	-

DIMENSIONS in millimeters AND AVAILABLE FORMS



The minus terminal can be marked with a black dot or an imprinted sign.
Fig. 2 - Two terminal snap-in

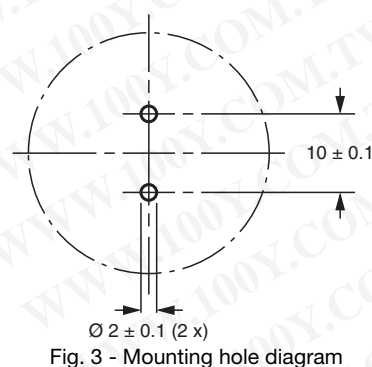


Fig. 3 - Mounting hole diagram



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Table 1

DIMENSIONS in millimeters, MASS AND PACKAGING QUANTITIES					
NOMINAL CASE SIZE Ø D x L	Ø D _{MAX.}	L _{MAX.}	MASS (g)	PACKAGING QUANTITIES	CARDBOARD BOX DIMENSIONS L x W x H
22 x 25	22.5	26.5	≈ 12	216	280 x 240 x 140
22 x 30	22.5	31.5	≈ 16	216	280 x 240 x 140
22 x 35	22.5	36.5	≈ 20	144	280 x 240 x 105
22 x 40	22.5	41.5	≈ 23	144	280 x 240 x 105
22 x 45	22.5	46.5	≈ 26	144	280 x 240 x 140
22 x 50	22.5	51.5	≈ 29	72	280 x 240 x 105
25 x 25	25.5	26.5	≈ 20	216	280 x 240 x 140
25 x 30	25.5	33.5	≈ 22	216	280 x 240 x 140
25 x 35	25.5	36.5	≈ 24	144	280 x 240 x 105
25 x 40	25.5	41.5	≈ 27	144	280 x 240 x 105
25 x 45	25.5	46.5	≈ 32	144	280 x 240 x 140
25 x 50	25.5	51.5	≈ 38	144	280 x 240 x 140
30 x 25	30.5	28.5	≈ 25	168	280 x 240 x 140
30 x 30	30.5	33.5	≈ 30	168	280 x 240 x 140
30 x 35	30.5	38.5	≈ 35	112	280 x 240 x 105
30 x 40	30.5	42.5	≈ 40	112	280 x 240 x 105
30 x 45	30.5	47.5	≈ 45	112	280 x 240 x 140
30 x 50	30.5	52.5	≈ 50	112	280 x 240 x 140
35 x 25	35.5	26.5	≈ 33	126	280 x 240 x 140
35 x 30	35.5	33.5	≈ 40	126	280 x 240 x 140
35 x 35	35.5	36.5	≈ 48	84	280 x 240 x 105
35 x 40	35.5	42.5	≈ 55	84	280 x 240 x 105
35 x 45	35.5	47.5	≈ 63	84	280 x 240 x 140
35 x 50	35.5	52.5	≈ 72	84	280 x 240 x 140

ELECTRICAL DATA	
SYMBOL	DESCRIPTION
C _R	Rated capacitance at 120 Hz
I _R	Rated RMS ripple current at 120 Hz, 105 °C
I _{L5}	Max. leakage current after 5 min at U _R
ESR	Max. equivalent series resistance at 120 Hz ⁽¹⁾

Notes

- ⁽¹⁾ ESR at 100 Hz is approximately 1.05 x ESR 120 Hz
- Unless otherwise specified, all electrical values in table 2 apply at T_{amb} = 20 °C, P = 86 kPa to 106 kPa, RH = 45 % to 75 %

ORDERING EXAMPLE

Electrolytic capacitor 199 series

820 µF/160 V; ± 20 %

Nominal case size: Ø 25 mm x 40 mm

Ordering code: MAL2 199 51821 E3

Former 12NC: 2222 199 51821

Table 2

ELECTRICAL DATA AND ORDERING INFORMATION							
U _R (V)	C _R 120 Hz (µF)	NOMINAL CASE SIZE Ø D x L (mm)	I _R 120 Hz (A)	I _{L5} (mA)	MAX. ESR 120 Hz ⁽¹⁾ (Ω)	MAX. Z 10 kHz (mΩ)	ORDERING CODE MAL2199.....
160	330	22 x 25	1.00	1.06	0.50	316	51331E3
	390	22 x 30	1.17	1.25	0.43	260	51391E3
	470	22 x 35	1.35	1.50	0.35	216	51471E3
	560	22 x 40	1.53	1.50	0.30	183	51561E3
	560	25 x 30	1.42	1.50	0.30	199	41561E3
	680	25 x 35	1.60	1.50	0.24	170	51681E3
	820	25 x 40	1.80	1.50	0.20	144	51821E3
	820	30 x 30	1.67	1.50	0.20	166	41821E3
	820	35 x 25	1.44	1.50	0.30	219	31821E3
	1000	30 x 35	1.86	1.50	0.17	144	41102E3

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ELECTRICAL DATA AND ORDERING INFORMATION							
U _R (V)	C _R 120 Hz (μF)	NOMINAL CASE SIZE Ø D x L (mm)	I _R 120 Hz (A)	I _{L5} (mA)	MAX. ESR 120 Hz ⁽¹⁾ (Ω)	MAX. Z 10 kHz (mΩ)	ORDERING CODE MAL2199.....
160	1000	35 x 30	1.82	1.50	0.25	157	31102E3
	1200	25 x 50	2.24	1.50	0.14	105	51122E3
	1200	30 x 40	2.06	1.50	0.21	124	41122E3
	1200	35 x 30	1.81	1.50	0.21	152	31122E3
	1500	30 x 45	2.30	1.50	0.11	106	51152E3
	1500	35 x 35	1.97	1.50	0.17	134	41152E3
	1800	30 x 50	2.51	1.50	0.09	92	51182E3
	1800	35 x 45	2.45	1.50	0.14	102	41182E3
	2200	35 x 50	2.66	1.50	0.11	90	51222E3
200	330	22 x 35	1.19	1.32	0.50	241	42331E3
	390	22 x 35	1.27	1.50	0.43	212	42391E3
	390	25 x 30	1.27	1.50	0.43	219	52391E3
	470	30 x 25	1.28	1.50	0.35	231	52471E3
	560	30 x 30	1.53	1.50	0.30	180	52561E3
	680	30 x 30	1.57	1.50	0.24	167	52681E3
	680	35 x 25	1.36	1.50	0.37	225	62681E3
	820	25 x 50	2.04	1.50	0.20	115	32821E3
	820	30 x 35	1.75	1.50	0.20	146	42821E3
	820	35 x 30	1.72	1.50	0.30	160	52821E3
	1000	30 x 45	2.14	1.50	0.17	113	42102E3
	1000	35 x 35	1.90	1.50	0.25	140	52102E3
	1200	30 x 50	2.36	1.50	0.14	98	42122E3
	1500	35 x 45	2.31	1.50	0.17	104	52152E3
	1800	35 x 50	2.52	1.50	0.14	92	52182E3
250	220	22 x 30	1.14	1.10	0.75	294	43221E3
	220	25 x 25	0.94	1.10	0.75	317	53221E3
	270	22 x 35	1.11	1.35	0.61	240	43271E3
	270	25 x 30	1.12	1.35	0.61	247	53271E3
	270	30 x 25	1.11	1.35	0.61	274	63271E3
	330	22 x 40	1.27	1.50	0.50	199	33331E3
	330	25 x 30	1.20	1.50	0.50	216	43331E3
	330	30 x 25	1.17	1.50	0.50	250	53331E3
	390	25 x 35	1.35	1.50	0.43	186	43391E3
	390	30 x 30	1.38	1.50	0.43	196	53391E3
	470	25 x 40	1.52	1.50	0.35	158	33471E3
	470	30 x 30	1.43	1.50	0.35	181	43471E3
	470	35 x 25	1.28	1.50	0.53	240	53471E3
	560	30 x 35	1.60	1.50	0.30	158	53561E3
	560	35 x 30	1.59	1.50	0.44	172	63561E3
	680	30 x 40	1.79	1.50	0.24	135	43681E3
	680	35 x 35	1.76	1.50	0.37	150	53682E3
	820	30 x 45	2.00	1.50	0.20	116	43821E3
	820	35 x 35	1.77	1.50	0.30	147	53821E3
	820	35 x 40	1.96	1.50	0.30	130	63821E3
	1000	35 x 40	1.96	1.50	0.25	127	53102E3
	1000	35 x 45	2.17	1.50	0.25	111	63102E3
	1200	35 x 45	2.16	1.50	0.21	110	43122E3
	1200	35 x 50	2.38	1.50	0.21	98	53122E3



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ELECTRICAL DATA AND ORDERING INFORMATION							
U_R (V)	C_R 120 Hz (μ F)	NOMINAL CASE SIZE \varnothing D x L (mm)	I_R 120 Hz (A)	I_{L5} (mA)	MAX. ESR 120 Hz ⁽¹⁾ (Ω)	MAX. Z 10 kHz (m Ω)	ORDERING CODE MAL2199.....
400	47	22 x 25	0.41	0.38	5.29	3127	56479E3
	56	22 x 25	0.45	0.45	4.44	2635	56569E3
	68	22 x 25	0.49	0.54	3.66	2161	56689E3
	82	22 x 30	0.57	0.66	3.03	1788	46829E3
	82	25 x 25	0.58	0.66	3.03	1808	56829E3
	100	22 x 35	0.66	0.80	2.49	1467	46101E3
	100	25 x 30	0.67	0.80	2.49	1472	56101E3
	120	22 x 35	0.72	0.96	2.07	1231	46121E3
	120	25 x 30	0.73	0.96	2.07	1238	56121E3
	120	30 x 25	0.75	0.96	2.07	1266	66121E3
	150	22 x 40	0.84	1.20	1.66	990	36151E3
	150	25 x 35	0.85	1.20	1.66	997	46151E3
	150	30 x 30	0.89	1.20	1.66	1006	56151E3
	180	25 x 40	0.97	1.44	1.38	835	36181E3
	180	30 x 30	0.96	1.44	1.38	854	46181E3
	180	35 x 25	0.94	1.44	1.38	907	56181E3
	220	30 x 35	1.09	1.50	1.13	707	56221E3
	220	35 x 30	1.12	1.50	1.13	719	66221E3
	270	25 x 50	1.25	1.50	0.92	564	46271E3
	270	30 x 40	1.24	1.50	0.92	582	56271E3
	270	35 x 30	1.19	1.50	0.92	611	66271E3
	330	30 x 45	1.41	1.50	0.75	480	56331E3
	330	35 x 35	1.34	1.50	0.75	510	66331E3
390	30 x 50	1.56	1.50	0.64	410	46391E3	
390	35 x 40	1.50	1.50	0.64	435	56391E3	
470	35 x 45	1.68	1.50	0.53	365	56471E3	
470	35 x 50	1.68	1.50	0.53	365	66471E3	
560	35 x 50	1.85	1.50	0.44	311	56561E3	
450	56	22 x 25	0.46	0.50	4.44	2161	57569E3
	68	22 x 30	0.53	0.61	3.66	1776	47689E3
	68	25 x 25	0.54	0.61	3.66	1797	57689E3
	82	22 x 35	0.62	0.74	3.03	1473	57829E3
	100	22 x 40	0.71	0.90	2.49	1211	37101E3
	100	25 x 30	0.69	0.90	2.49	1225	47101E3
	100	30 x 25	0.71	0.90	2.49	1254	57101E3
	120	25 x 35	0.78	1.08	2.07	1025	57121E3
	150	25 x 40	0.91	1.35	1.66	826	47151E3
	150	30 x 30	0.90	1.35	1.66	847	57151E3
	150	35 x 25	0.89	1.35	1.66	902	67151E3
	180	30 x 35	1.02	1.50	1.38	712	57181E3
	220	30 x 40	1.16	1.50	1.13	588	47221E3
	220	35 x 30	1.12	1.50	1.13	618	57221E3
	270	30 x 45	1.31	1.50	0.92	484	47271E3
	270	35 x 35	1.26	1.50	0.75	515	57271E3
	330	30 x 50	1.48	1.50	0.75	402	47331E3
	330	35 x 40	1.42	1.50	1.13	429	57331E3
	390	35 x 45	1.58	1.50	0.64	365	57391E3
	470	35 x 50	1.76	1.50	0.53	309	57471E3

Note⁽²⁾ ESR at 100 Hz is approximately 1.05 x ESR 120 Hz

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ADDITIONAL ELECTRICAL DATA		
PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage	≥ 400 V versions	$U_S = 1.1 \times U_R$
	≤ 250 V versions	$U_S = 1.15 \times U_R$
Reverse voltage	≤ 1 V	-
Current		
Leakage current	After 5 min at U_R	$I_{L5} \leq 0.02 C_R \times U_R$ or 1.5 mA, whichever is smaller
Inductance		
Equivalent series inductance (ESL)	All case sizes	19 nH typical/25 nH max.

Table 3

LOW TEMPERATURE CHARACTERISTIC (at 120 Hz)						
DESCRIPTION		U_R (V) ⁽¹⁾				
		160	200	250	400	450
Impedance ratio	$Z(-25\text{ °C})/Z(+20\text{ °C})$	4	4	4	4	4

Note

(1) Impedance ratio shall not exceed the given values

RIPPLE CURRENT AND USEFUL LIFE

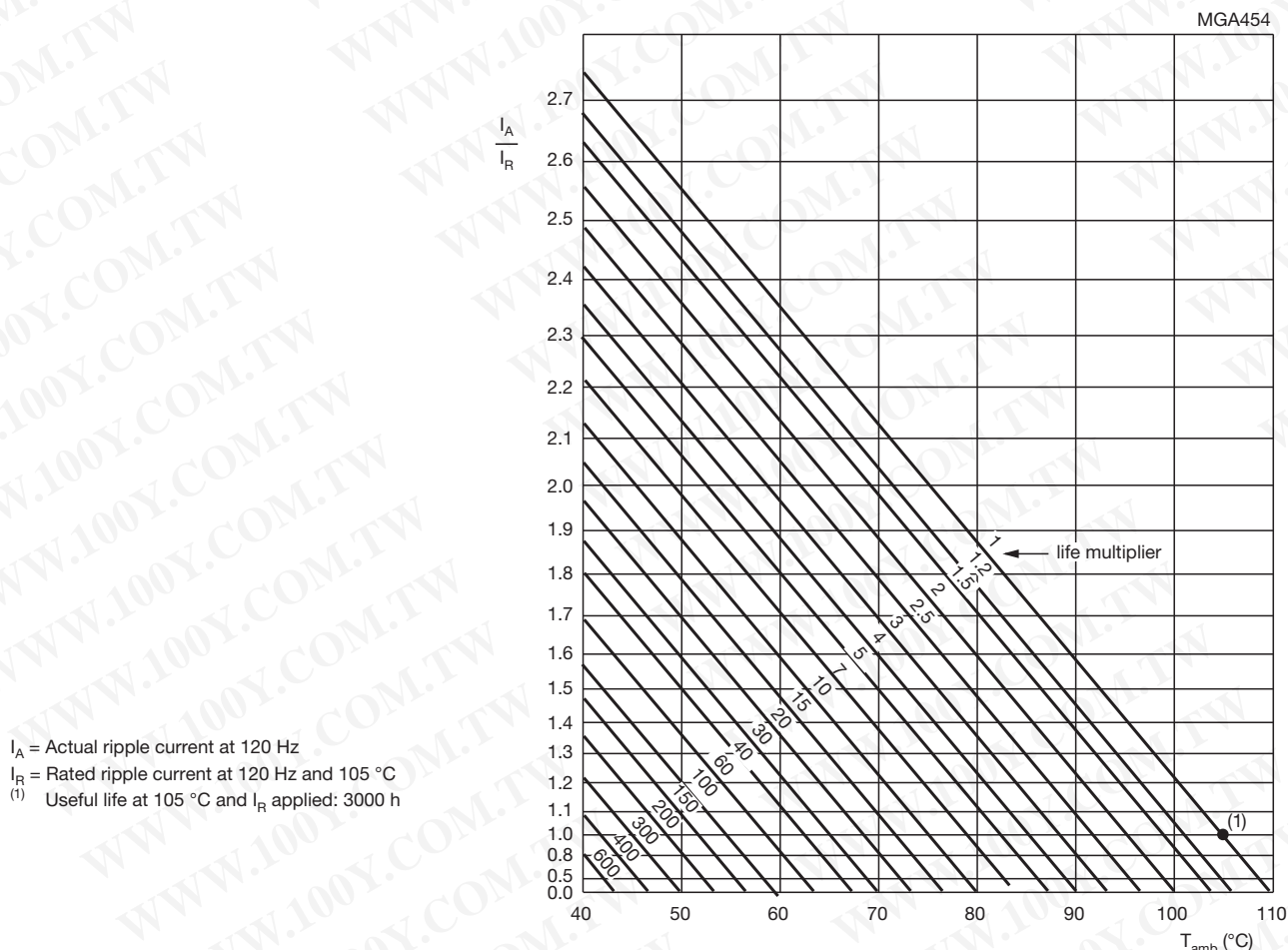


Fig. 4 - Multiplier of useful life as a function of ambient temperature and ripple current load



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Table 4

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
500	1.20
1000	1.30
$\geq 10\,000$	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	$T_{amb} = 105\text{ °C}$; U_R applied: 2000 h	$\Delta C/C: \pm 15\%$ ESR $\leq 1.3 \times$ spec. limit $I_{L5} \leq$ spec. limit
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 105\text{ °C}$; U_R and I_R applied: 3000 h	$\Delta C/C: \pm 30\%$ ESR $\leq 3 \times$ spec. limit $I_{L5} \leq$ 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	$T_{amb} = 105\text{ °C}$; no voltage applied; 500 h after test: U_R to be applied for 30 min, 24 h to 48 h before measurement	$\Delta C/C: \pm 20\%$ ESR $\leq 2 \times$ spec. limit $I_{L5} \leq 1 \times$ spec. limit



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