Aluminum Electrolytic Capacitors
Axial High Temperature, High Ripple Current



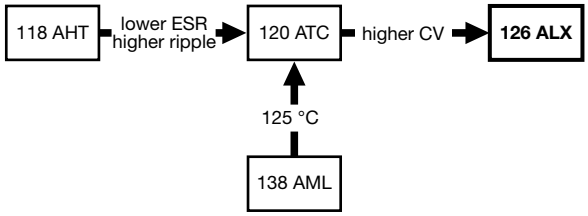


Fig. 1

FEATURES

AUTOMOTIVE GRADE

Pb-free

RoHS COMPLIANT

- Extra long useful life: up to 8000 h at 125 °C
- Low ESR levels provide very high ripple current capability
- Miniaturized, high CV-product per unit volume
- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Axial leads, cylindrical aluminum case, insulated with a blue sleeve
- Taped versions up to case Ø 15 mm x 30 mm available for automatic insertion
- AEC-Q200 qualified
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

APPLICATIONS

- Automotive, industrial, and telecommunication
- Smoothing, filtering, buffering
- Low mounting height applications, vibration and shock resistant
- SMPS and standard power supplies

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)
- Upper category temperature (125 °C)
- Date code in accordance with IEC 60062
- Code for factory of origin
- Name of manufacturer
- Negative terminal identification
- Series number (126)

QUICK REFERENCE DATA		
DESCRIPTION	VALUE	
Nominal case sizes (Ø D x L in mm)	6.5 x 18 to 10 x 25	10 x 30 to 21 x 38
Rated capacitance range, C_R	33 µF to 12 000 µF	
Tolerance on C_R	± 20 %	
Rated voltage range, U_R	10 V to 63 V	
Category temperature range	-40 °C to +125 °C	
Endurance test at 125 °C	2000 h	3000 h
Useful life at 125 °C	4000 h	8000 h
Useful life at 85 °C, 1.4 x I_R applied	40 000 h	
Shelf life at 0 V, 125 °C	1000 h	
Based on sectional specification	IEC 60384-4 / EN 130300	
Climatic category IEC 60068	40 / 125 / 56	

SELECTION CHART FOR C_R, U_R, AND RELEVANT NOMINAL CASE SIZE (Ø D x L in mm)

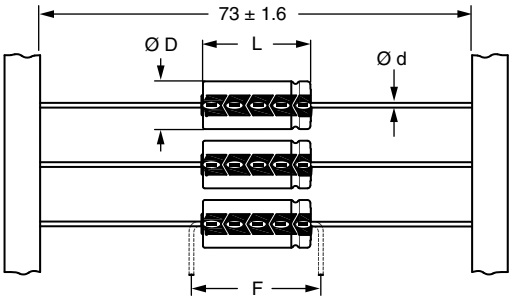
C_R (µF)	U_R (V)				
	10	16	25	40	63
33	→	→	→	→	6.5 x 18
56	→	→	→	→	8 x 18
68	→	→	→	6.5 x 18	-
120	→	→	→	8 x 18	10 x 25
150	→	→	6.5 x 18	10 x 18	10 x 30
180	→	6.5 x 18	-	-	-
220	→	→	8 x 18	10 x 25	-
270	→	→	10 x 18	-	-
330	→	8 x 18	→	10 x 30	12.5 x 30
470	6.5 x 18	10 x 18	→	→	15 x 30
560	→	→	10 x 25	12.5 x 30	-
680	8 x 18	10 x 25	10 x 30	→	18 x 30

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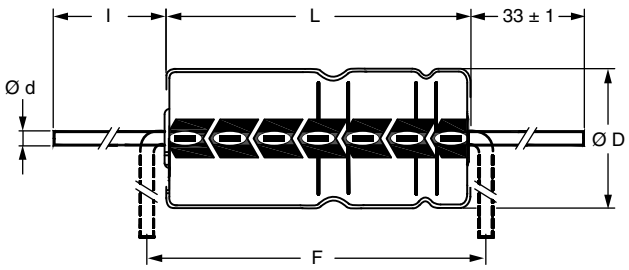
SELECTION CHART FOR C_R, U_R, AND RELEVANT NOMINAL CASE SIZE (Ø D x L in mm)					
C_R (µF)	U_R (V)				
	10	16	25	40	63
820	→	→	→	15 x 30	-
1000	10 x 18	10 x 30	→	→	18 x 38
1200	→	→	12.5 x 30	18 x 30	21 x 38
1500	10 x 30	-	-	-	-
1800	→	→	15 x 30	18 x 38	-
2200	→	12.5 x 30	-	-	-
2700	12.5 x 30	15 x 30	18 x 30	21 x 38	-
3900	15 x 30	→	18 x 38	-	-
4700	→	18 x 30	-	-	-
5600	→	→	21 x 38	-	-
6800	18 x 30	18 x 38	-	-	-
8200	→	21 x 38	-	-	-
10 000	18 x 38	-	-	-	-
12 000	21 x 38	-	-	-	-

DIMENSIONS in millimeters AND AVAILABLE FORMS



Form BA: taped in box (ammopack)
Case Ø D x L = 6.5 mm x 18 mm to 10 mm x 25 mm
Form BR: taped on reel
Case Ø D x L = 6.5 mm x 18 mm to 15 mm x 30 mm

Fig. 2 - **Form BA and BR**



Form AA: Axial in box
Case Ø D x L = 10 mm x 30 mm to 21 mm x 38 mm

Fig. 3 - **Form AA**

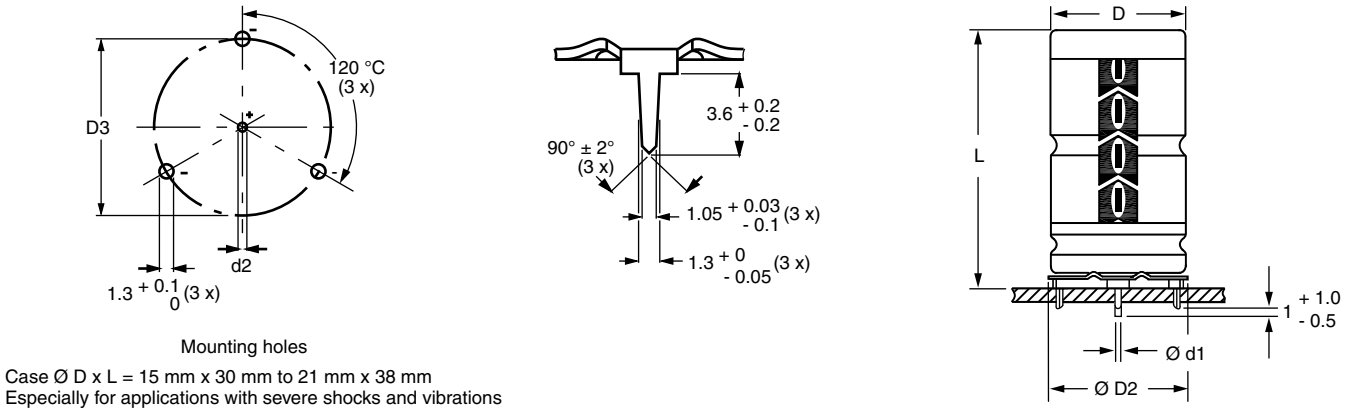
Table 1

AXIAL; DIMENSIONS in millimeters, MASS, AND PACKAGING QUANTITIES										
NOMINAL CASE SIZE Ø D x L (mm)	CASE CODE	AXIAL: FORM AA, BA, AND BR					MASS (g)	PACKAGING QUANTITIES		
		Ø d	l	Ø $D_{max.}$	$L_{max.}$	$F_{min.}$		FORM AA	FORM BA	FORM BR
6.5 x 18	4	0.8	-	6.9	18.5	25	1.3	-	1000	1000
8 x 18	5	0.8	-	8.5	18.5	25	1.7	-	500	500
10 x 18	6	0.8	-	10.5	18.5	25	2.5	-	500	500
10 x 25	7	0.8	-	10.5	25.5	30	3.3	-	500	500
10 x 30	00	0.8	55 ± 1	10.5	30.5	35	4.8	340	-	500
12.5 x 30	01	0.8	55 ± 1	13.0	30.5	35	7.4	260	-	400
15 x 30	02	0.8	55 ± 1	15.5	30.5	35	11.7	200	-	250
18 x 30	03	0.8	55 ± 1	18.5	30.5	35	12.9	120	-	-
18 x 38	04	0.8	34 ± 1	18.5	39.5	44	19	125	-	-
21 x 38	05	0.8	34 ± 1	21.5	39.5	44	24	100	-	-

Note

- For detailed tape dimensions, please see www.vishay.com/doc?28361

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Mounting holes

Case Ø D x L = 15 mm x 30 mm to 21 mm x 38 mm
Especially for applications with severe shocks and vibrations

Fig. 4 - Mounting hole diagram and outline; **form MR:** With mounting ring and pins

Table 2

MOUNTING RING; DIMENSIONS in millimeters, **MASS, AND PACKAGING QUANTITIES**									
NOMINAL CASE SIZE Ø D x L	**CASE CODE**	**MOUNTING RING: FORM MR**						**MASS (g)**	**PACKAGING QUANTITIES**
		Ø d1	**Ø d2**	**Ø $D_{max.}$**	**Ø $D2_{max.}$**	**D3**	**$L_{max.}$**		
15 x 30	02	0.8	1.0 + 0.4	15.5	17.5	16.5 ± 0.2	33	≈ 8.6	200
18 x 30	03	0.8	1.0 + 0.4	18.5	19.5	18.5 ± 0.2	33	≈ 11.5	240
18 x 38	04	0.8	1.0 + 0.4	18.5	19.5	18.5 ± 0.2	42	≈ 14.0	100
21 x 38	05	0.8	1.0 + 0.4	21.5	22.5	21.5 ± 0.2	42	≈ 19.2	100

ELECTRICAL DATA	
SYMBOL	**DESCRIPTION**
C_R	Rated capacitance at 100 Hz, tolerance ± 20 %
I_R	Rated RMS ripple current at 10 kHz, 125 °C
I_{L1}	Max. leakage current after 1 min at U_R
I_{L5}	Max. leakage current after 5 min at U_R
ESR	Equivalent series resistance at 100 Hz (calculated from tan $\delta_{max.}$ and C_R)
Z	Max. impedance at 10 kHz

Note

- Unless otherwise specified, all electrical values in Table 3 apply at T_{amb} = 20 °C, P = 86 kPa to 106 kPa, RH = 45 % to 75 %.

ORDERING EXAMPLE

Electrolytic capacitor 126 series

1000 µF / 16 V; ± 20 %

Nominal case size: Ø 10 mm x 30 mm; form BR

Ordering code: MAL212625102E3

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Table 3

ELECTRICAL DATA AND ORDERING INFORMATION													
U_R (V)	C_R 100 Hz (µF)	NOMINAL CASE SIZE Ø D x L (mm)	I_R 100 Hz 125 °C (mA)	I_{L1} 1 min (µA)	I_{L5} 5 min (µA)	tan δ 100 Hz	MAX. ESR 100 Hz (Ω)	MAX. ESR 10 kHz (Ω)	Z MAX. 10 kHz (Ω)	ORDERING CODE MAL2126.....			
										IN BOX FORM AA	TAPED ON REEL FORM BR	TAPED IN BOX FORM BA	MOUNTING RING FORM MR
10	470	6.5 x 18	190	96	59	0.30	1.016	0.991	2.100	-	24471E3	34471E3	-
	680	8 x 18	300	122	67	0.30	0.702	0.579	1.000	-	24681E3	34681E3	-
	1000	10 x 18	520	160	80	0.32	0.509	0.382	0.750	-	24102E3	34102E3	-
	1500	10 x 30	670	220	100	0.32	0.224	0.091	0.078	14152E3	24152E3	-	-
	2700	12.5 x 30	890	364	148	0.34	0.132	0.070	0.061	14272E3	24272E3	-	-
	3900	15 x 30	1140	508	196	0.36	0.097	0.055	0.046	14392E3	24392E3	-	44392E3
	6800	18 x 30	1450	856	312	0.42	0.065	0.037	0.043	14682E3	-	-	44682E3
	10 000	18 x 38	1880	1240	440	0.50	0.053	0.032	0.029	14103E3	-	-	44103E3
	12 000	21 x 38	2200	1480	520	0.54	0.047	0.029	0.029	14123E3	-	-	44123E3
16	180	6.5 x 18	180	75	52	0.20	1.768	1.121	2.500	-	25181E3	35181E3	-
	330	8 x 18	230	103	61	0.20	0.965	0.517	1.500	-	25331E3	35331E3	-
	470	10 x 18	330	130	70	0.20	0.677	0.330	0.830	-	25471E3	35471E3	-
	680	10 x 25	490	171	84	0.20	0.468	0.228	0.550	-	25681E3	35681E3	-
	1000	10 x 30	630	232	104	0.22	0.231	0.090	0.108	15102E3	25102E3	-	-
	2200	12.5 x 30	860	462	181	0.24	0.115	0.058	0.061	15222E3	25222E3	-	-
	2700	15 x 30	1090	558	213	0.24	0.093	0.051	0.046	15272E3	25272E3	-	45272E3
	4700	18 x 30	1480	942	341	0.28	0.063	0.034	0.043	15472E3	-	-	45472E3
	6800	18 x 38	1930	1346	475	0.32	0.049	0.029	0.035	15682E3	-	-	45682E3
	8200	21 x 38	2100	1614	565	0.36	0.046	0.027	0.029	15822E3	-	-	45822E3
25	150	6.5 x 18	160	85	55	0.18	1.910	1.162	2.300	-	26151E3	36151E3	-
	220	8 x 18	210	106	62	0.18	1.302	0.670	0.910	-	26221E3	36221E3	-
	270	10 x 18	270	121	67	0.18	1.061	0.497	1.250	-	26271E3	36271E3	-
	560	10 x 25	440	208	96	0.18	0.512	0.239	0.570	-	26561E3	36561E3	-
	680	10 x 30	580	244	108	0.18	0.278	0.099	0.119	16681E3	26681E3	-	-
	1200	12.5 x 30	790	400	160	0.20	0.175	0.050	0.061	16122E3	26122E3	-	-
	1800	15 x 30	1020	580	220	0.20	0.117	0.041	0.046	16182E3	26182E3	-	46182E3
	2700	18 x 30	1320	850	310	0.24	0.093	0.033	0.043	16272E3	-	-	46272E3
	3900	18 x 38	1840	1210	430	0.26	0.070	0.030	0.036	16392E3	-	-	46392E3
	5600	21 x 38	2100	1720	600	0.30	0.056	0.024	0.029	16562E3	-	-	46562E3
40	68	6.5 x 18	120	73	51	0.11	2.575	1.566	2.800	-	27689E3	37689E3	-
	120	8 x 18	180	98	59	0.11	1.459	0.751	1.300	-	27121E3	37121E3	-
	150	10 x 18	250	112	64	0.11	1.167	0.546	1.000	-	27151E3	37151E3	-
	220	10 x 25	350	146	75	0.11	0.786	0.372	0.680	-	27221E3	37221E3	-
	330	10 x 30	490	198	93	0.11	0.350	0.125	0.150	17331E3	27331E3	-	-
	560	12.5 x 30	750	309	130	0.11	0.206	0.081	0.097	17561E3	27561E3	-	-
	820	15 x 30	970	434	171	0.11	0.141	0.050	0.055	17821E3	27821E3	-	47821E3
	1200	18 x 30	1250	616	232	0.13	0.114	0.041	0.049	17122E3	-	-	47122E3
	1800	18 x 38	1640	904	328	0.13	0.076	0.036	0.043	17182E3	-	-	47182E3
	2700	21 x 38	1810	1336	472	0.15	0.058	0.027	0.031	17272E3	-	-	47272E3

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ELECTRICAL DATA AND ORDERING INFORMATION

U_R (V)	C_R 100 Hz (µF)	NOMINAL CASE SIZE Ø D x L (mm)	I_R 100 Hz 125 °C (mA)	I_{L1} 1 min (µA)	I_{L5} 5 min (µA)	tan δ 100 Hz	MAX. ESR 100 Hz (Ω)	MAX. ESR 10 kHz (Ω)	Z MAX. 10 kHz (Ω)	ORDERING CODE MAL2126.....			
										IN BOX FORM AA	TAPED ON REEL FORM BR	TAPED IN BOX FORM BA	MOUNTING RING FORM MR
63	33	6.5 x 18	100	65	48	0.08	3.858	2.347	5.600	-	28339E3	38339E3	-
	56	8 x 18	150	82	54	0.08	2.274	1.171	1.500	-	28569E3	38569E3	-
	120	10 x 25	280	131	70	0.08	1.061	0.497	0.700	-	28121E3	38121E3	-
	180	10 x 30	410	176	85	0.08	0.467	0.121	0.249	18181E3	28181E3	-	-
	330	12.5 x 30	660	289	123	0.08	0.255	0.099	0.126	18331E3	28331E3	-	-
	470	15 x 30	860	395	158	0.08	0.179	0.070	0.091	18471E3	28471E3	-	48471E3
	680	18 x 30	1130	554	211	0.08	0.124	0.048	0.074	18681E3	-	-	48681E3
	1000	18 x 38	1460	796	292	0.10	0.105	0.041	0.049	18102E3	-	-	48102E3
	1200	21 x 38	1680	947	342	0.12	0.105	0.041	0.043	18122E3	-	-	48122E3

ADDITIONAL ELECTRICAL DATA

PARAMETER	CONDITIONS	VALUE	
		AXIAL	MOUNTING RING
Voltage			
Surge voltage		$U_s \leq 1.15 \times U_R$	
Reverse voltage		$U_{rev} \leq 1$ V	
Current			
Leakage current	After 1 min at U_R	$I_{L1} \leq 0.012\ C_R \times U_R + 40$ µA	
	After 5 min at U_R	$I_{L5} \leq 0.004\ C_R \times U_R + 40$ µA	
Inductance			
Equivalent series inductance (ESL)	Case Ø D x L mm:		
	6.5 x 18	Typ. 15 nH	
	8 x 18	Typ. 35 nH	
	10 x 18	Typ. 69 nH	
	10 x 25, 10 x 30	Typ. 38 nH	
	12.5 x 30	Typ. 46 nH	
	15 x 30	Typ. 48 nH	Typ. 39 nH
	18 x 30	Typ. 50 nH	Typ. 39 nH
	18 x 38	Typ. 54 nH	Typ. 39 nH
	21 x 38	Typ. 59 nH	Typ. 39 nH

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CAPACITANCE (C)

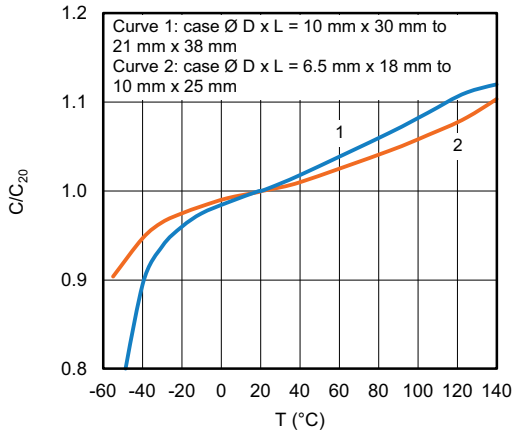


Fig. 5 - Typical multiplier of capacitance as a function of ambient temperature (C_{20} = capacitance at 20 °C, 100 Hz)

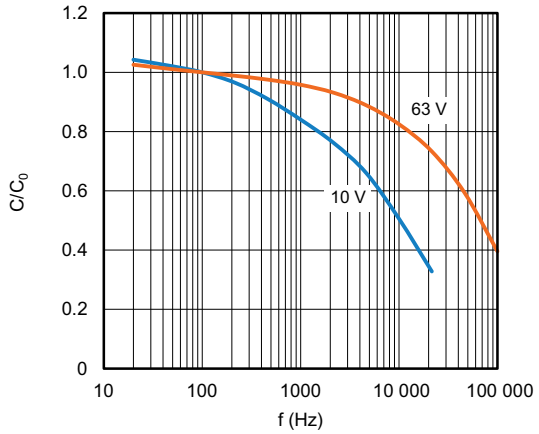


Fig. 6 - Typical multiplier of capacitance as a function of frequency (C_0 = typical capacitance at 100 Hz at 20 °C)

EQUIVALENT SERIES RESISTANCE (ESR)

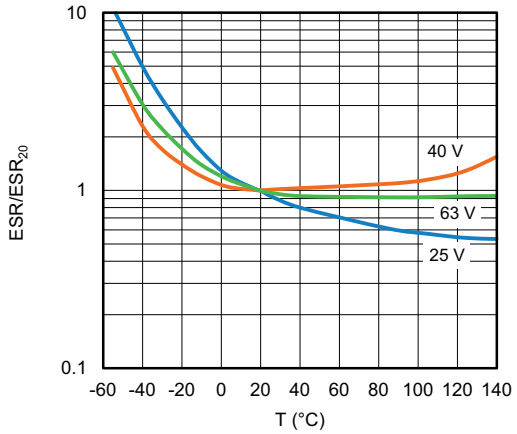


Fig. 7 - Typical multiplier of ESR as a function of ambient temperature (ESR_{20} = typical ESR at 100 Hz at 20 °C)

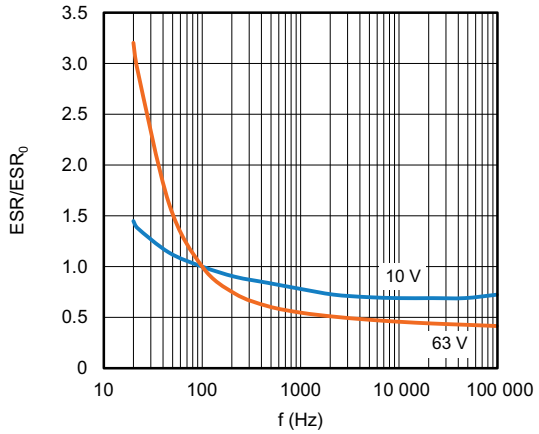


Fig. 8 - Typical multiplier of ESR as a function of frequency (ESR_0 = typical ESR at 100 Hz at 20 °C)

RIPPLE CURRENT AND USEFUL LIFE

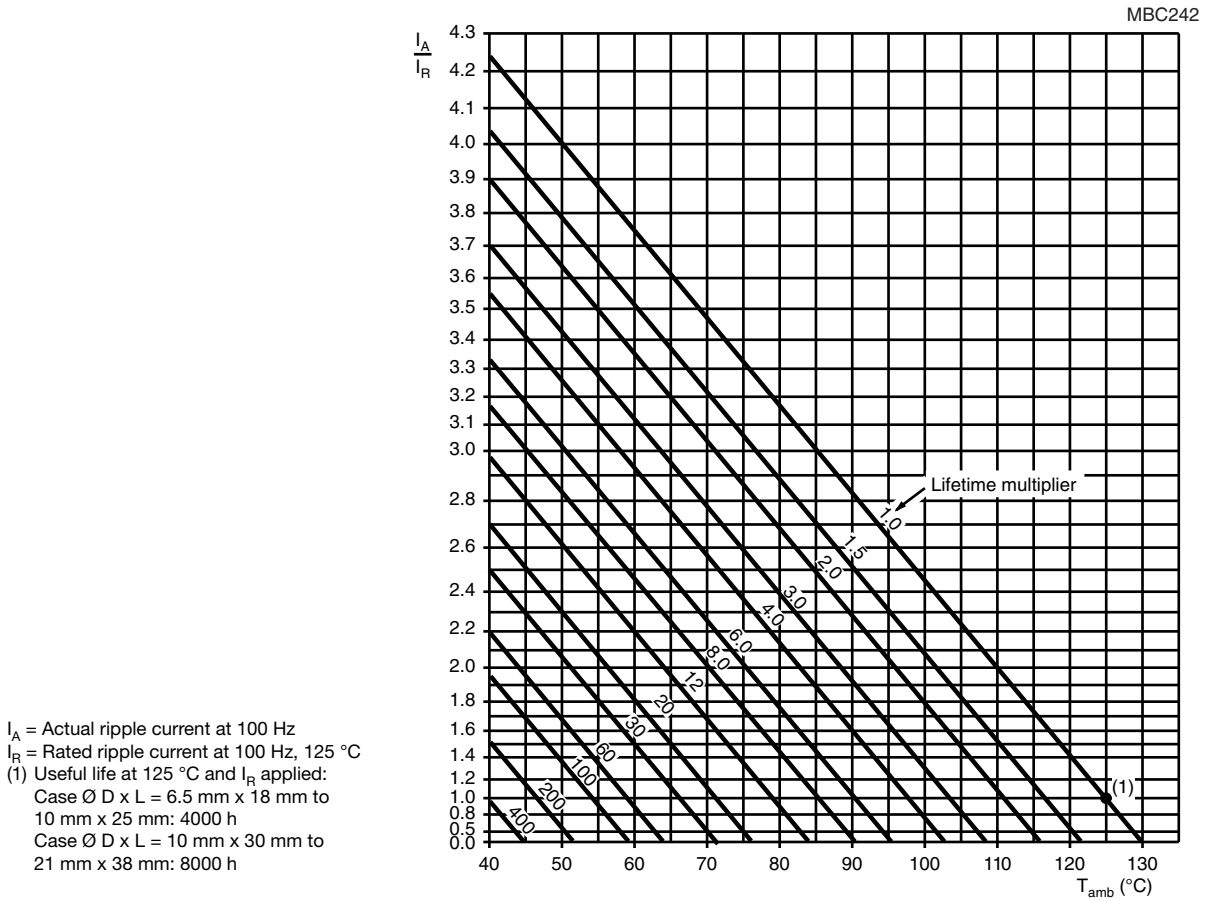
Table 4

ENDURANCE TEST DURATION AND USEFUL LIFE		
NOMINAL CASE SIZE Ø D x L (mm)	ENDURANCE AT 125 °C (h)	USEFUL LIFE AT 125 °C (h)
6.5 x 18	2000	4000
8 x 18	2000	4000
10 x 18	2000	4000
10 x 25	2000	4000
10 x 30	3000	8000
12.5 x 30	3000	8000
15 x 30	3000	8000
18 x 30	3000	8000
18 x 38	3000	8000
21 x 38	3000	8000

Note

- Multiplier of useful life code: MBC242

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I_A = Actual ripple current at 100 Hz
I_R = Rated ripple current at 100 Hz, 125 °C
(1) Useful life at 125 °C and I_R applied:
Case Ø D x L = 6.5 mm x 18 mm to 10 mm x 25 mm: 4000 h
Case Ø D x L = 10 mm x 30 mm to 21 mm x 38 mm: 8000 h

Fig. 9 - Multiplier of useful life as a function of ambient temperature and ripple current load

Table 5

MULTIPLIER OF RIPPLE CURRENT (I_R) AS A FUNCTION OF FREQUENCY						
U_R (V)	FREQUENCY (Hz)					
	50	100	300	1000	3000	≥ 10 000
	I_R MULTIPLIER					
10	0.95	1.00	1.07	1.12	1.15	1.20
16	0.95	1.00	1.07	1.12	1.15	1.20
25	0.95	1.00	1.07	1.12	1.15	1.20
40	0.90	1.00	1.12	1.20	1.25	1.30
63	0.90	1.00	1.12	1.20	1.25	1.30

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Table 6

TEST PROCEDURES AND REQUIREMENTS			
TEST		**PROCEDURE (quick reference)**	**REQUIREMENTS**
NAME OF TEST	**REFERENCE**		
Endurance	IEC 60384-4 / EN 130300 subclause 4.13	T_{amb} = 125 °C; U_R applied; Case sizes: 6.5 mm x 18 mm to 10 mm x 25 mm: 2000 h; 10 mm x 30 mm to 21 mm x 38 mm: 3000 h	U_R = 10 V; ΔC/C: ± 20 % U_R > 10 V; ΔC/C: ± 15 % tan δ ≤ 1.3 x spec. limit Z ≤ 2 x spec. limit I_{L5} ≤ spec. limit
Useful life	CECC 30301 subclause 1.8.1	T_{amb} = 125 °C; U_R and I_R applied; Case Ø D x L = 6.5 mm x 18 mm to 10 mm x 25 mm: 4000 h Case Ø D x L = 10 mm x 30 mm to 21 mm x 38 mm: 8000 h	U_R > 10 V; ΔC/C: ± 45 % tan δ ≤ 3 x spec. limit Z ≤ 3 x spec. limit I_{L5} ≤ spec. limit no short or open circuit total failure percentage: ≤ 1 %
Shelf life (storage at high temperature)	IEC 60384-4 / EN 130300 subclause 4.17	T_{amb} = 125 °C; no voltage applied; U_R = 6.3 V to 63 V: 1000 h; After test: U_R to be applied for 30 min, 24 h to 48 h before measurement	ΔC/C, tan δ, Z: for requirements see “Endurance test” above I_{L5} ≤ 2 x spec. limit
Reverse voltage	IEC 60384-4 / EN 130300 subclause 4.15	T_{amb} = 125 °C: 125 h at U = -1 V followed by 125 h at U_R	ΔC/C: ± 20 % tan δ ≤ spec. limit I_{L5} ≤ 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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