

Aluminium electrolytic capacitors

Radial Semi-Professional

036 RSP

FEATURES

- Polarized aluminium electrolytic capacitors, non-solid
- Radial leads, cylindrical aluminium 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.

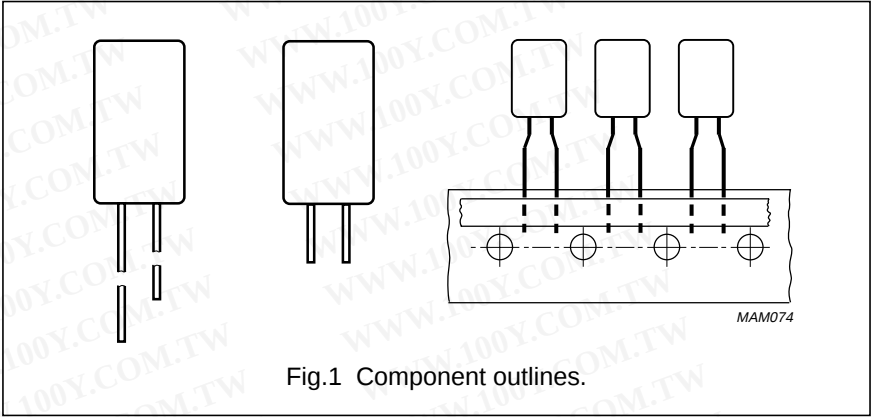
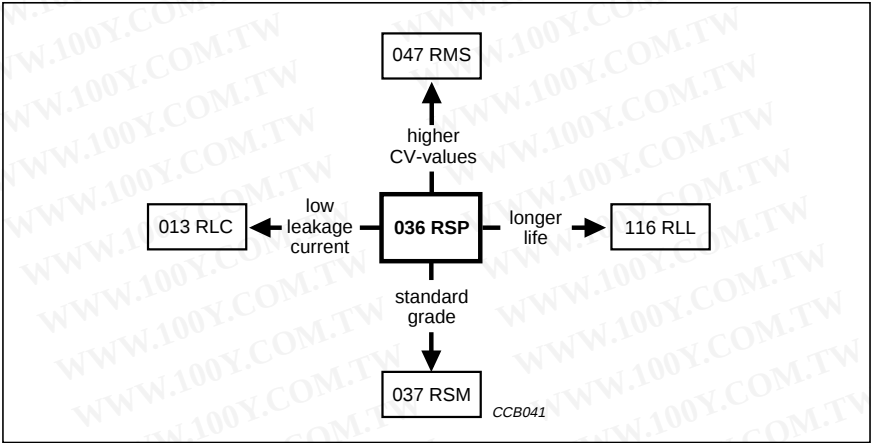


Fig.1 Component outlines.

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	±20% (±10% on request)
Rated voltage range, U_R	6.3 to 160 V
Category temperature range	−55 to +85 °C
Endurance test at 85 °C	2000 hours
Useful life at 105 °C	750 hours
Useful life at 85 °C	3000 hours
Useful life at 40 °C, $1.4 \times I_R$ applied	80000 hours
Shelf life at 0 V, 85 °C	500 hours
Based on sectional specification	IEC 384-4/CECC 30 300
Climatic category IEC 68	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

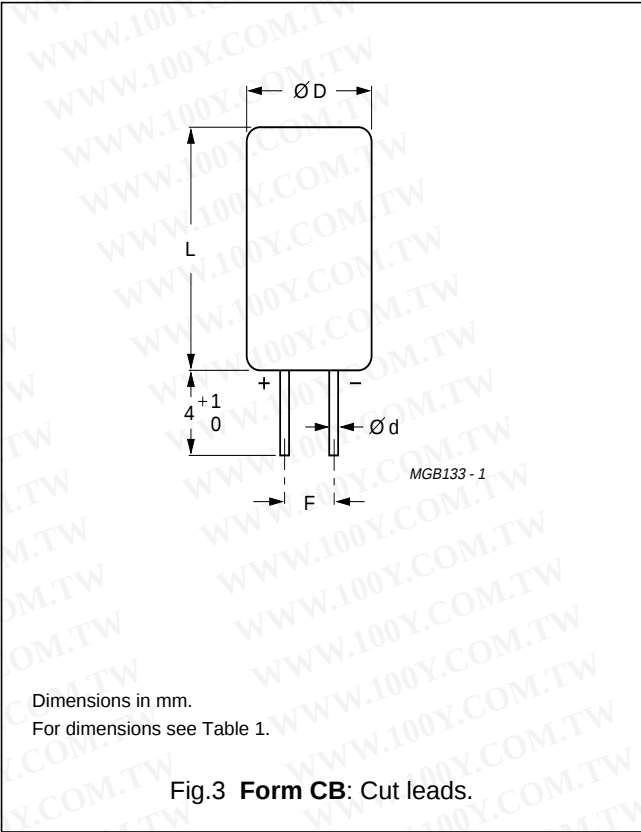
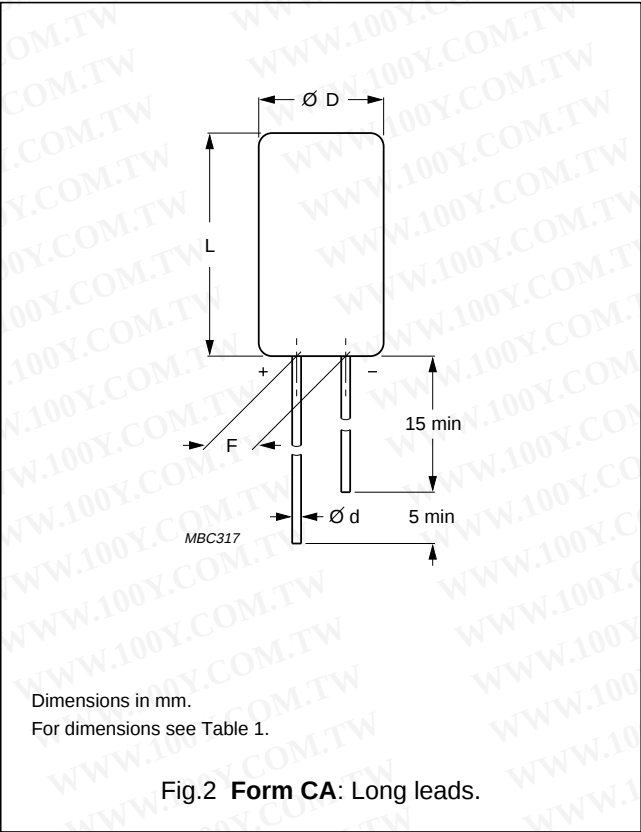


Table 1 Physical dimensions, mass and packaging quantities; see Figs 2 and 3

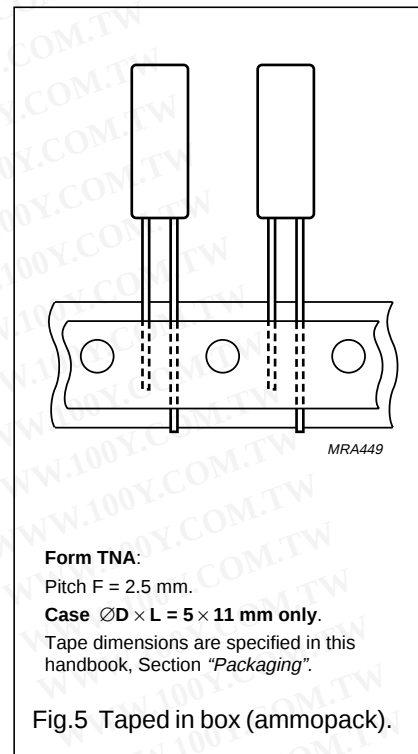
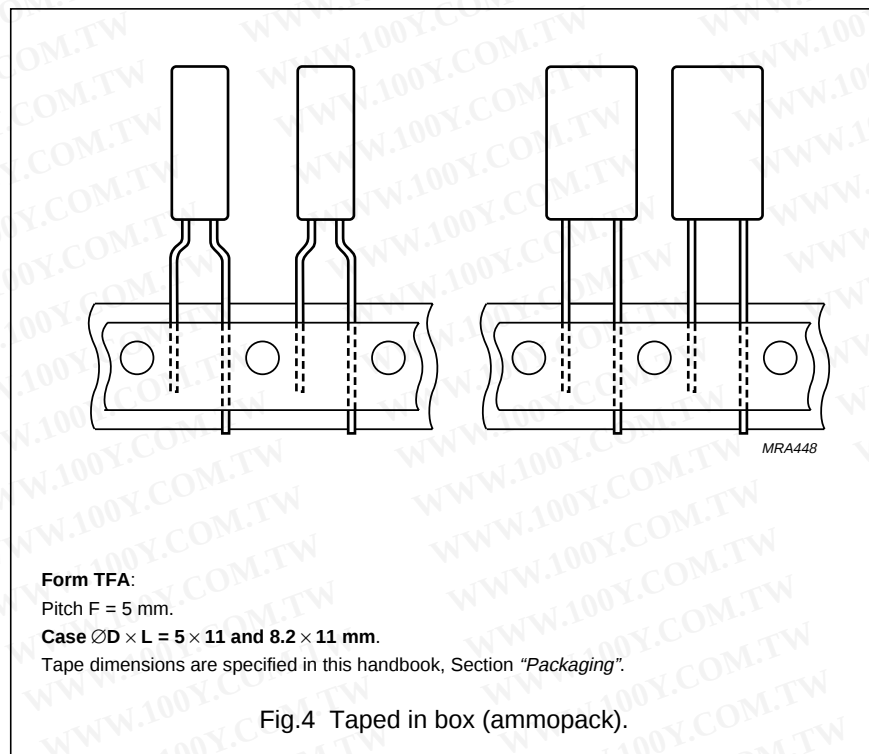
NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	$\varnothing d$ (mm)	$\varnothing D_{max}$ (mm)	L_{max} (mm)	F (mm)	MASS (g)	PACKAGING QUANTITIES	
							FORM CA, CB	FORM TFA, TNA
5 × 11	11	0.5	5.5	12	2.5 ± 0.5	≈ 0.4	1000	2000
8.2 × 11	13	0.6	8.7	12	5.0 ± 0.5	≈ 1.1	1000	1000

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Taped products



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 62"
- Rated voltage (in V)
- Group number (036)
- Name of manufacturer (PH)
- Date code in accordance with "IEC 62"
- Code indicating factory of origin
- Minus-sign on top to identify the negative terminal.

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ELECTRICAL DATA

Unless otherwise specified, all electrical values in Tables 2 and 4 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 $\pm 20\%$
I_R	rated RMS ripple current at 100 Hz, 85 °C
I_{L1}	max. leakage current after 1 minute at U_R
I_{L5}	max. leakage current after 5 minutes at U_R
$\tan \delta$	max. dissipation factor at 100 Hz
ESR	equivalent series resistance at 100 Hz (calculated from $\tan \delta_{max}$ and C_R)
Z	max. impedance at 10 kHz and 20, -25 or -40 °C

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

U_R (V)	C_R 100 Hz (μF)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 100 Hz 85 °C (mA)	I_{L1} 1 min (μA)	I_{L5} 5 min (μA)	$\tan \delta$ 100 Hz	ESR 100 Hz (Ω)	Z 10 kHz 20 °C (Ω)	Z 10 kHz -25 °C (Ω)	Z 10 kHz -40 °C (Ω)
6.3	100	5×11	11	130	7	3.6	0.20	3.2	1.7	9.0	25
	330	8.2×11	13	300	16	5.1	0.20	1.0	0.52	2.7	7.6
10	47	5×11	11	95	6	3.5	0.16	5.4	2.8	12	32
	150	5×11	11	150	12	4.5	0.20	2.1	1.3	8.0	21
	220	8.2×11	13	260	17	5.2	0.16	1.2	0.59	2.6	6.8
	470	8.2×11	13	400	31	7.7	0.20	0.68	0.43	2.6	6.8
16	33	5×11	11	90	7	3.5	0.14	6.8	2.7	12	33
	100	5×11	11	160	13	4.6	0.16	2.5	1.6	7.5	20.0
	150	8.2×11	13	230	18	5.4	0.14	1.5	0.6	2.7	7.3
	220	8.2×11	13	280	24	6.5	0.16	1.2	0.55	2.5	6.8
	330	8.2×11	13	390	35	8.3	0.16	0.7	0.48	2.3	6.1
25	68	5×11	11	140	13	4.7	0.14	3.3	1.8	8.2	22
	100	8.2×11	13	210	18	5.5	0.12	1.9	0.7	3.0	9.0
	220	8.2×11	13	310	36	8.5	0.14	1	0.55	2.6	6.8
35	22	5×11	11	87	8	3.8	0.10	7.2	2.7	11	34
	47	5×11	11	130	13	4.6	0.12	4.1	1.9	8.5	23
	150	8.2×11	13	270	35	8.3	0.12	1.3	0.6	2.7	7.3
40	15	5×11	11	72	7	3.6	0.10	11	3.7	15	47
	68	8.2×11	13	180	20	5.7	0.10	2.3	0.81	3.2	10
50	10	5×11	11	60	6	3.5	0.08	13	4.5	16	58
	33	5×11	11	110	13	4.7	0.10	4.8	2.1	9.1	27
	47	8.2×11	13	160	18	5.4	0.08	2.7	0.96	3.4	12
	100	8.2×11	13	250	33	8.0	0.10	1.6	0.7	3.0	9.0

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ORDERING INFORMATION**Ordering example**

Electrolytic capacitor 036 series

100 μ F/16 V; $\pm 20\%$ Nominal case size: $\varnothing 5 \times 11$ mm; Form TFA

Catalogue number: 2222 036 35101.

Table 3 Ordering information; preferred types in **bold**

U _R (V)	C _R 100 Hz (μF)	CASE CODE	CATALOGUE NUMBER 2222							
			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	11	036 53101	2.5	—	—	036 33101	5.0	036 73101	2.5
	330	13	036 53331	5.0	036 63331	5.0	036 33331	5.0	—	—
10	47	11	036 54479	2.5	—	—	036 34479	5.0	036 74479	2.5
	150	11	036 54151	2.5	—	—	036 34151	5.0	036 74151	2.5
	220	13	036 54221	5.0	036 64221	5.0	036 34221	5.0	—	—
	470	13	036 54471	5.0	036 64471	5.0	036 34471	5.0	—	—
16	33	11	036 55339	2.5	—	—	036 35339	5.0	036 75339	2.5
	100	11	036 55101	2.5	—	—	036 35101	5.0	036 75101	2.5
	150	13	036 55151	5.0	036 65151	5.0	036 35151	5.0	—	—
	220	13	036 55221	5.0	036 65221	5.0	036 35221	5.0	—	—
	330	13	036 55331	5.0	036 65331	5.0	036 35331	5.0	—	—
25	68	11	036 56689	2.5	—	—	036 36689	5.0	036 76689	2.5
	100	13	036 56101	5.0	036 66101	5.0	036 36101	5.0	—	—
	220	13	036 56221	5.0	036 66221	5.0	036 36221	5.0	—	—
35	22	11	036 90001	2.5	—	—	036 90027	5.0	036 90389	2.5
	47	11	036 90094	2.5	—	—	036 90098	5.0	036 90391	2.5
	150	13	036 90099	5.0	036 90101	5.0	036 90103	5.0	—	—
40	15	11	036 57159	2.5	—	—	036 37159	5.0	036 77159	2.5
	68	13	036 57689	5.0	036 67689	5.0	036 37689	5.0	—	—
50	10	11	036 90004	2.5	—	—	036 90028	5.0	036 90392	2.5
	33	11	036 90104	2.5	—	—	036 90108	5.0	036 90393	2.5
	47	13	036 90011	5.0	036 90012	5.0	036 90031	5.0	—	—
	100	13	036 90109	5.0	036 90111	5.0	036 90113	5.0	—	—

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ELECTRICAL DATA (continued)

Table 4 Electrical data continued; preferred types in **bold**

U_R (V)	C_R 100 Hz (μ F)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	CASE CODE	I_R 100 Hz 85 °C (mA)	I_{L1} 1 min (μ A)	I_{L5} 5 min (μ A)	Tan δ 100 Hz	ESR 100 Hz (Ω)	Z 10 kHz 20 °C (Ω)	Z 10 kHz -25 °C (Ω)	Z 10 kHz -40 °C (Ω)
63	0.47	5 × 11	11	5	4	3	0.06	200	85	280	850
	1.0	5 × 11	11	11	4	3.1	0.06	95	40	130	400
	2.2	5 × 11	11	25	4	3.1	0.06	43	18	59	180
	3.3	5 × 11	11	38	5	3.2	0.06	29	12	39	120
	4.7	5 × 11	11	45	5	3.3	0.06	20	8.5	27	85
	6.8	5 × 11	11	55	6	3.4	0.06	14	5.9	19	59
	10	5 × 11	11	70	7	3.6	0.06	9.5	4.0	13	40
	10	8.2 × 11	13	120	7	3.6	0.04	6.5	2.8	7	19
	15	5 × 11	11	80	9	3.9	0.07	7.4	3.1	12	36
	22	5 × 11	11	100	11	4.4	0.08	5.8	2.7	10	32
	22	8.2 × 11	13	150	11	4.4	0.05	3.6	1.4	5.1	15
	33	8.2 × 11	13	160	16	5.1	0.06	2.9	1.2	3.9	12
	47	8.2 × 11	13	190	21	6.0	0.07	2.4	1.0	3.5	11
	68	8.2 × 11	13	210	29	7.3	0.08	1.9	0.88	3.2	10
100	10	8.2 × 11	13	80	9	4	0.06	9.5	3.5	15	45
	22	8.2 × 11	13	110	16	5.2	0.06	4.3	1.8	7.3	23
160	2.2	8.2 × 11	13	45	75	15	0.05	36	14	70	170
	4.7	8.2 × 11	13	62	115	21	0.07	24	9.6	60	150

Additional electrical data

PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage for short periods		$U_S \leq 1.15 U_R$
Reverse voltage		$U_{rev} \leq 1 \text{ V}$
Current		
Leakage current	after 1 minute:	
	$U_R = 6.3 \text{ to } 100 \text{ V}$	$I_{L1} \leq 0.006 C_R \times U_R + 3 \mu\text{A}$
	$U_R = 160 \text{ V}$	$I_{L1} \leq 0.1 C_R \times U_R + 40 \mu\text{A}$
	after 5 minutes:	
	$U_R = 6.3 \text{ to } 100 \text{ V}$	$I_{L5} \leq 0.001 C_R \times U_R + 3 \mu\text{A}$
	$U_R = 160 \text{ V}$	$I_{L5} \leq 0.015 C_R \times U_R + 10 \mu\text{A}$
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

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ORDERING INFORMATION (continued)

Table 5 Ordering information continued; preferred types in **bold**

U _R (V)	C _R 100 Hz (μF)	CASE CODE	CATALOGUE NUMBER 2222							
			BULK PACKAGING				TAPED AMMOPACK			
			LONG LEADS		CUT LEADS					
			FORM CA	F (mm)	FORM CB	F (mm)	FORM TFA	F (mm)	FORM TNA	F (mm)
63	0.47	11	036 58477	2.5	—	—	036 38477	5.0	036 78477	2.5
	1.0	11	036 58108	2.5	—	—	036 38108	5.0	036 78108	2.5
	2.2	11	036 58228	2.5	—	—	036 38228	5.0	036 78228	2.5
	3.3	11	036 58338	2.5	—	—	036 38338	5.0	036 78338	2.5
	4.7	11	036 58478	2.5	—	—	036 38478	5.0	036 78478	2.5
	6.8	11	036 58688	2.5	—	—	036 38688	5.0	036 78688	2.5
	10	11	036 58109	2.5	—	—	036 38109	5.0	036 78109	2.5
	10	13	036 90036	5.0	036 90041	5.0	036 90181	5.0	—	—
	15	11	036 58159	2.5	—	—	036 38159	5.0	036 78159	2.5
	22	11	036 58229	2.5	—	—	036 38229	5.0	036 78229	2.5
	22	13	036 90117	5.0	036 90118	5.0	036 90139	5.0	—	—
	33	13	036 58339	5.0	036 68339	5.0	036 38339	5.0	—	—
	47	13	036 58479	5.0	036 68479	5.0	036 38479	5.0	—	—
	68	13	036 58689	5.0	036 68689	5.0	036 38689	5.0	—	—
100	10	13	036 59109	5.0	036 69109	5.0	036 39109	5.0	—	—
	22	13	036 59229	5.0	036 69229	5.0	036 39229	5.0	—	—
160	2.2	13	036 90333	5.0	036 90334	5.0	036 90336	5.0	—	—
	4.7	13	036 90337	5.0	036 90338	5.0	036 90341	5.0	—	—

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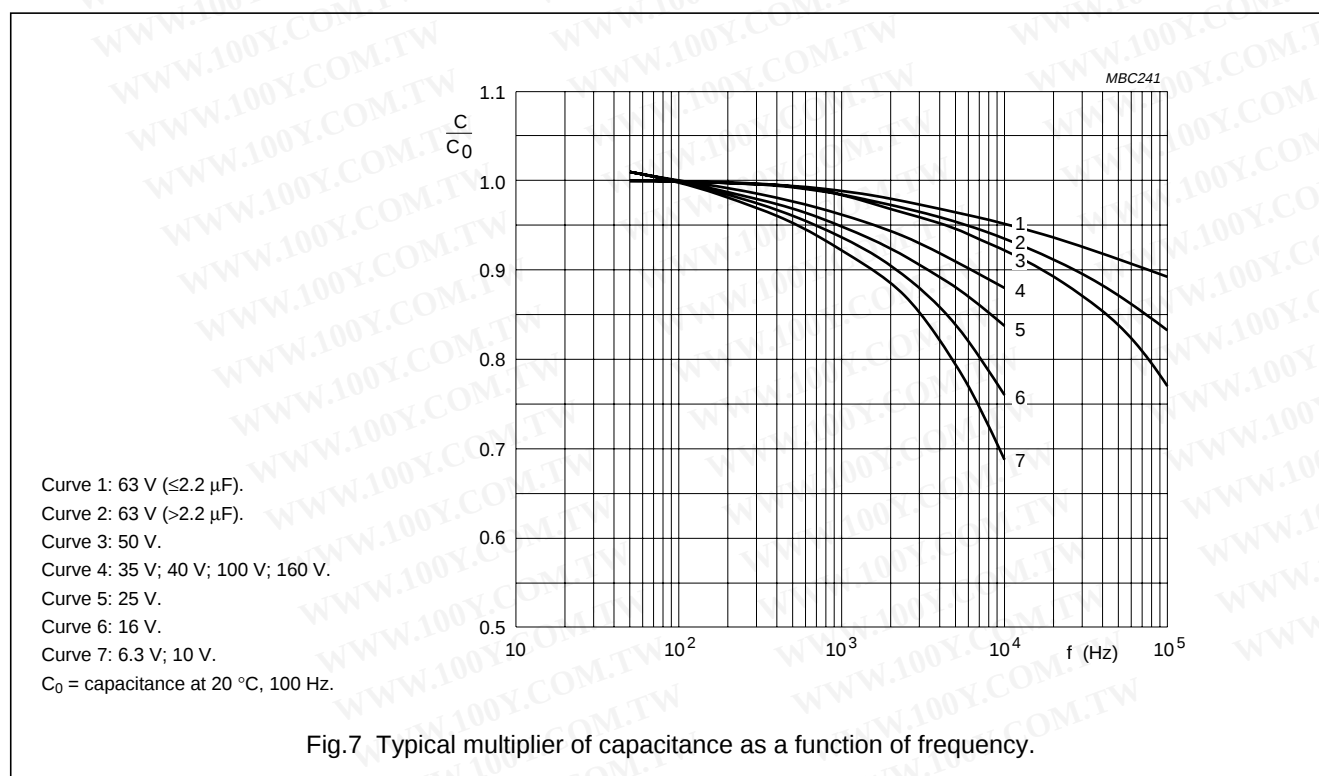
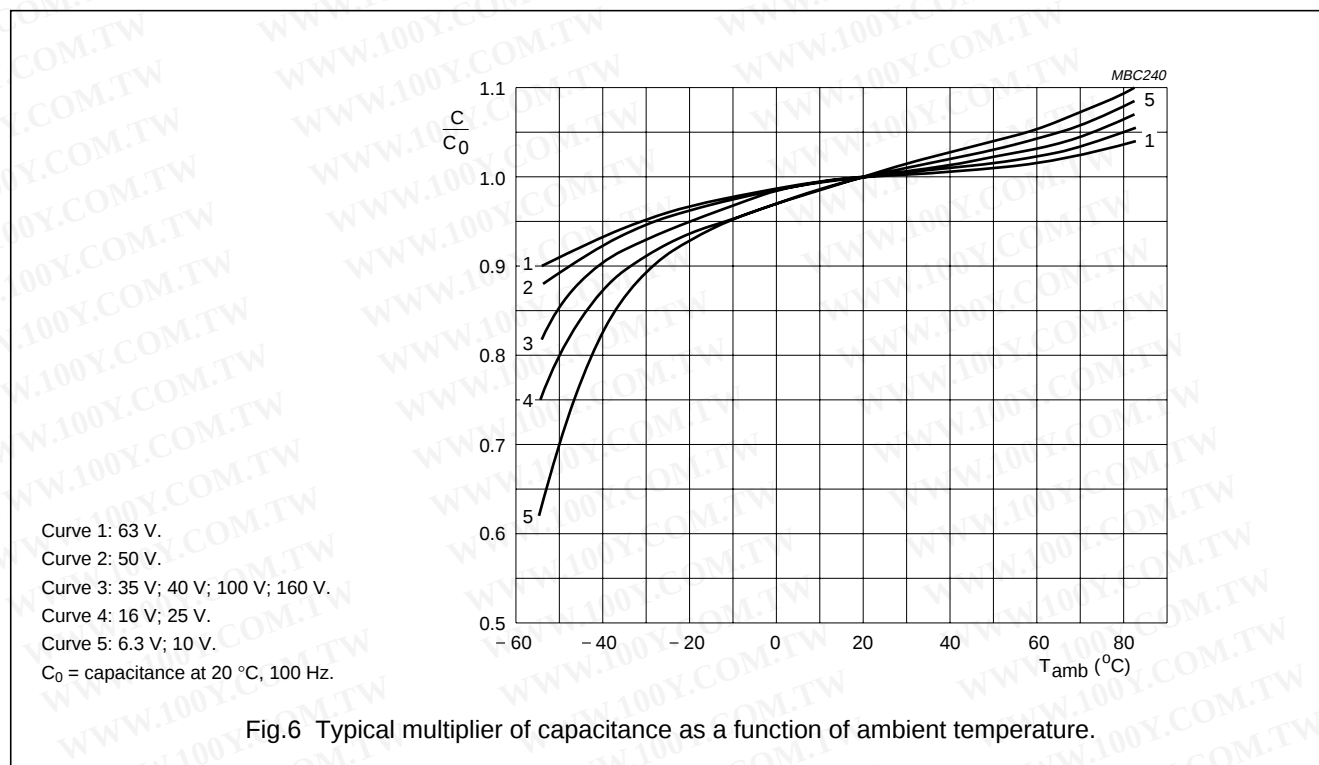
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ELECTRICAL DATA (continued)

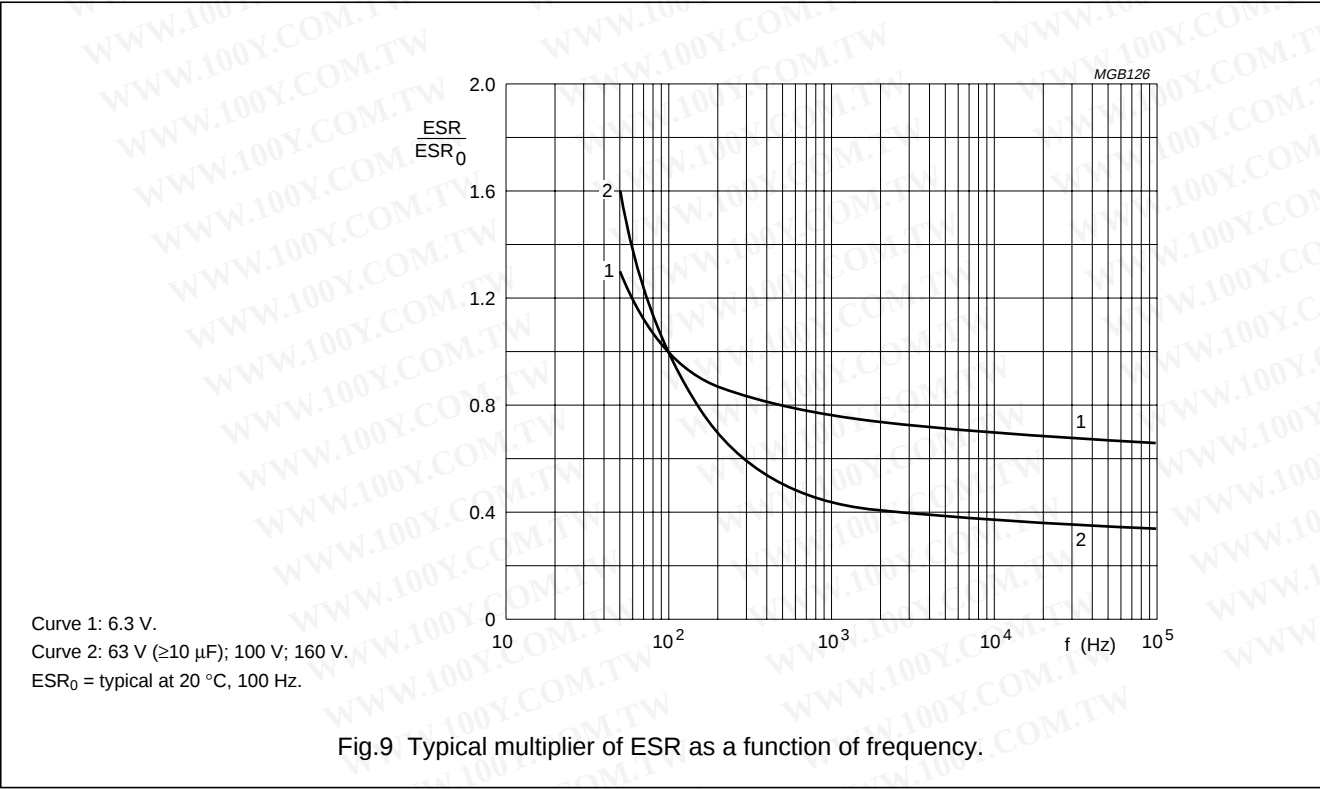
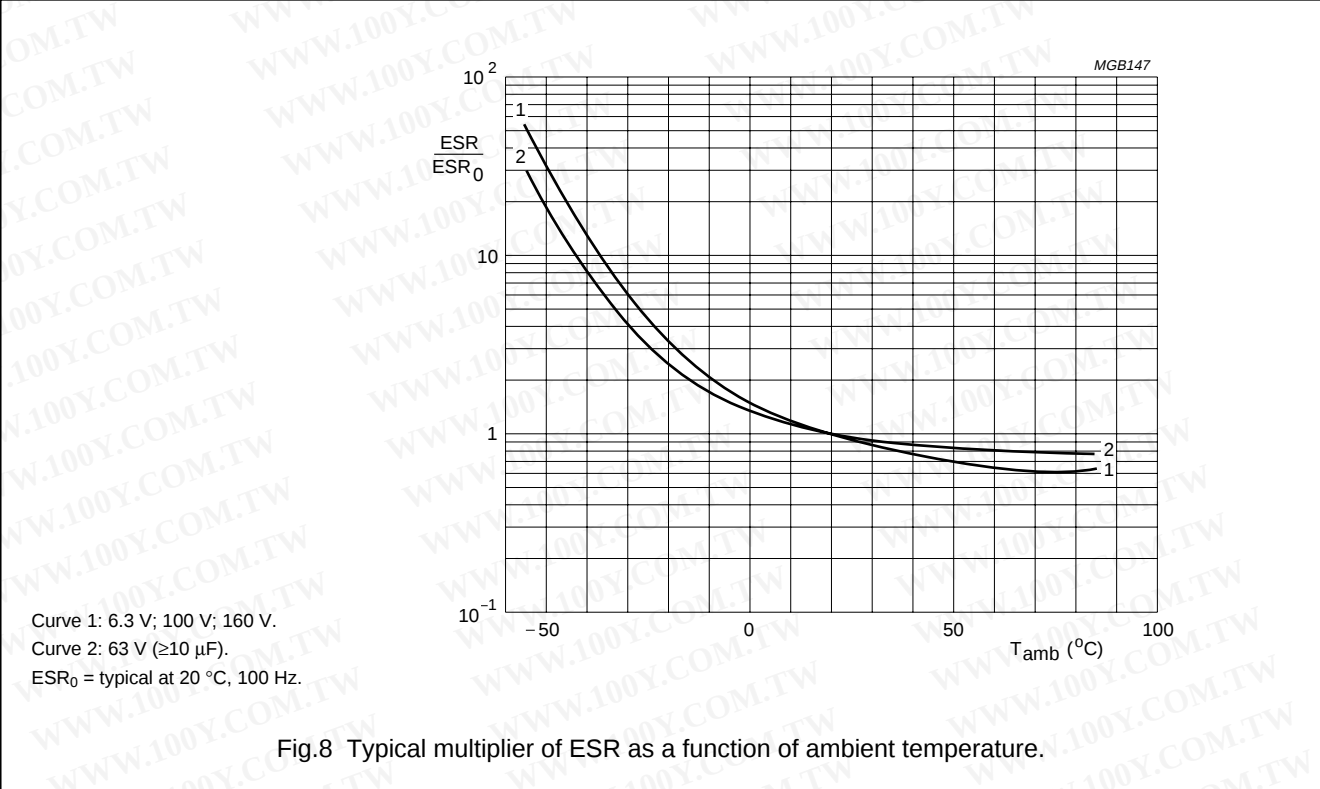
Capacitance (C)



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Equivalent series resistance (ESR)

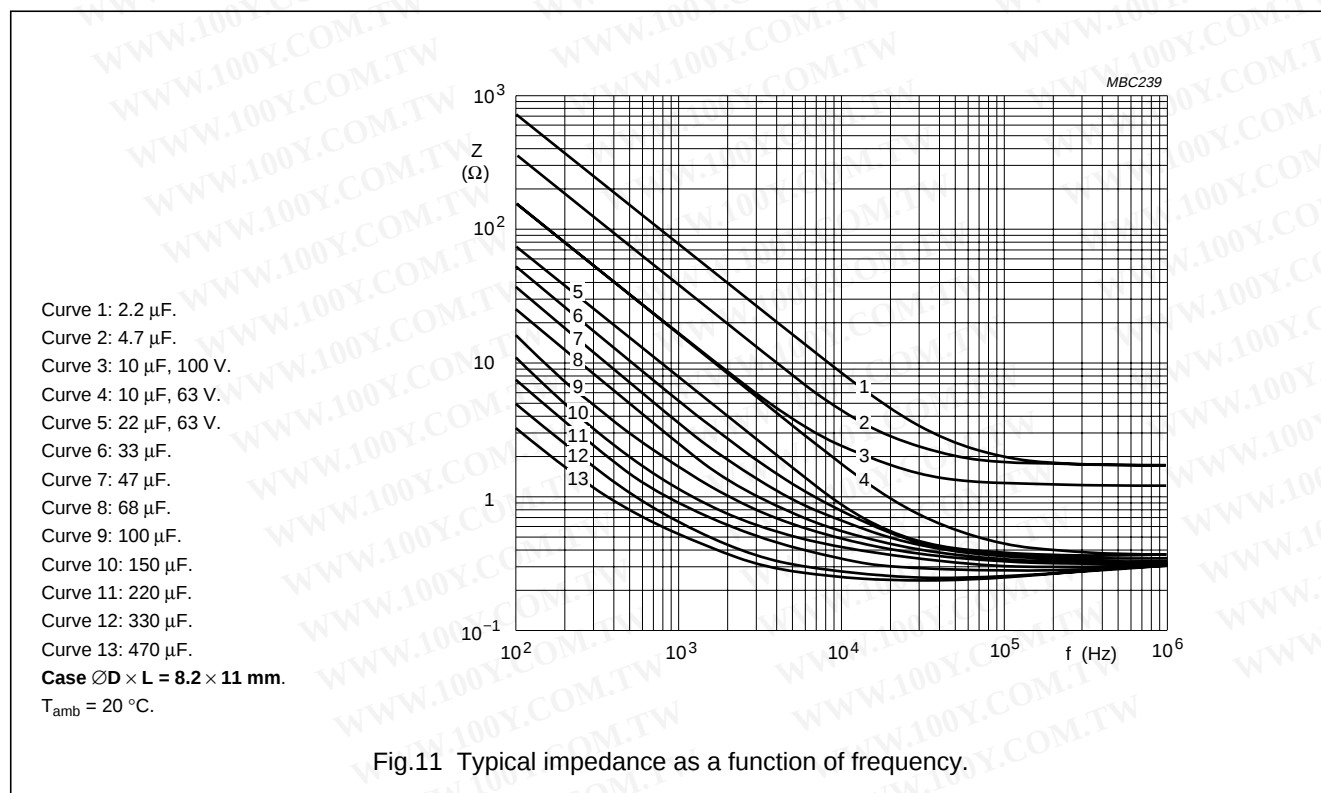
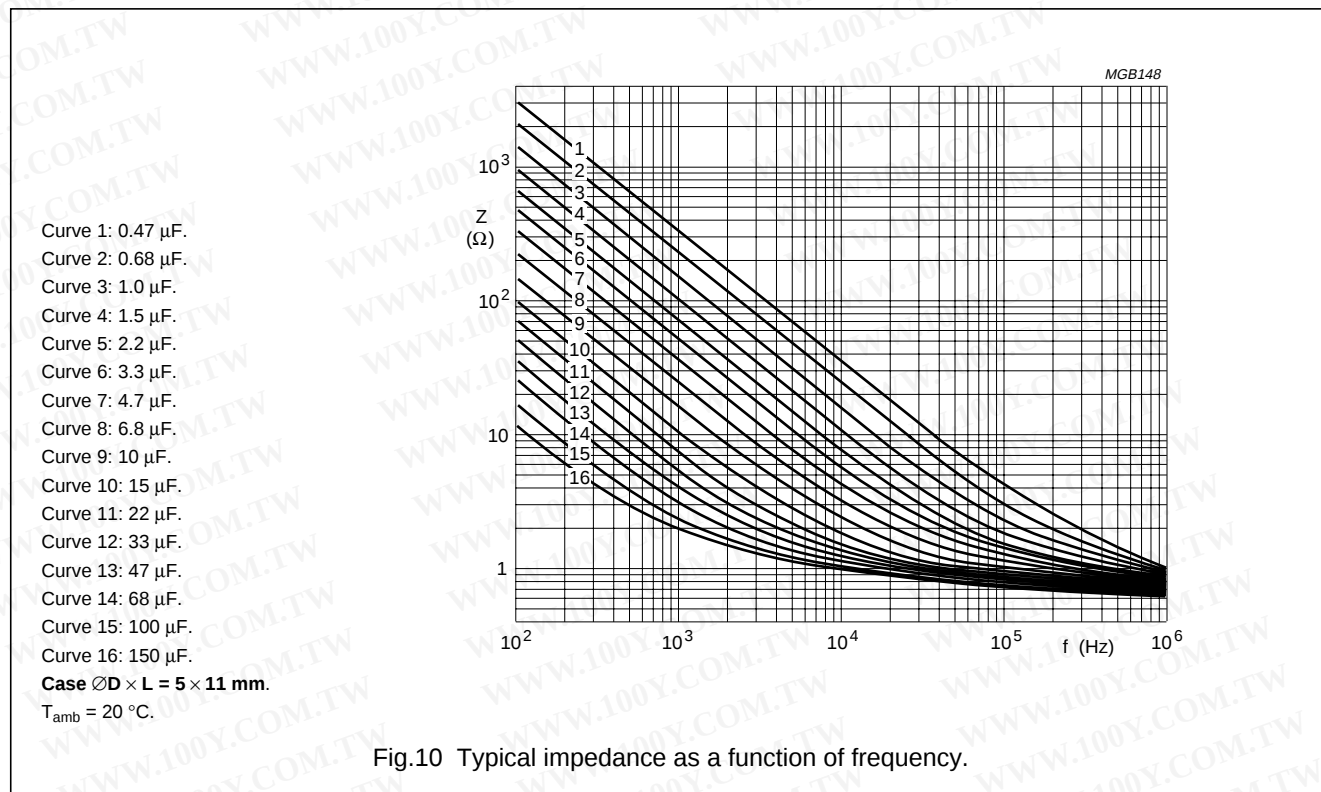


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Impedance (Z)



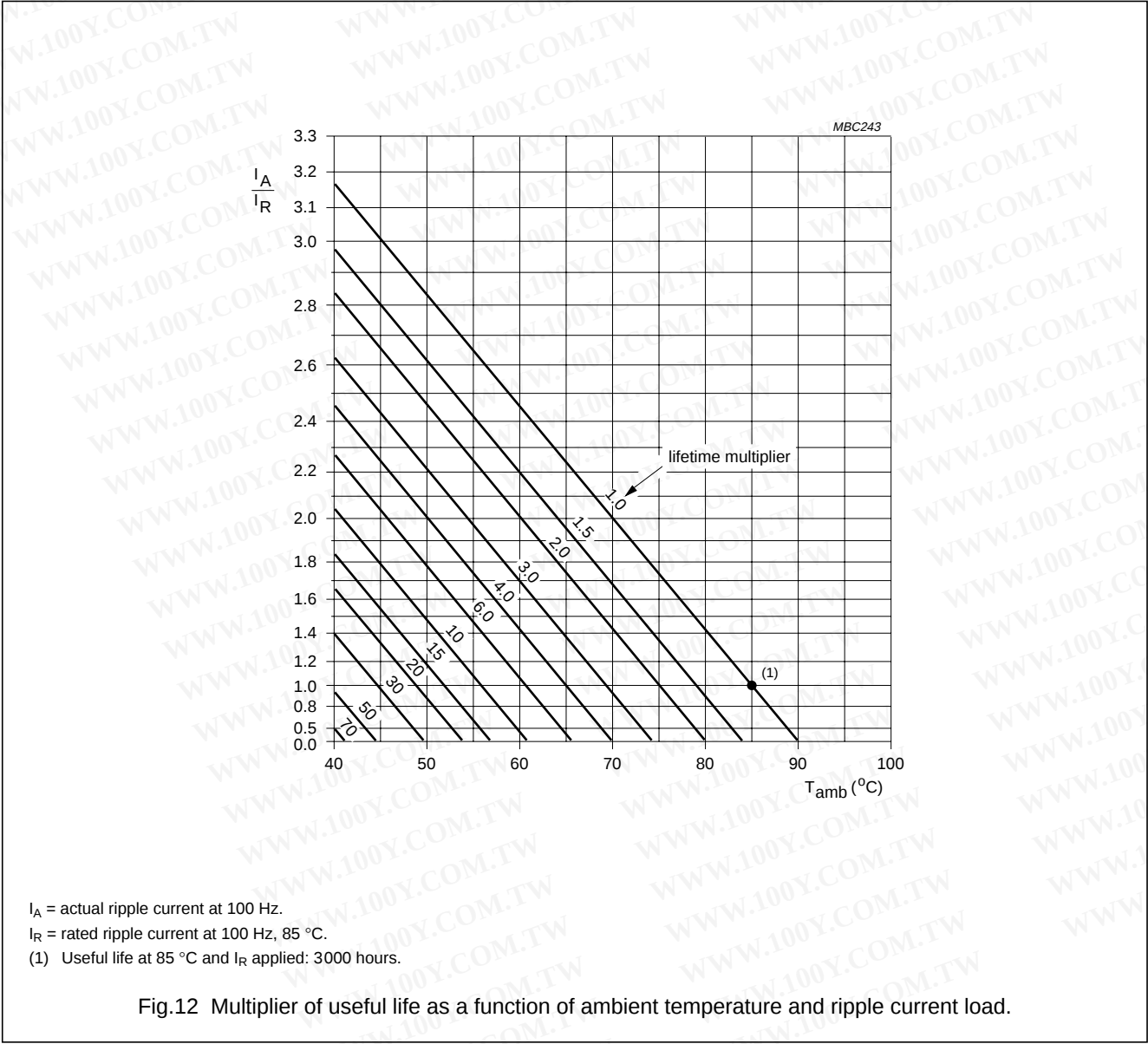
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RIPPLE CURRENT AND USEFUL LIFE

Table 6 Multiplier of ripple current (I_R/I_{R0}) as a function of frequency; I_{R0} = ripple current at 100 Hz

FREQUENCY (Hz)	I_R MULTIPLIER		
	$U_R = 6.3 \text{ to } 10 \text{ V}$	$U_R = 16 \text{ to } 35 \text{ V}$	$U_R = 40 \text{ to } 160 \text{ V}$
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



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SPECIFIC TESTS AND REQUIREMENTS

General tests and requirements are specified in this handbook, Section "Tests and Requirements".

Table 7 Test procedures and requirements

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 384-4/ CECC 30300 subclause 4.13	$T_{amb} = 85\text{ }^{\circ}\text{C}$; 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	$T_{amb} = 85\text{ }^{\circ}\text{C}$; 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 384-4/ CECC 30300 subclause 4.17	$T_{amb} = 85\text{ }^{\circ}\text{C}$; 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 $I_{L5} \leq \text{spec. limit}$

勝特力材料 886-3-5753170
 勝特力电子(上海) 86-21-34970699
 勝特力电子(深圳) 86-755-83298787
[Http://www.100y.com.tw](http://www.100y.com.tw)