

DATA SHEET

036 RSP

Aluminum electrolytic capacitors
Radial Semi-Professional

Product specification
Supersedes data of 18th January 2000
File under BCcomponents, BC01

2001 Oct 25

Aluminum electrolytic capacitors

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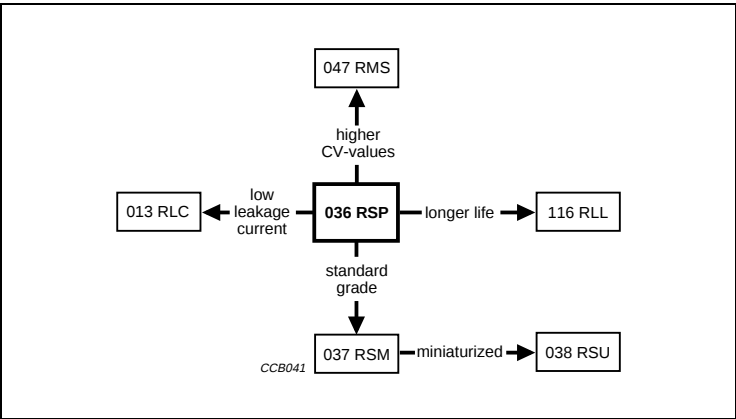
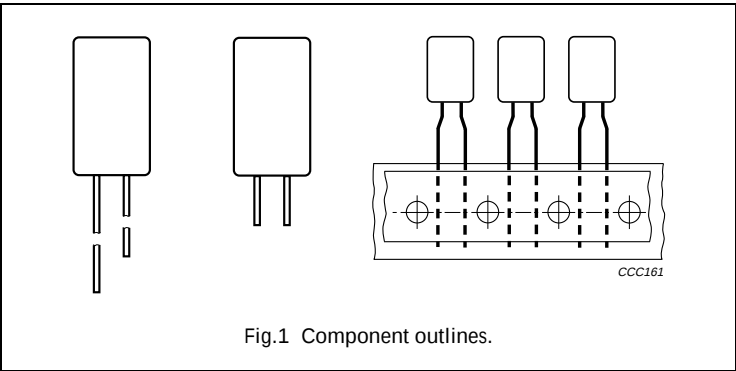
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FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Radial leads, cylindrical aluminum case, all-insulated (light blue)
- Natural pitch 2.5 mm and 5 mm
- Charge and discharge proof
- Miniaturized, high CV-product per unit volume
- Reduced leakage current.

APPLICATIONS

- Automotive, telecommunication, industrial, EDP and audio-video
- Coupling, decoupling, smoothing, filtering, buffering, timing
- Portable and mobile equipment (small size, low mass).



QUICK REFERENCE DATA

DESCRIPTION	VALUE
Case sizes ($\varnothing D_{nom} \times L_{nom}$ in mm)	5×11 and 8.2×11
Rated capacitance range, C_R	0.47 to 470 μF
Tolerance on C_R	$\pm 20\%$; $\pm 10\%$ on request
Rated voltage range, U_R	6.3 to 160 V
Category temperature range	-55 to $+85$ $^{\circ}C$
Endurance test at 85 $^{\circ}C$	2000 hours
Useful life at 105 $^{\circ}C$	750 hours
Useful life at 85 $^{\circ}C$	3000 hours
Useful life at 40 $^{\circ}C$, $1.4 \times I_R$ applied	80000 hours
Shelf life at 0 V, 85 $^{\circ}C$	500 hours
Based on sectional specification	IEC 60384-4/EN130 300
Climatic category IEC 60068	55/085/56

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Selection chart for C_R , U_R and relevant nominal case sizes ($\varnothing D \times L$ in mm)

Preferred types in **bold**.

C_R (μF)	U_R (V)									
	6.3	10	16	25	35	40	50	63	100	160
0.47	–	–	–	–	–	–	–	5 × 11	–	–
1.0	–	–	–	–	–	–	–	5 × 11	–	–
2.2	–	–	–	–	–	–	–	5 × 11	–	8.2 × 11
3.3	–	–	–	–	–	–	–	5 × 11	–	–
4.7	–	–	–	–	–	–	–	5 × 11	–	8.2 × 11
6.8	–	–	–	–	–	–	–	5 × 11	–	–
10	–	–	–	–	–	–	5 × 11	5 × 11	8.2 × 11	–
	–	–	–	–	–	–	–	8.2 × 11	–	–
15	–	–	–	–	–	5 × 11	–	5 × 11	–	–
22	–	–	–	–	5 × 11	–	–	5 × 11	8.2 × 11	–
	–	–	–	–	–	–	–	8.2 × 11	–	–
33	–	–	5 × 11	–	–	–	5 × 11	8.2 × 11	–	–
47	–	5 × 11	–	–	5 × 11	–	8.2 × 11	8.2 × 11	–	–
68	–	–	–	5 × 11	–	8.2 × 11	–	8.2 × 11	–	–
100	5 × 11	–	5 × 11	8.2 × 11	–	–	8.2 × 11	–	–	–
150	–	5 × 11	8.2 × 11	–	8.2 × 11	–	–	–	–	–
220	–	8.2 × 11	8.2 × 11	8.2 × 11	–	–	–	–	–	–
330	8.2 × 11	–	8.2 × 11	–	–	–	–	–	–	–
470 ⁽¹⁾	–	8.2 × 11	–	–	–	–	–	–	–	–

Note

- For higher CV-values see data sheet "047 RMS".

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MECHANICAL DATA, AVAILABLE FORMS AND PACKAGING QUANTITIES

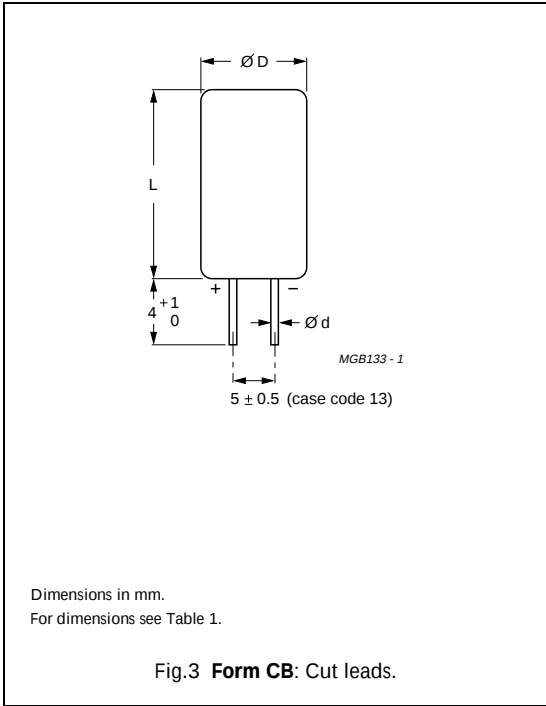
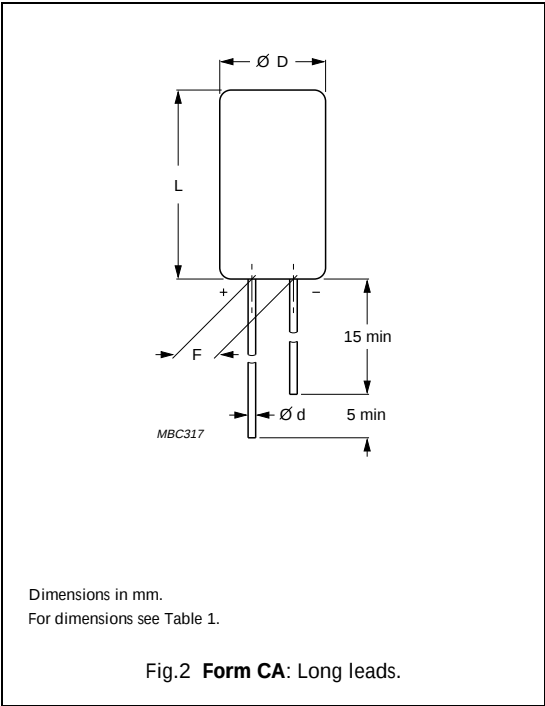


Table 1 Physical dimensions, mass and packaging quantities; see Figs 2 and 3

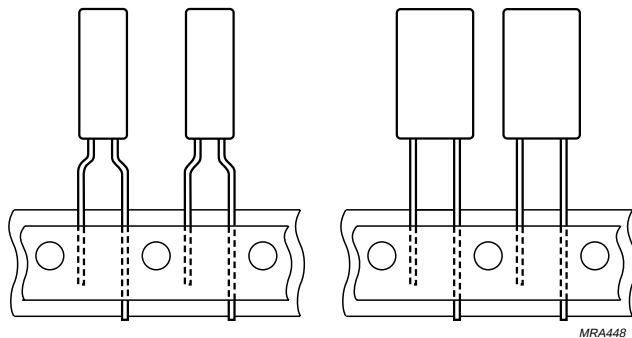
NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	$\varnothing d$ (mm)	$\varnothing D_{\text{max}}$ (mm)	L_{max} (mm)	F (mm)	MASS (g)	PACKAGING QUANTITIES	
							FORM CA, CB	FORM TFA, TNA
5 × 11	11	0.5	5.5	12	2.5 ± 0.5	≈ 0.4	1000	2000
8.2 × 11	13	0.6	8.7	12	5.0 ± 0.5	≈ 1.1	1000	1000

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Taped products

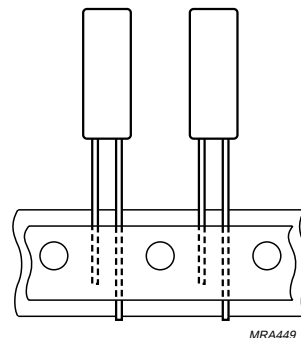

Form TFA:

Pitch F = 5 mm.

Case $\varnothing D \times L = 5 \times 11$ and 8.2×11 mm.

Tape dimensions are specified in data handbook BC01, section "Packaging".

Fig.4 Taped in box (ammopack).


Form TNA:

Pitch F = 2.5 mm.

Case $\varnothing D \times L = 5 \times 11$ mm only.

Tape dimensions are specified in data handbook BC01, section "Packaging".

Fig.5 Taped in box (ammopack).

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"
- Rated voltage (in V)
- Group number (036)
- Name of manufacturer
- Date code in accordance with "IEC 60062"
- Code indicating factory of origin
- Minus-sign on top to identify the negative terminal.

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Ordering example

Electrolytic capacitor 036 series

100 µF/16 V; ±20%

Nominal case size: Ø5 × 11 mm; Form TFA

Catalogue number: 2222 036 35101.

ELECTRICAL DATA

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

SYMBOL	DESCRIPTION
C_R	rated capacitance at 100 Hz, tolerance ±20%
I_R	rated RMS ripple current at 100 Hz, 85 °C
I_{L1}	max. leakage current after 1 minute at U_R
$\tan \delta$	max. dissipation factor at 100 Hz
Z	max. impedance at 10 kHz and 20 °C

Table 2 Electrical data; preferred types in **bold**

U _R (V)	C _R 100 Hz (μF)	NOMINAL CASE SIZE ØD × L (mm)	I _R 100 Hz 85 °C (mA)	I _{L1} 1 min (μA)	Tan δ 100 Hz	Z 10 kHz 20 °C (Ω)	CATALOGUE NUMBER 2222 036							
							BULK PACKAGING				TAPED AMMOPACK			
							LONG LEADS		CUT LEADS					
							FORM CA	F (mm)	FORM CB	F (mm)	FORM TFA	F (mm)	FORM TNA	F (mm)
6.3	100	5 × 11	130	7	0.20	1.7	53101	2.5	–	–	33101	5.0	73101	2.5
	330	8.2 × 11	300	16	0.20	0.52	53331	5.0	63331	5.0	33331	5.0	–	–
10	47	5 × 11	95	6	0.16	2.8	54479	2.5	–	–	34479	5.0	74479	2.5
	150	5 × 11	150	12	0.20	1.3	54151	2.5	–	–	34151	5.0	74151	2.5
	220	8.2 × 11	260	17	0.16	0.59	54221	5.0	64221	5.0	34221	5.0	–	–
	470	8.2 × 11	400	31	0.20	0.43	54471	5.0	64471	5.0	34471	5.0	–	–
16	33	5 × 11	90	7	0.14	2.7	55339	2.5	–	–	35339	5.0	75339	2.5
	100	5 × 11	160	13	0.16	1.6	55101	2.5	–	–	35101	5.0	75101	2.5
	150	8.2 × 11	230	18	0.14	0.6	55151	5.0	65151	5.0	35151	5.0	–	–
	220	8.2 × 11	280	24	0.16	0.55	55221	5.0	65221	5.0	35221	5.0	–	–
	330	8.2 × 11	390	35	0.16	0.48	55331	5.0	65331	5.0	35331	5.0	–	–
25	68	5 × 11	140	13	0.14	1.8	56689	2.5	–	–	36689	5.0	76689	2.5
	100	8.2 × 11	210	18	0.12	0.7	56101	5.0	66101	5.0	36101	5.0	–	–
	220	8.2 × 11	310	36	0.14	0.55	56221	5.0	66221	5.0	36221	5.0	–	–
35	22	5 × 11	87	8	0.10	2.7	90001	2.5	–	–	90027	5.0	90389	2.5
	47	5 × 11	130	13	0.12	1.9	90094	2.5	–	–	90098	5.0	90391	2.5
	150	8.2 × 11	270	35	0.12	0.6	90099	5.0	90101	5.0	90103	5.0	–	–

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U _R (V)	C _R 100 Hz (μF)	NOMINAL CASE SIZE ØD × L (mm)	I _R 100 Hz 85 °C (mA)	I _{L1} 1 min (μA)	Tan δ 100 Hz	Z 10 kHz 20 °C (Ω)	CATALOGUE NUMBER 2222 036							
							BULK PACKAGING				TAPED AMMOPACK			
							LONG LEADS		CUT LEADS					
							FORM CA	F (mm)	FORM CB	F (mm)	FORM TFA	F (mm)	FORM TNA	F (mm)
40	15	5 × 11	72	7	0.10	3.7	57159	2.5	–	–	37159	5.0	77159	2.5
	68	8.2 × 11	180	20	0.10	0.81	57689	5.0			67689	5.0	37689	5.0
50	10	5 × 11	60	6	0.08	4.5	90004	2.5	–	–	90028	5.0	90392	2.5
	33	5 × 11	110	13	0.10	2.1	90104	2.5	–	–	90108	5.0	90393	2.5
	47	8.2 × 11	160	18	0.08	0.96	90011	5.0	90012	5.0	90031	5.0	–	–
	100	8.2 × 11	250	33	0.10	0.7	90109	5.0	90111	5.0	90113	5.0	–	–
63	0.47	5 × 11	5	4	0.06	85	58477	2.5	–	–	38477	5.0	78477	2.5
	1.0	5 × 11	11	4	0.06	40	58108	2.5	–	–	38108	5.0	78108	2.5
	2.2	5 × 11	25	4	0.06	18	58228	2.5	–	–	38228	5.0	78228	2.5
	3.3	5 × 11	38	5	0.06	12	58338	2.5	–	–	38338	5.0	78338	2.5
	4.7	5 × 11	45	5	0.06	8.5	58478	2.5	–	–	38478	5.0	78478	2.5
	6.8	5 × 11	55	6	0.06	5.9	58688	2.5	–	–	38688	5.0	78688	2.5
	10	5 × 11	70	7	0.06	4.0	58109	2.5	–	–	38109	5.0	78109	2.5
	10	8.2 × 11	120	7	0.04	2.8	90036	5.0	90041	5.0	90181	5.0	–	–
	15	5 × 11	80	9	0.07	3.1	58159	2.5	–	–	38159	5.0	78159	2.5
	22	5 × 11	100	11	0.08	2.7	58229	2.5	–	–	38229	5.0	78229	2.5
	22	8.2 × 11	150	11	0.05	1.4	90117	5.0	90118	5.0	90139	5.0	–	–
	33	8.2 × 11	160	16	0.06	1.2	58339	5.0	68339	5.0	38339	5.0	–	–
	47	8.2 × 11	190	21	0.07	1.0	58479	5.0	68479	5.0	38479	5.0	–	–
	68	8.2 × 11	210	29	0.08	0.88	58689	5.0	68689	5.0	38689	5.0	–	–
100	10	8.2 × 11	80	9	0.06	3.5	59109	5.0	69109	5.0	39109	5.0	–	–
	22	8.2 × 11	110	16	0.06	1.8	59229	5.0	69229	5.0	39229	5.0	–	–
160	2.2	8.2 × 11	45	75	0.05	14	90333	5.0	90334	5.0	90336	5.0	–	–
	4.7	8.2 × 11	62	115	0.07	9.6	90337	5.0	90338	5.0	90341	5.0	–	–

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036 RSP**Additional electrical data**

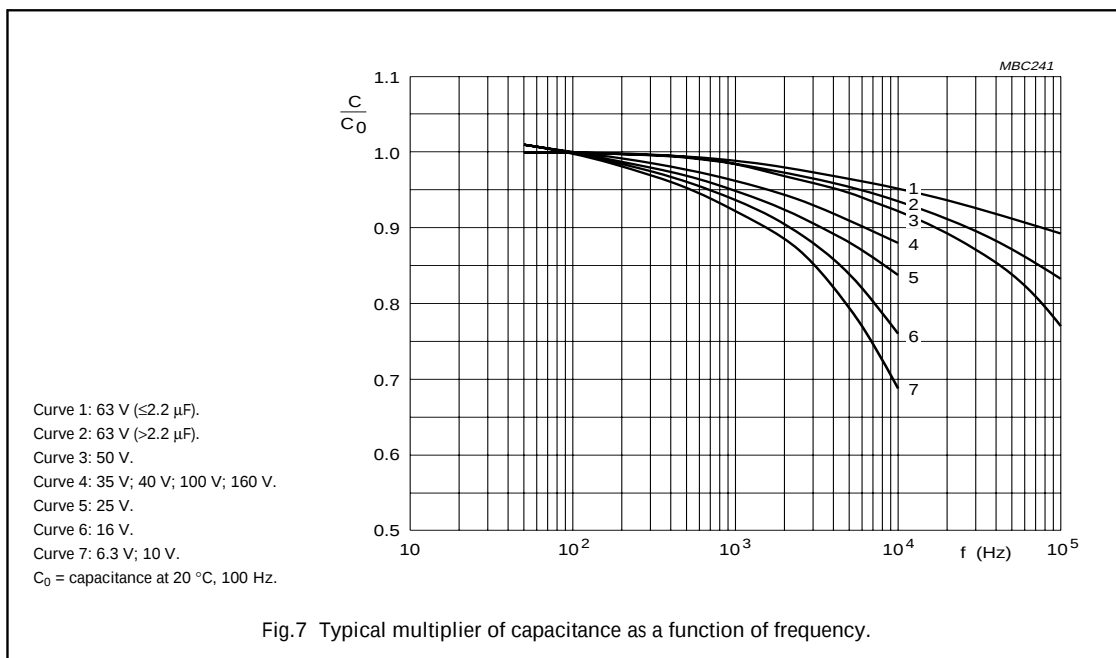
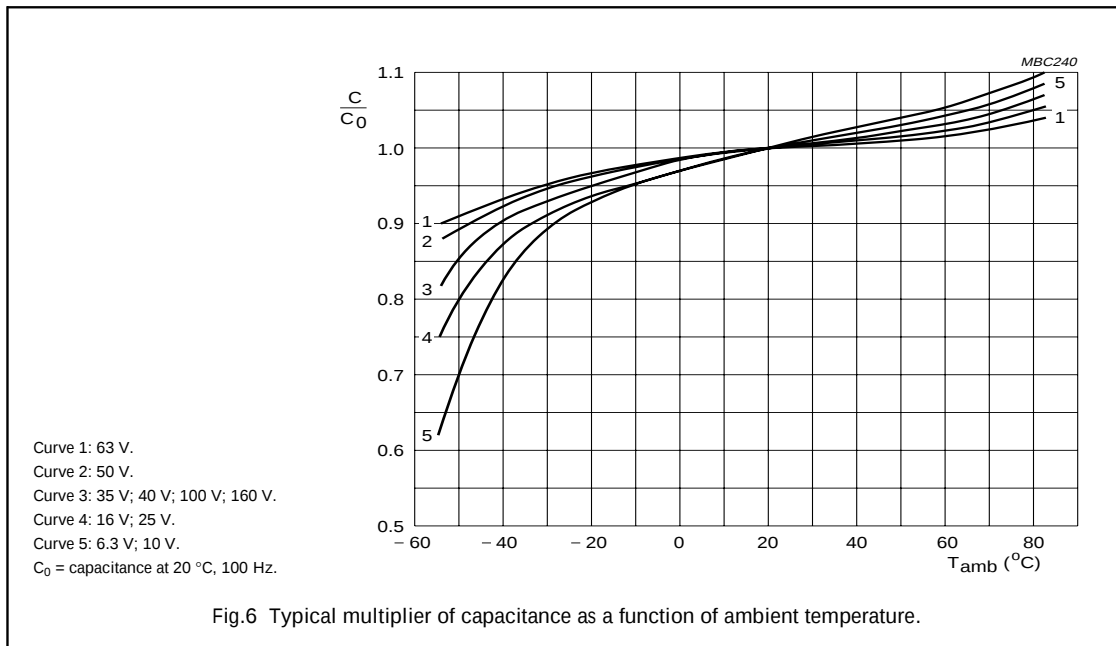
PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage		$U_s \leq 1.15 U_R$
Reverse voltage		$U_{rev} \leq 1 \text{ V}$
Current		
Leakage current	after 1 minute: $U_R = 6.3 \text{ to } 100 \text{ V}$ $U_R = 160 \text{ V}$	$I_{L1} \leq 0.006C_R \times U_R + 3 \mu\text{A}$ $I_{L1} \leq 0.1C_R \times U_R + 40 \mu\text{A}$
	after 5 minutes: $U_R = 6.3 \text{ to } 100 \text{ V}$ $U_R = 160 \text{ V}$	$I_{L5} \leq 0.001C_R \times U_R + 3 \mu\text{A}$ $I_{L5} \leq 0.015C_R \times U_R + 10 \mu\text{A}$
Inductance		
Equivalent series inductance (ESL)	case $\varnothing D \times L = 5 \times 11 \text{ mm}$	typ. 13 nH
	case $\varnothing D \times L = 8.2 \times 11 \text{ mm}$	typ. 16 nH
Resistance		
Equivalent series resistance (ESR)	calculated from $\tan \delta_{\max}$ and C_R (see Table 2)	$\text{ESR} = \tan \delta / 2\pi f C_R$

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Capacitance (C)



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Impedance (Z)

Curve 1: 0.47 μF .
 Curve 2: 0.68 μF .
 Curve 3: 1.0 μF .
 Curve 4: 1.5 μF .
 Curve 5: 2.2 μF .
 Curve 6: 3.3 μF .
 Curve 7: 4.7 μF .
 Curve 8: 6.8 μF .
 Curve 9: 10 μF .
 Curve 10: 15 μF .
 Curve 11: 22 μF .
 Curve 12: 33 μF .
 Curve 13: 47 μF .
 Curve 14: 68 μF .
 Curve 15: 100 μF .
 Curve 16: 150 μF .
Case $\varnothing D \times L = 5 \times 11 \text{ mm}$.
 $T_{\text{amb}} = 20^\circ\text{C}$.

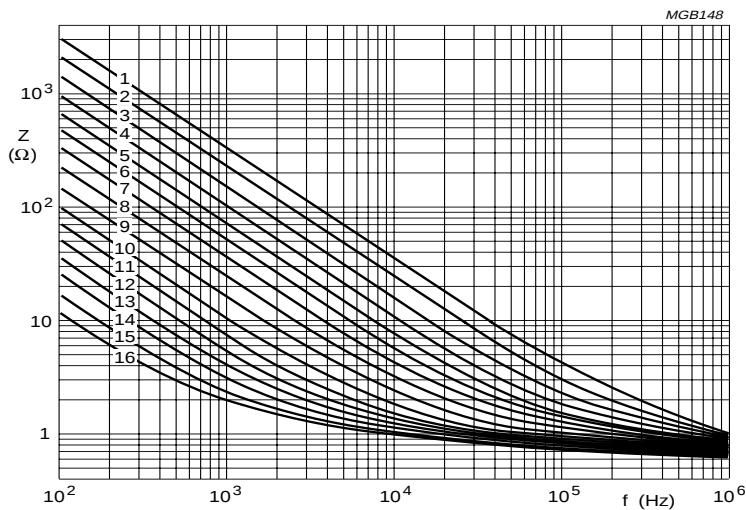


Fig.8 Typical impedance as a function of frequency.

Curve 1: 2.2 μF .
 Curve 2: 4.7 μF .
 Curve 3: 10 μF , 100 V.
 Curve 4: 10 μF , 63 V.
 Curve 5: 22 μF , 63 V.
 Curve 6: 33 μF .
 Curve 7: 47 μF .
 Curve 8: 68 μF .
 Curve 9: 100 μF .
 Curve 10: 150 μF .
 Curve 11: 220 μF .
 Curve 12: 330 μF .
 Curve 13: 470 μF .
Case $\varnothing D \times L = 8.2 \times 11 \text{ mm}$.
 $T_{\text{amb}} = 20^\circ\text{C}$.

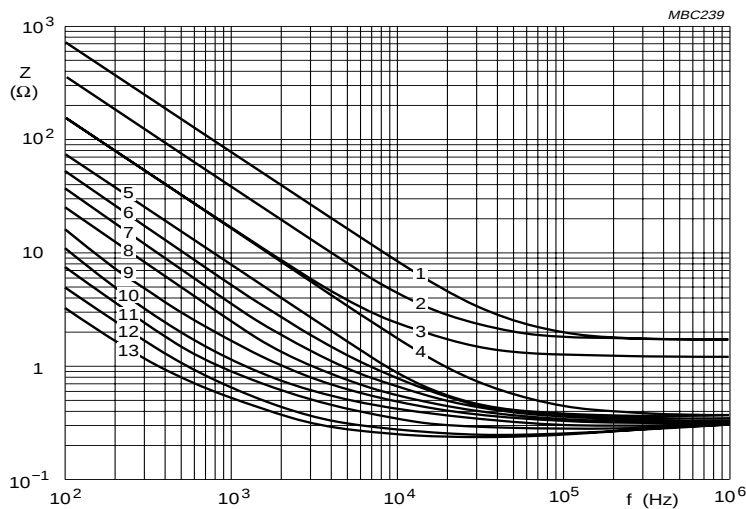


Fig.9 Typical impedance as a function of frequency.

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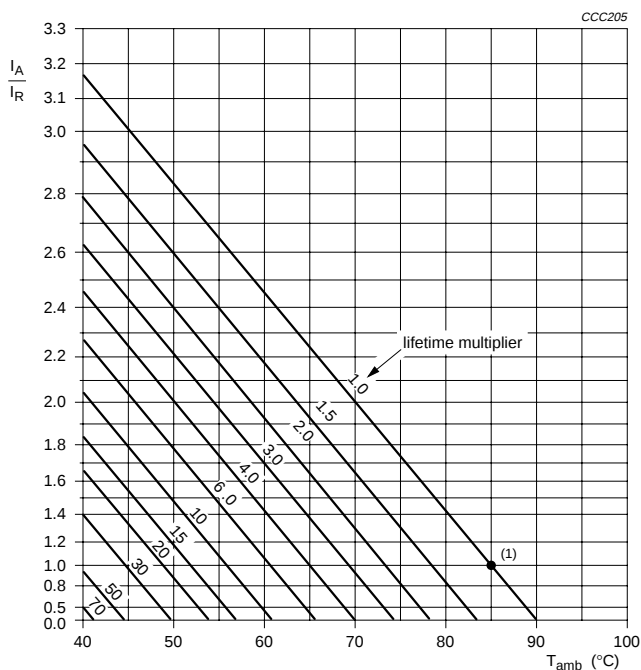
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RIPPLE CURRENT AND USEFUL LIFE

Table 3 Multiplier of ripple current (I_R) as a function of frequency

FREQUENCY (Hz)	I _R MULTIPLIER		
	U _R = 6.3 to 10 V	U _R = 16 to 35 V	U _R = 40 to 160 V
50	0.9	0.85	0.8
100	1.0	1.0	1.0
300	1.12	1.2	1.25
1000	1.2	1.3	1.4
3000	1.25	1.35	1.5
≥10000	1.3	1.4	1.6



I_A = actual ripple current at 100 Hz.

I_R = rated ripple current at 100 Hz, 85 °C.

(1) Useful life at 85 °C and I_R applied: 3000 hours.

Fig.10 Multiplier of useful life as a function of ambient temperature and ripple current load.

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036 RSP**SPECIFIC TESTS AND REQUIREMENTS**

General tests and requirements are specified in data handbook BC01, section “*Tests and Requirements*”.

Table 4 Test procedures and requirements

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4/ EN130300 subclause 4.13	$T_{amb} = 85\text{ °C}$; U_R applied; 2000 hours	$U_R \leq 6.3\text{ V}$; $\Delta C/C$: +15/–30% $U_R > 6.3\text{ V}$; $\Delta C/C$: $\pm 15\%$ $\tan \delta \leq 1.3 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 85\text{ °C}$; U_R and I_R applied; 3000 hours	$U_R \leq 6.3\text{ V}$; $\Delta C/C$: +45/–50% $U_R > 6.3\text{ V}$; $\Delta C/C$: $\pm 45\%$ $\tan \delta \leq 3 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit total failure percentage: $\leq 1\%$
Shelf life (storage at high temperature)	IEC 60384-4/ EN130300 subclause 4.17	$T_{amb} = 85\text{ °C}$; no voltage applied; 500 hours after test: U_R to be applied for 30 minutes, 24 to 48 hours before measurement	$\Delta C/C$, $\tan \delta$, Z : for requirements see ‘Endurance test’ above $I_{L5} \leq \text{spec. limit}$