

DATA SHEET

047 RMS

Aluminum electrolytic capacitors
Radial Miniature Semi-Professional

Product specification
Supersedes data of January 1998
File under BC Components, BC01

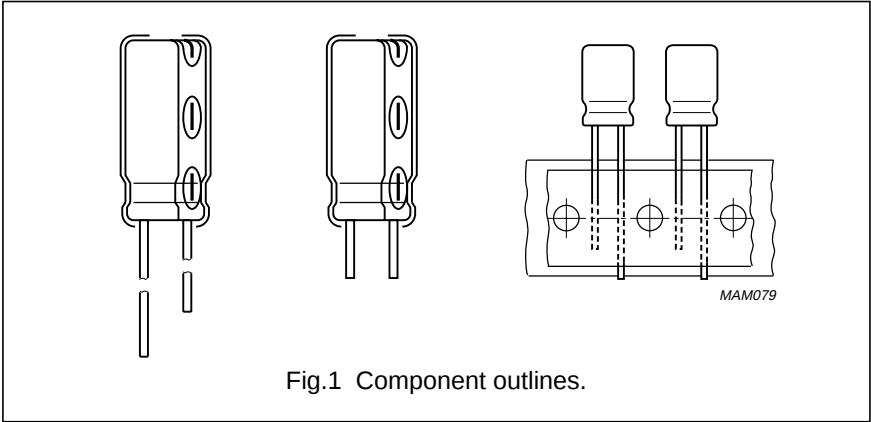
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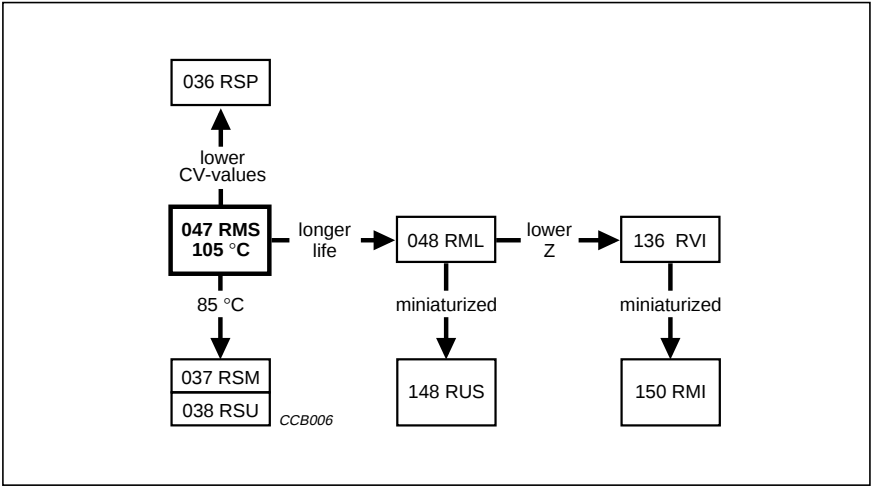
FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Radial leads, cylindrical aluminum case with pressure relief, insulated with a blue vinyl sleeve
- Charge and discharge proof
- Long useful life:
1500 hours at 105 °C
- Miniaturized, high CV-product per unit volume.



APPLICATIONS

- EDB, telecommunication, industrial, automotive and audio-video
- Smoothing, filtering, buffering in SMPS, timing
- Portable and mobile equipment (small size, low mass).



QUICK REFERENCE DATA

DESCRIPTION	VALUE
Case sizes ($\varnothing D_{nom} \times L_{nom}$ in mm)	10 × 12 to 18 × 35
Rated capacitance range, C_R	100 to 10000 μF
Tolerance on C_R	±20%
Rated voltage range, U_R	16 to 63 V
Category temperature range	−40 to +105 °C
Endurance test at 105 °C	1000 hours
Useful life at 105 °C	1500 hours
Useful life at 40 °C, $1.3 \times I_R$ applied	150000 hours
Shelf life at 0 V, 105 °C	500 hours
Based on sectional specification	IEC 60384-4/EN130300
Climatic category IEC 60068	40/105/56

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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)					
	16	25	35	40	50	63
100 ⁽¹⁾	–	–	–	–	–	10 × 12
220	–	–	10 × 12	–	10 × 16	10 × 20
330	–	–	10 × 16	10 × 20	–	12.5 × 20
470	10 × 12	10 × 16	10 × 20	–	12.5 × 20	12.5 × 25
1000	10 × 20	12.5 × 20	12.5 × 25	–	16 × 25	16 × 31
2200	12.5 × 25	16 × 25	16 × 31	16 × 35	18 × 35	18 × 35
3300	16 × 25	16 × 31	18 × 35	18 × 35	18 × 35	–
4700	16 × 31	18 × 35	18 × 35	–	–	–
6800	16 × 35	18 × 35	–	–	–	–
10000	18 × 35	–	–	–	–	–

Note

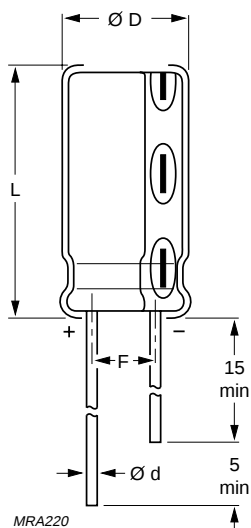
1. For lower CV-values see data sheet "036 RSP".

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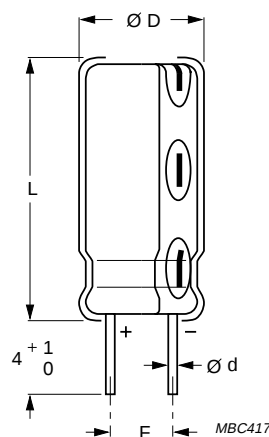
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MECHANICAL DATA, AVAILABLE FORMS AND PACKAGING QUANTITIES



Dimensions in mm.
For dimensions see Table 1.

Fig.2 Form CA: Long leads.



Dimensions in mm.
For dimensions see Table 1.

Fig.3 Form CB: Cut leads.

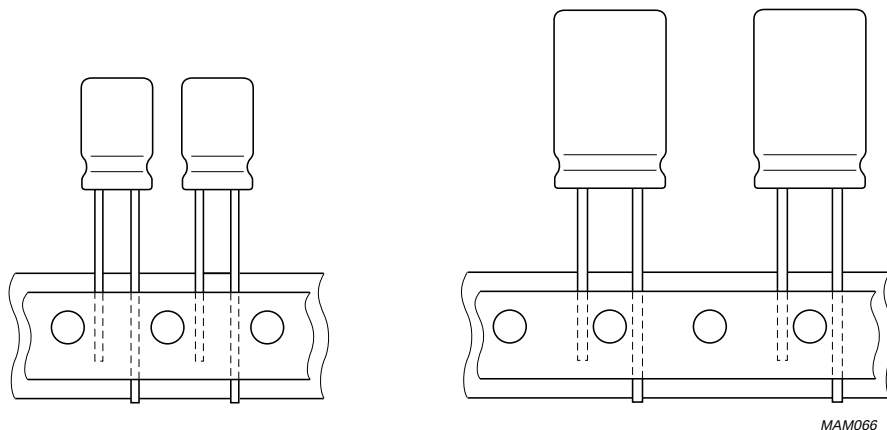
Table 1 Physical dimensions, mass and packaging quantities; see Figs 2 and 3

NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	$\varnothing d$ (mm)	$\varnothing D_{max}$ (mm)	L_{max} (mm)	F (mm)	MASS (g)	PACKAGING QUANTITIES		
							FORM CA per box	FORM CB per box	FORM TFA per box
10 × 12	14	0.6	10.5	13.5	5.0 ± 0.5	≈ 1.6	1000	500	800
10 × 16	15	0.6	10.5	17.5	5.0 ± 0.5	≈ 1.9	500	500	800
10 × 20	16	0.6	10.5	22.0	5.0 ± 0.5	≈ 2.2	500	500	800
12.5 × 20	17	0.6	13.0	22.0	5.0 ± 0.5	≈ 4.0	500	500	500
12.5 × 25	18	0.6	13.0	27.0	5.0 ± 0.5	≈ 5.0	250	250	500
16 × 25	19	0.8	16.5	27.0	7.5 ± 0.5	≈ 8.0	250	250	250
16 × 31	20	0.8	16.5	33.5	7.5 ± 0.5	≈ 9.0	100	100	250
16 × 35	21	0.8	16.5	37.5	7.5 ± 0.5	≈ 11.5	100	100	—
18 × 35	22	0.8	18.5	37.5	7.5 ± 0.5	≈ 14.5	100	100	—

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Taped products

**Form TFA:****Case $\varnothing D \times L \leq 16 \times 31$ mm.**

Tape dimensions are specified in this handbook, section "Packaging".

Fig.4 Taped in box (ammopack).

MARKING

The capacitors are marked with the following information:

- Rated capacitance value (in μF)
- Tolerance on rated capacitance, code letter in accordance with "IEC 60062" (M for $\pm 20\%$)
- Rated voltage (in V)
- Upper category temperature (105 °C)
- Group number (047)
- Code indicating factory of origin
- Name of manufacturer
- Date code, in accordance with "IEC 60062"
- Negative terminal identification.

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Ordering example

Electrolytic capacitor 047 series

1000 µF/35 V; ±20

Nominal case size: Ø12.5 × 25 mm; Form TFA

Catalogue number: 2222 047 30102.

SYMBOL	DESCRIPTION
C _R	rated capacitance at 100 Hz, tolerance ±20%
I _R	rated RMS ripple current at 100 Hz, 105 °C
I _{L1}	max. leakage current after 1 minute at U _R
I _{L5}	max. leakage current after 5 minutes at U _R
Tan δ	max. dissipation factor at 100 Hz
ESR	equivalent series resistance at 100 Hz (calculated from tan δ _{max} and C _R)
Z	max. impedance at 10 kHz or 100 kHz

Table 2 Electrical data and ordering information; preferred types in **bold**

U _R (V)	C _R 100 Hz (μF)	NOMINAL CASE SIZE ØD × L (mm)	CASE CODE	I _R 100 Hz 105 °C (mA)	I _{L1} 1 min (μA)	I _{L5} 5 min (μA)	Tan δ 100 Hz	ESR 100 Hz (Ω)	Z 10 kHz (Ω)	Z 100 kHz (Ω)	CATALOGUE NUMBER 2222		
											BULK PACKAGING		TAPED
											FORM CA	FORM CB	
16	470	10 × 12	14	330	78	18	0.16	0.51	0.45	0.33	047 55471	047 65471	047 35471
	1000	10 × 20	16	540	160	35	0.16	0.24	0.21	0.17	047 55102	047 65102	047 35102
	2200	12.5 × 25	18	830	360	73	0.20	0.14	0.12	0.10	047 55222	047 65222	047 35222
	3300	16 × 25	19	1100	530	110	0.22	0.10	0.09	0.08	047 55332	047 65332	047 35332
	4700	16 × 31	20	1300	760	150	0.24	0.08	0.07	0.07	047 55472	047 65472	047 35472
	6800	16 × 35	21	1600	1100	220	0.28	0.06	0.06	0.06	047 55682	047 65682	—
	10000	18 × 35	22	1800	1600	320	0.36	0.05	0.05	0.05	047 55103	047 65103	—
25	470	10 × 16	15	360	120	27	0.14	0.45	0.38	0.25	047 56471	047 66471	047 36471
	1000	12.5 × 20	17	630	250	53	0.14	0.21	0.18	0.13	047 56102	047 66102	047 36102
	2200	16 × 25	19	990	550	110	0.18	0.12	0.09	0.08	047 56222	047 66222	047 36222
	3300	16 × 31	20	1200	830	170	0.20	0.09	0.07	0.07	047 56332	047 66332	047 36332
	4700	18 × 35	22	1500	1200	240	0.22	0.07	0.05	0.05	047 56472	047 66472	—
	6800	18 × 35	22	1700	1700	340	0.26	0.06	0.04	0.04	047 56682	047 66682	—

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U _R (V)	C _R 100 Hz (μF)	NOMINAL CASE SIZE ∅D × L (mm)	CASE CODE	I _R 100 Hz 105 °C (mA)	I _{L1} 1 min (μA)	I _{L5} 5 min (μA)	Tan δ 100 Hz	ESR 100 Hz (Ω)	Z 10 kHz (Ω)	Z 100 kHz (Ω)	CATALOGUE NUMBER 2222		
											BULK PACKAGING		TAPED
											FORM CA	FORM CB	FORM TFA
35	220	10 × 12	14	270	80	18	0.12	0.83	0.57	0.38	047 50221	047 60221	047 30221
	330	10 × 16	15	350	120	26	0.12	0.55	0.38	0.28	047 50331	047 60331	047 30331
	470	10 × 20	16	450	170	36	0.12	0.39	0.27	0.22	047 50471	047 60471	047 30471
	1000	12.5 × 25	18	780	350	73	0.12	0.18	0.13	0.12	047 50102	047 60102	047 30102
	2200	16 × 31	20	1200	770	160	0.16	0.11	0.07	0.07	047 50222	047 60222	047 30222
40	3300	18 × 35	22	1500	1200	230	0.18	0.09	0.05	0.05	047 50332	047 60332	–
	4700	18 × 35	22	1800	1600	330	0.20	0.06	0.04	0.04	047 50472	047 60472	–
	330	10 × 20	16	380	140	29	0.12	0.55	0.33	0.26	047 57331	047 67331	047 37331
	2200	16 × 35	21	1200	880	180	0.16	0.11	0.06	0.06	047 57222	047 67222	–
	3300	18 × 35	22	1500	1300	270	0.18	0.08	0.04	0.04	047 57332	047 67332	–
50	220	10 × 16	15	310	110	25	0.10	0.69	0.43	0.33	047 51221	047 61221	047 31221
	470	12.5 × 20	17	540	240	50	0.10	0.32	0.20	0.17	047 51471	047 61471	047 31471
	1000	16 × 25	19	940	500	100	0.10	0.15	0.10	0.09	047 51102	047 61102	047 31102
	2200	18 × 35	22	1400	1100	220	0.14	0.10	0.05	0.05	047 51222	047 61222	–
	3300	18 × 35	22	1600	1700	330	0.16	0.07	0.03	0.04	047 51332	047 61332	–
63	100	10 × 12	14	210	66	16	0.09	1.40	0.75	0.65	047 58101	047 68101	047 38101
	220	10 × 20	16	350	140	31	0.09	0.62	0.34	0.32	047 58221	047 68221	047 38221
	330	12.5 × 20	17	470	210	45	0.09	0.41	0.23	0.22	047 58331	047 68331	047 38331
	470	12.5 × 25	18	620	300	62	0.09	0.29	0.16	0.16	047 58471	047 68471	047 38471
	1000	16 × 31	20	1100	630	130	0.09	0.14	0.08	0.08	047 58102	047 68102	047 38102
	2200	18 × 35	22	1500	1400	280	0.13	0.09	0.04	0.04	047 58222	047 68222	–

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Additional electrical data

DESCRIPTION	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 at U_R	$I_{L1} \leq 0.01 C_R \times U_R + 3 \mu\text{A}$
	after 5 minutes at U_R	$I_{L5} \leq 0.002 C_R \times U_R + 3 \mu\text{A}$
Inductance		
Equivalent series inductance (ESL)	case $\varnothing D = 10 \text{ mm}$	typ. 16 nH
	case $\varnothing D \geq 12.5 \text{ mm}$	typ. 18 nH

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Capacitance (C)

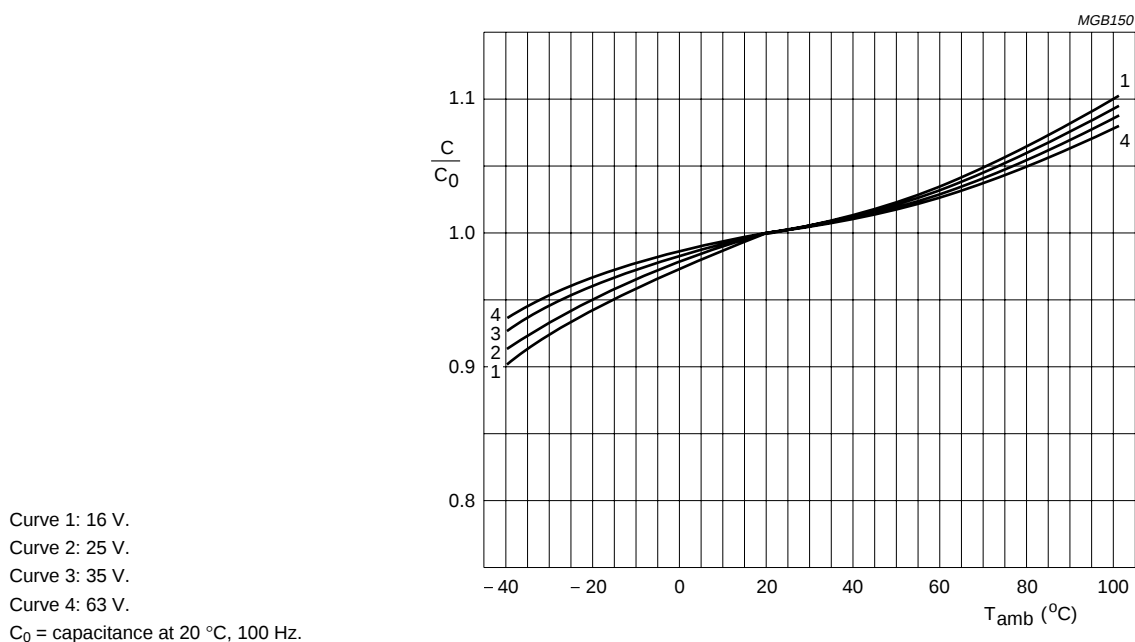


Fig.5 Typical multiplier of capacitance as a function of ambient temperature.

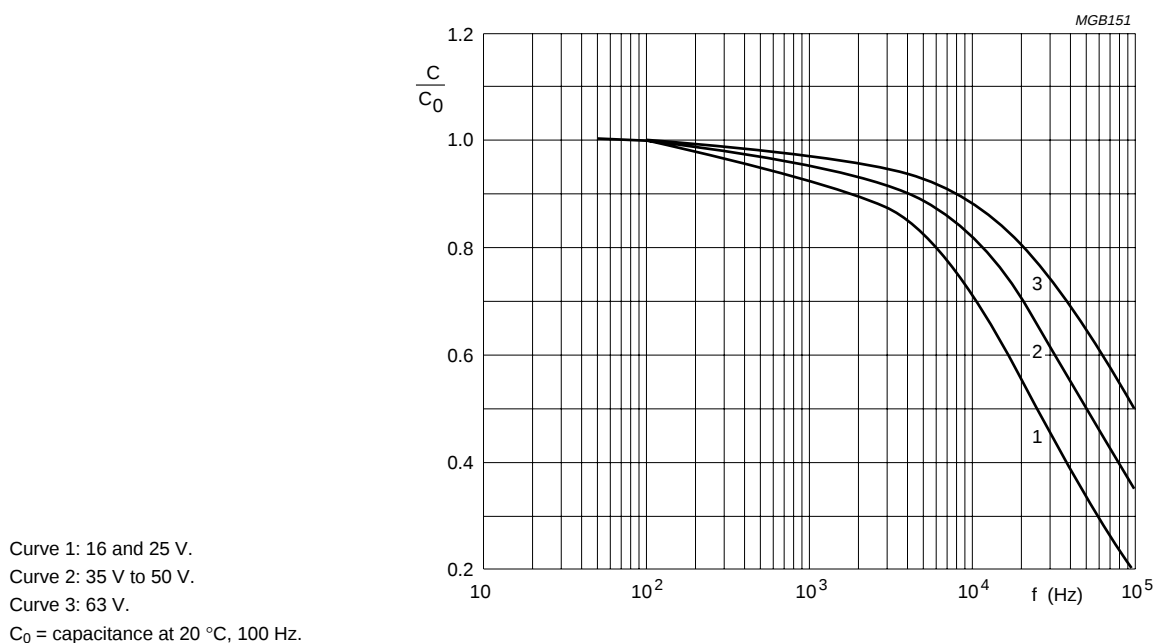
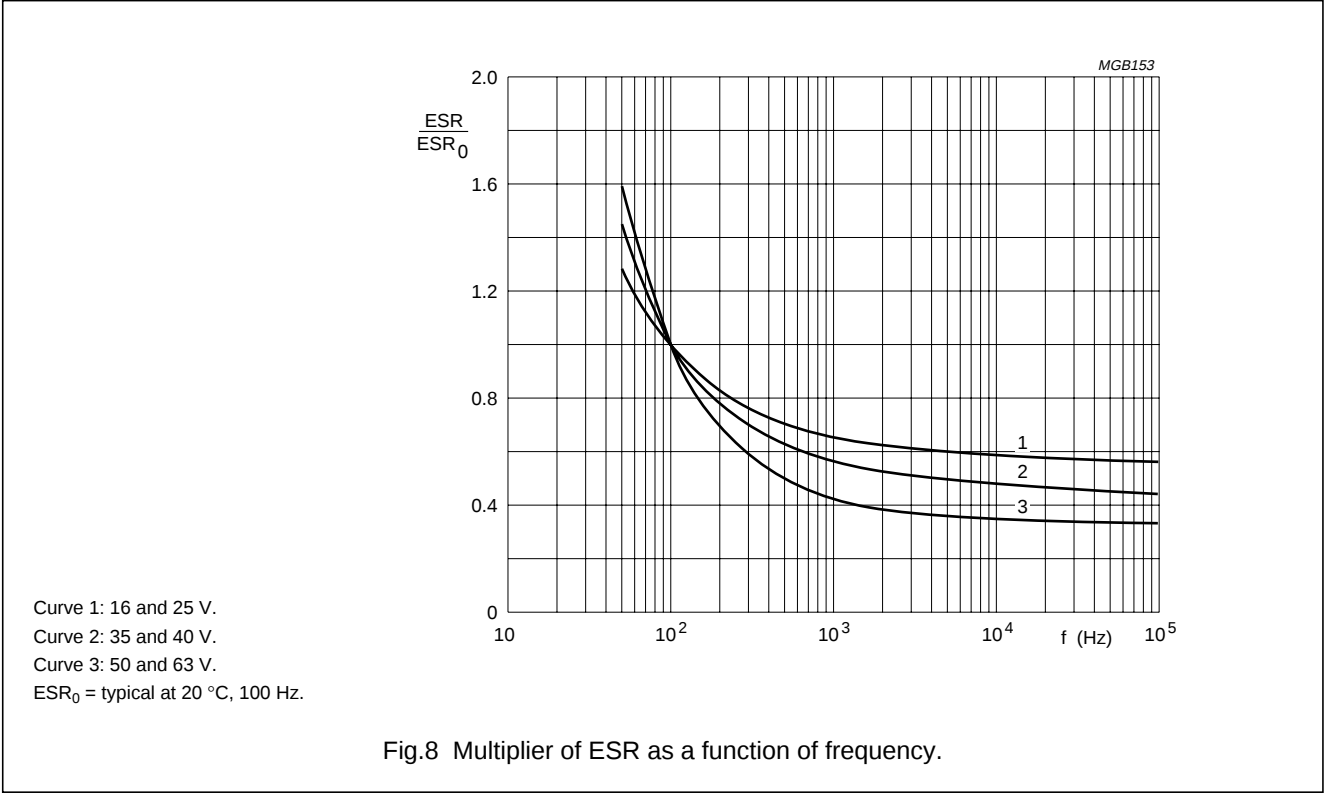
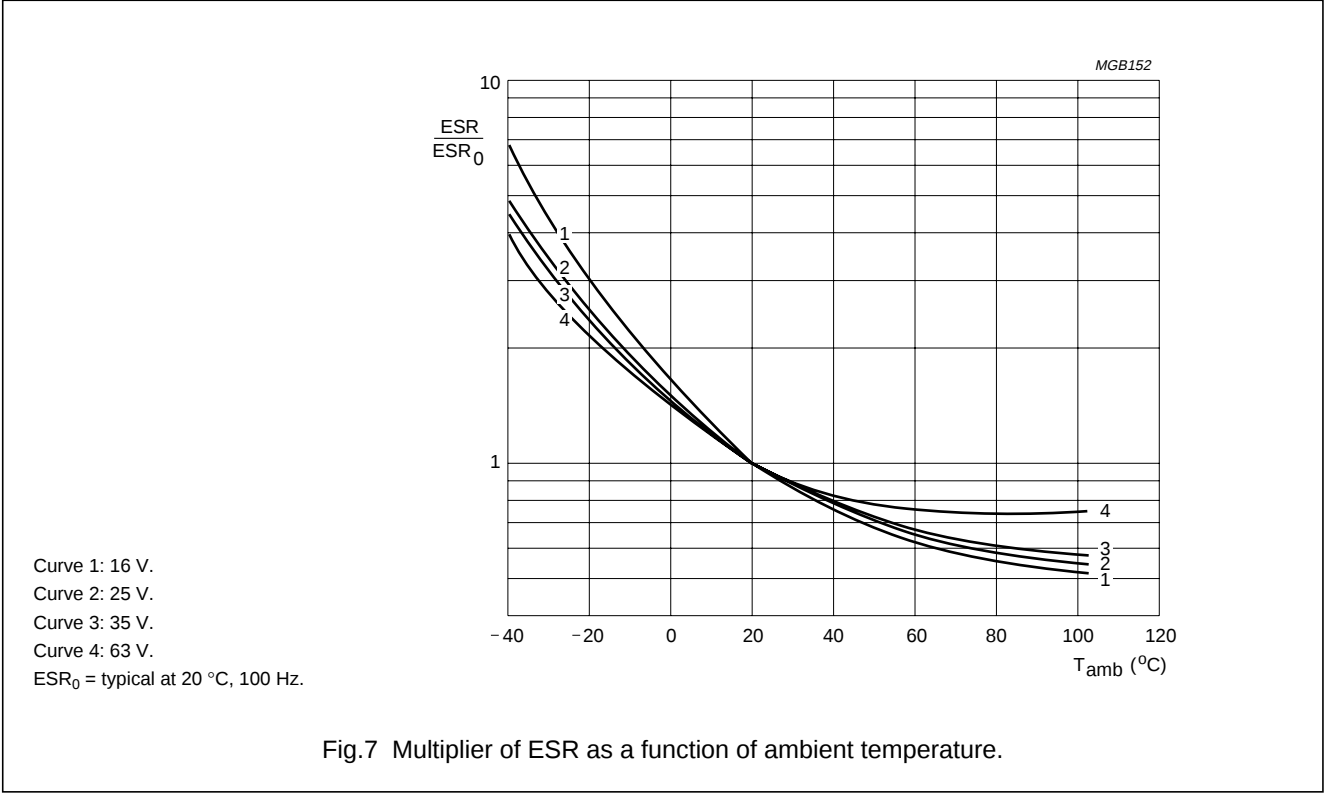


Fig.6 Typical multiplier of capacitance as a function of frequency.

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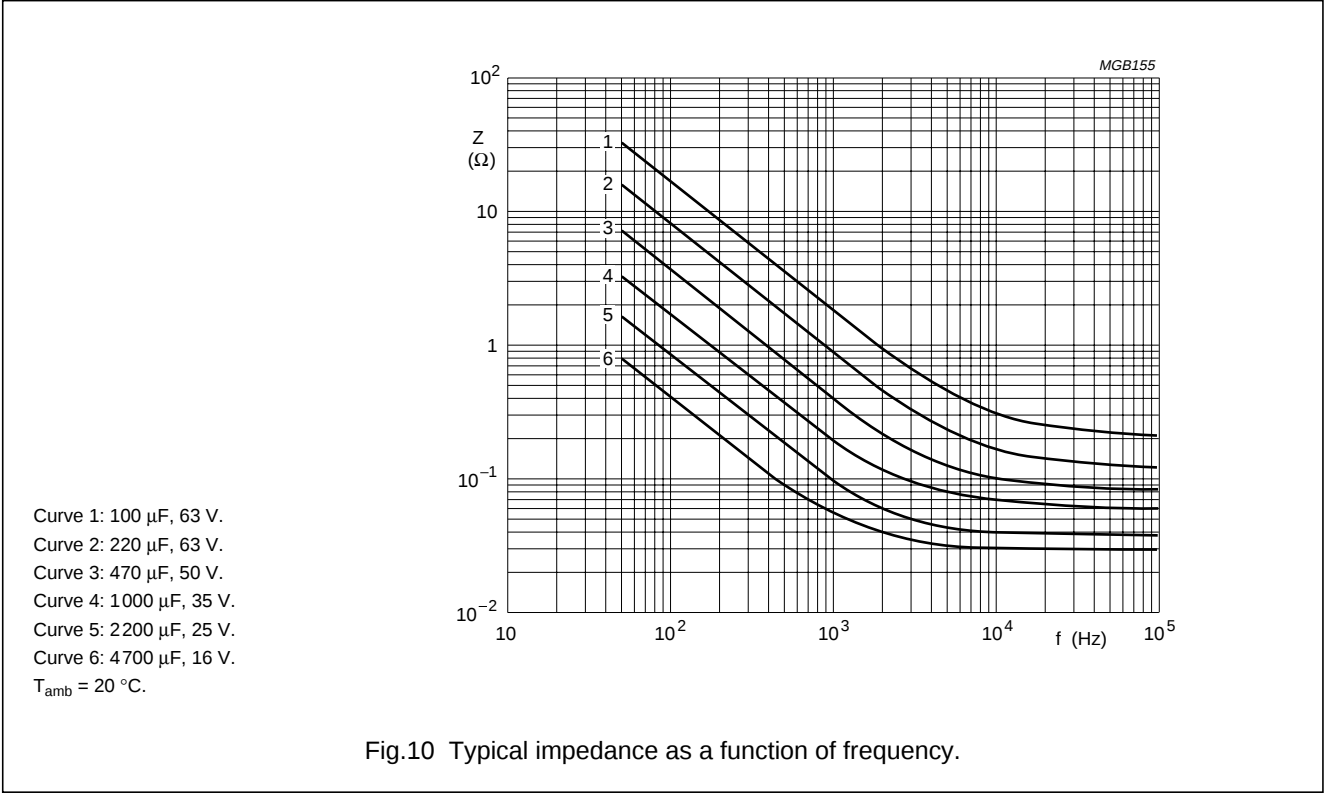
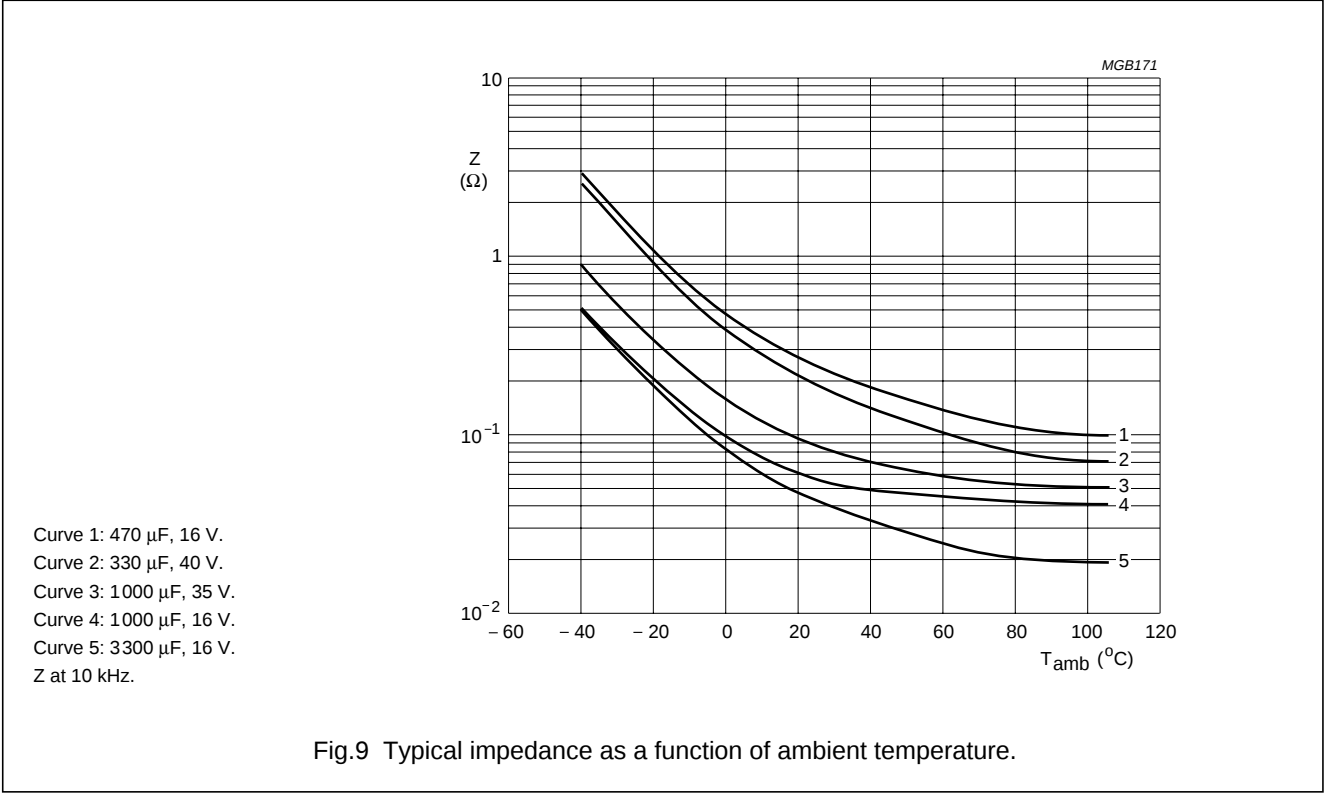
Equivalent series resistance (ESR)



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Impedance (Z)



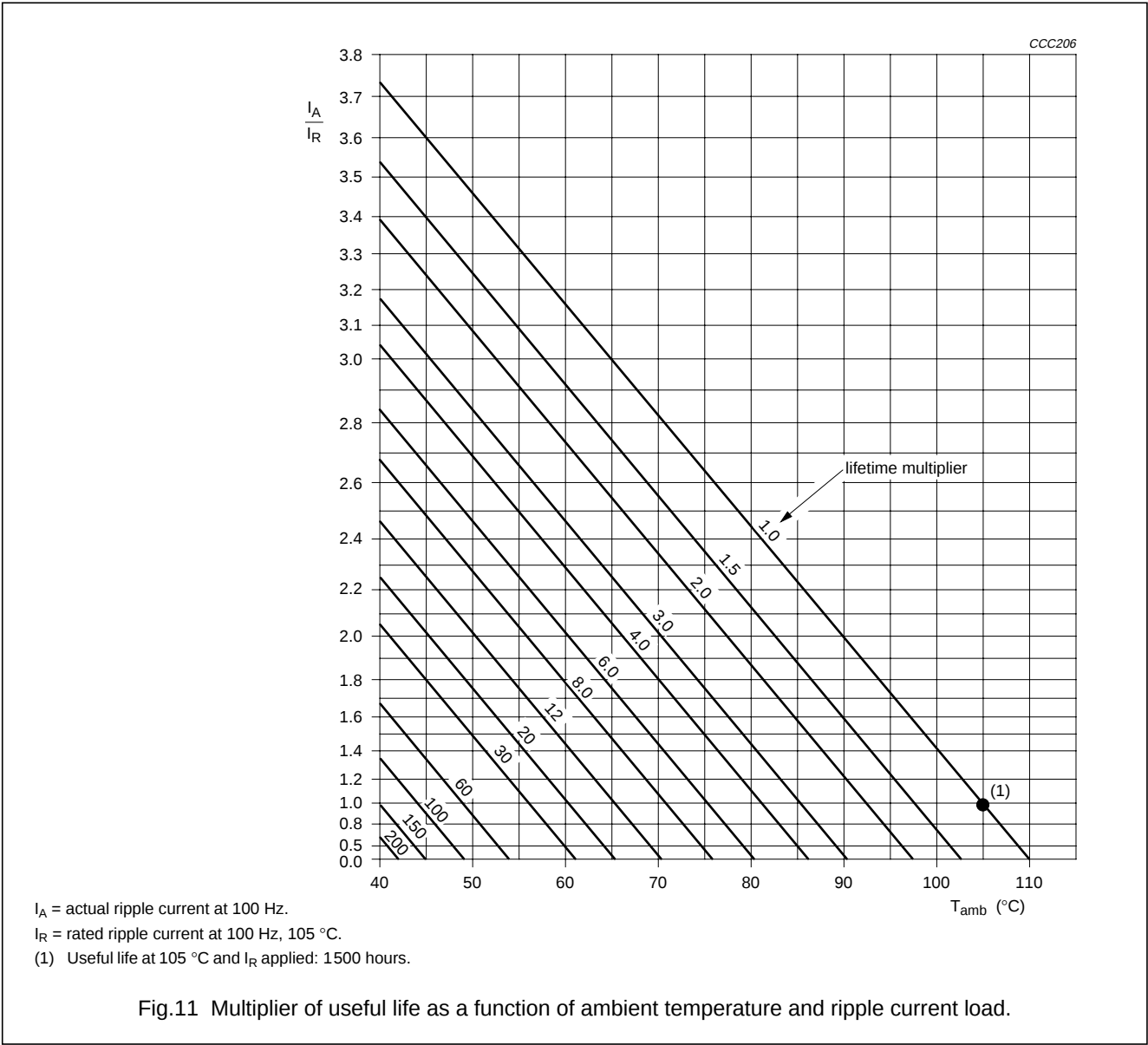
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RIPPLE CURRENT AND USEFUL LIFE

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

FREQUENCY (Hz)	I_R MULTIPLIER		
	$U_R = 16 \text{ and } 25 \text{ V}$	$U_R = 35 \text{ and } 40 \text{ V}$	$U_R = 50 \text{ and } 63 \text{ V}$
50	0.95	0.85	0.80
100	1.00	1.00	1.00
300	1.07	1.20	1.25
1000	1.12	1.30	1.40
3000	1.15	1.35	1.50
≥ 10000	1.20	1.40	1.60



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SPECIFIC TESTS AND REQUIREMENTS

General tests and requirements are specified in this handbook, 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	$T_{amb} = 105\text{ °C}$; U_R applied; 1000 hours	$\Delta C/C: \pm 15\%$ $\tan \delta \leq 1.3 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 105\text{ °C}$; U_R and I_R applied; 1500 hours	$\Delta C/C: \pm 45\%$ $\tan \delta \leq 3 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit total failure percentage: $\leq 1\%$
Shelf life (storage at high temperature)	IEC 60384-4/ EN130300, subclause 4.17	$T_{amb} = 105\text{ °C}$; no voltage applied; 500 hours after test: U_R to be applied for 30 minutes, 24 to 48 hours before measurement	$\Delta C/C: \pm 15\%$ $\tan \delta \leq 1.3 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq 2 \times \text{spec. limit}$