Aluminium electrolytic capacitors
SMD (Chip) Standard

085 CS

FEATURES

- Polarized aluminium electrolytic capacitors, non-solid, self healing
- SMD-version, rectangular case, insulated
- Miniaturized, high CV per unit volume, low height
- Flexible terminals, reflow and wave solderable
- Charge and discharge proof
- Supplied in blister tape on reel.

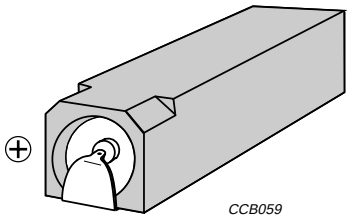
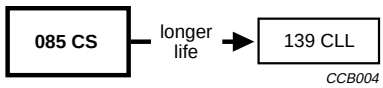


Fig.1 Component outline.

APPLICATIONS

- SMD technology, boards with restricted mounting height
- General applications, consumer electronics, low profile and lightweight equipment
- Decoupling, smoothing, filtering and buffering.



QUICK REFERENCE DATA

DESCRIPTION	VALUE
Nominal case sizes (L × W × H in mm)	8.8 × 3.7 × 3.9 and 11.9 × 3.7 × 3.9
Rated capacitance range, C_R	0.47 to 22 μF
Tolerance on C_R	–10 to +50% or ±20%
Rated voltage range, U_R	6.3 to 63 V
Category temperature range	–40 to +85 °C
Endurance test at 85 °C	1000 hours
Useful life at 85 °C	1500 hours
Useful life at 40 °C, 1.4 × I_R applied	40000 hours
Shelf life at 0 V, 85 °C	500 hours
Resistance to soldering heat test	immersion in solder: 10 s at 260 °C or 20 s at 215 °C
Based on sectional specification	IEC 384-18/CECC 32300
Climatic category IEC 68	40/085/56

Selection chart for C_R, U_R and relevant nominal case sizes (L × W × H in mm)

Preferred types in **bold**.

C_R (μF)	U_R (V)					
	6.3	**10**	**16**	**25**	**40**	**63**
0.47	–	–	–	–	–	8.8 × 3.7 × 3.9
1.0	–	–	–	–	–	**8.8 × 3.7 × 3.9**
2.2	–	–	–	–	**8.8 × 3.7 × 3.9**	11.9 × 3.7 × 3.9
3.3	–	–	–	8.8 × 3.7 × 3.9	–	11.9 × 3.7 × 3.9
4.7	–	–	**8.8 × 3.7 × 3.9**	–	**11.9 × 3.7 × 3.9**	–
6.8	–	8.8 × 3.7 × 3.9	–	11.9 × 3.7 × 3.9	–	–
10	**8.8 × 3.7 × 3.9**	–	**11.9 × 3.7 × 3.9**	–	–	–
15	–	11.9 × 3.7 × 3.9	–	–	–	–
22	11.9 × 3.7 × 3.9	–	–	–	–	–

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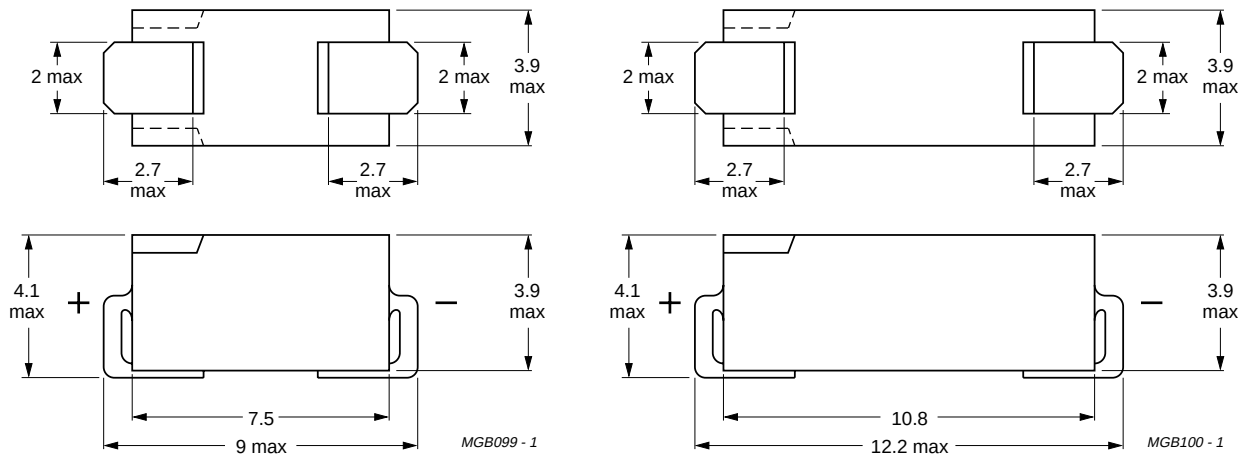
MECHANICAL DATA



a. b.

Dimensions in mm.

a. **Case size 8.8 × 3.7 × 3.9 mm.**

b. **Case size 11.9 × 3.7 × 3.9 mm.**

Fig.2 Dimensional outlines.

PACKAGING QUANTITIES

- Tape on reel packaging: 2000 per reel.

MARKING

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

- Rated capacitance (in μF)
- Rated voltage code (see Table 1), the U_R code letter indicates the position of the decimal point in the capacitance value
- Name of manufacturer (PHILIPS)
- '–' sign indicating the cathode. The anode is identified by bevelled edges.

Examples for C_{nom}; U_R marking:

H22 represents 0.22 μF; 63 V

2G2 represents 2.2 μF; 40 V

22C represents 22 μF; 6.3 V.

Table 1 Rated voltage marking code

U_R (V)	6.3	10	16	25	40	63
Code letter	C	D	E	F	G	H

MOUNTING

The capacitors are designed for automatic placement on printed-circuit boards or hybrid circuits.

Optimum dimensions of soldering pads depend upon soldering method, mounting accuracy, print lay-out and/or adjacent components.

For recommended pad dimensions, refer to Fig.3 and Table 2.

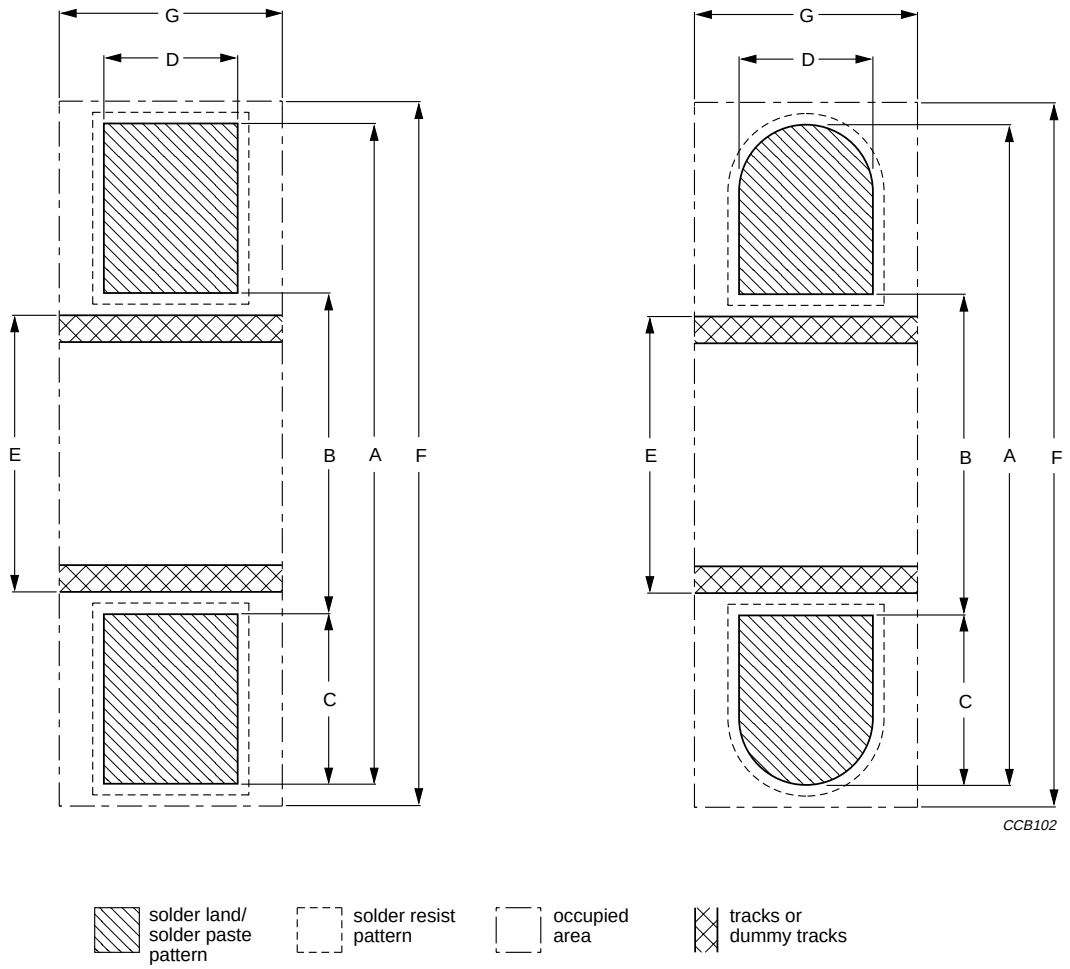


Fig.3 Recommended pad dimensions for reflow and wave soldering; see Table 2.

Table 2 Recommended soldering pad dimensions in **mm** (placement accuracy ±0.25 mm); see Fig.3

NOMINAL CASE SIZE L × W × H (mm)	FOR REFLOW SOLDERING							FOR WAVE SOLDERING						
	A	B	C	D	E	F	G	A	B	C	D	E	F	G
8.8 × 3.7 × 3.9	9.7	3.5	2.9	2.5	3.0	10.1	4.4	13.5	4.1	4.7	3.7	2.9	14.0	8.4
11.9 × 3.7 × 3.9	12.9	6.5	2.9	2.5	6.0	13.3	4.4	16.8	7.4	4.7	3.7	6.1	17.3	8.4

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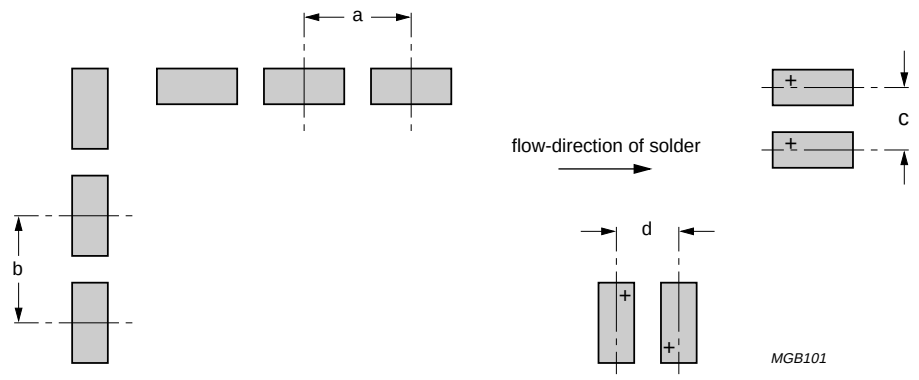

For dimensions a, b, c and d, refer to Table 3.
Flow direction of solder preferably onto side-walls or plus-side of the capacitors.

Fig.4 Minimum distances between 085 CS capacitors on a printed-circuit board for wave soldering.

Soldering

Soldering conditions are defined by the curve, temperature versus time. The temperature is that measured on the soldering pad during processing.

For maximum conditions of different soldering methods see Figs 5, 6 and 7.

Any temperature/time curve which does not exceed the specified maximum curves may be applied.

After soldering under maximum conditions, some drift of the electrical parameters may occur. Typical behaviour which can be expected under these circumstances is shown in Fig.8.

AS A GENERAL PRINCIPLE, TEMPERATURE AND DURATION SHALL BE THE **MINIMUM** NECESSARY REQUIRED TO ENSURE GOOD SOLDERING CONNECTIONS.

Table 3 Minimum distances between capacitors; see Fig.4

NOMINAL CASE SIZE $L \times W \times H$ (mm)	a_{min} (mm)	b_{min} (mm)	c_{min} (mm)	d_{min} (mm)
$8.8 \times 3.7 \times 3.9$	12	12	6.8	6.8
$11.9 \times 3.7 \times 3.9$	15	15	6.8	6.8

Maximum temperature load

Table 4 Curing conditions for SMD-glue

MAX. T_{amb} (°C)	MAX. EXPOSURE TIME (minutes)
125	10
140	3
150	1
160	0.5

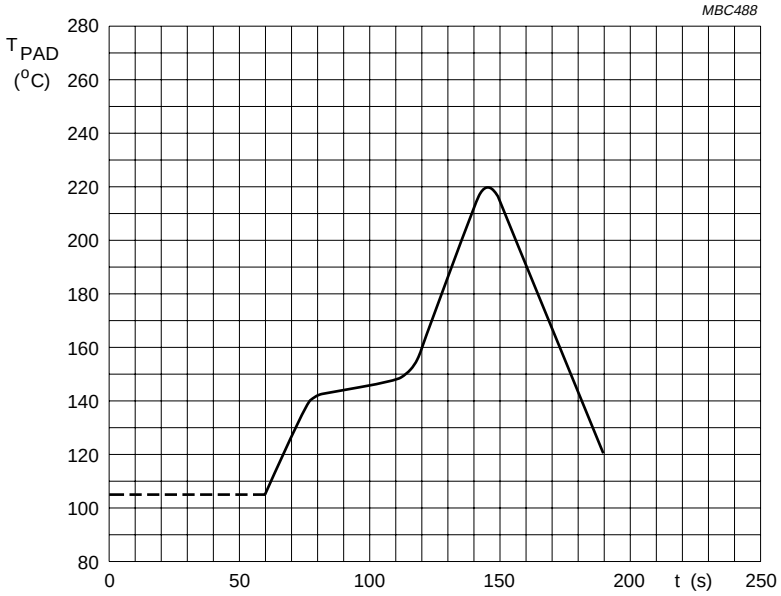

Fig.5 Maximum temperature load during infrared reflow soldering.

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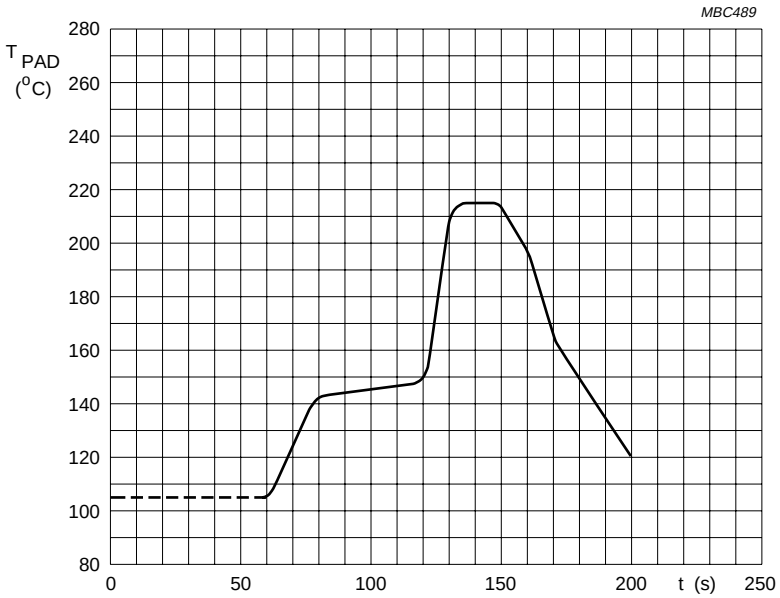


Fig.6 Maximum temperature load during vapour phase reflow soldering.

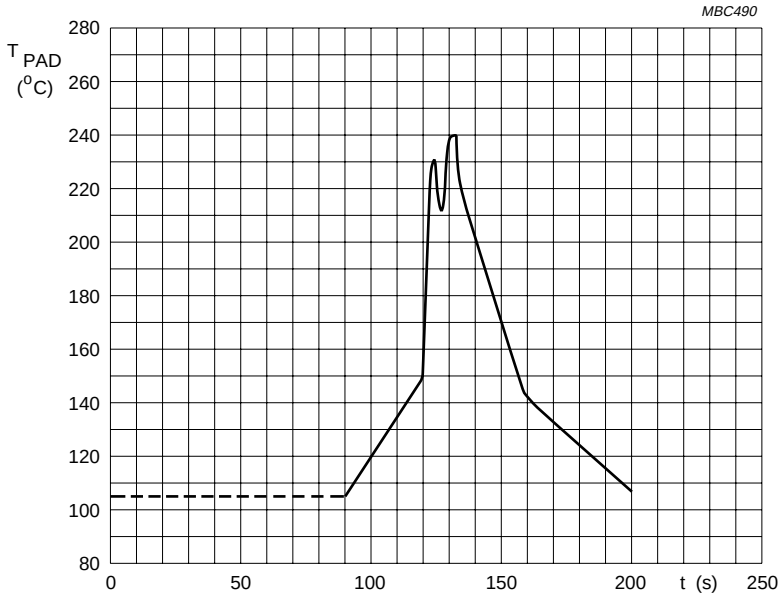


Fig.7 Maximum temperature load during (double-) wave soldering.

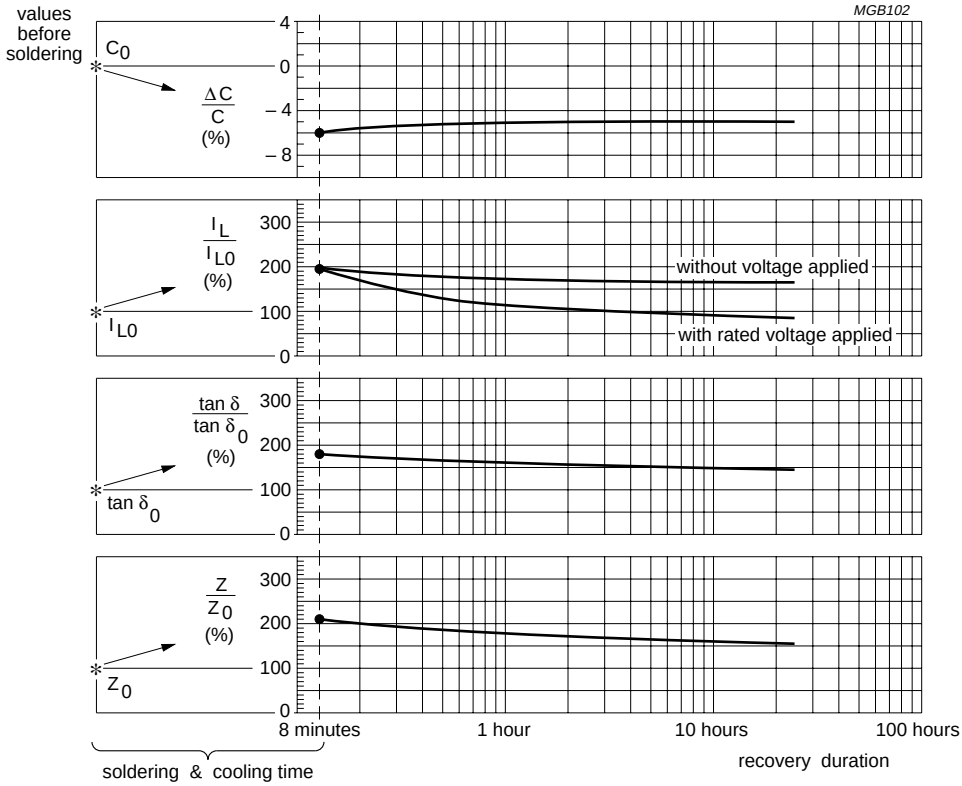


Fig.8 Typical drift of electrical parameters after soldering under maximum conditions, and subsequent recovery.

ELECTRICAL DATA AND ORDERING INFORMATION

Unless otherwise specified, all electrical values in Table 5 apply at T_{amb} = 20 °C, P = 86 to 106 kPa, RH = 45 to 75%.

SYMBOL	DESCRIPTION
C_R	rated capacitance at 100 Hz (tolerance −10 to +50% or ±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 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

Ordering example

Electrolytic capacitor 085 series

10 µF/16 V; −10/+50%

Nominal case size: 11.9 × 3.7 × 3.9 mm; Form BR

Catalogue number: 2222 085 25109.

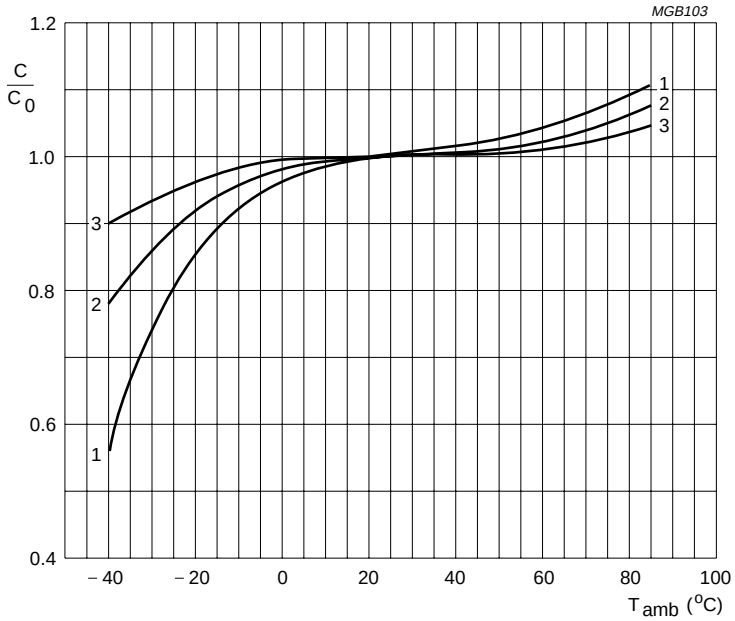
Table 5 Electrical data and catalogue numbers; preferred types in **bold**

U_R (V)	C_R 100 Hz (µF)	NOMINAL CASE SIZE L × W × H (mm)	CASE CODE	I_R 100 Hz 85 °C (mA)	I_{L1} 1 min (µA)	I_{L5} 5 min (µA)	Tan δ 100 Hz	ESR 100 Hz (Ω)	Z 10 kHz (Ω)	CATALOGUE NUMBER 2222	
										−10/+50%	±20%
										BLISTER TAPE ON REEL FORM BR	BLISTER TAPE ON REEL FORM BR
6.3	**10.0**	**8.8 × 3.7 × 3.9**	**1a**	11	4	3.1	0.30	48	20	**085 23109**	085 63109
	22	11.9 × 3.7 × 3.9	1	20	6	3.3	0.30	22	9	085 23229	085 63229
10	6.8	8.8 × 3.7 × 3.9	1a	10	4	3.1	0.25	59	24	085 24688	085 64688
	15	11.9 × 3.7 × 3.9	1	18	6	3.3	0.25	27	11	085 24159	085 64159
16	**4.7**	**8.8 × 3.7 × 3.9**	**1a**	9	5	3.2	0.20	68	26	**085 25478**	085 65478
	10	**11.9 × 3.7 × 3.9**	**1**	16	6	3.3	0.20	32	12	**085 25109**	085 65109
25	3.3	8.8 × 3.7 × 3.9	1a	8	5	3.2	0.18	87	27	085 26338	085 66338
	6.8	11.9 × 3.7 × 3.9	1	14	6	3.3	0.18	42	13	085 26688	085 66688
40	**2.2**	**8.8 × 3.7 × 3.9**	**1a**	7	5	3.2	0.16	120	32	**085 27228**	085 67228
	4.7	**11.9 × 3.7 × 3.9**	**1**	13	7	3.4	0.16	54	15	**085 27478**	085 67478
63	0.47	8.8 × 3.7 × 3.9	1a	4	4	3.1	0.10	340	120	085 28477	085 68477
	1.0	**8.8 × 3.7 × 3.9**	**1a**	6	4	3.1	0.12	190	55	**085 28108**	085 68108
	2.2	11.9 × 3.7 × 3.9	1	11	6	3.3	0.14	87	25	085 28228	085 68228
	3.3	11.9 × 3.7 × 3.9	1	13	7	3.4	0.14	68	17	085 28338	085 68338

Additional electrical data

PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage for short periods		$U_S \leq 1.15 \times U_R$
Reverse voltage		$U_{rev} \leq 1$ V
Current		
Leakage current	after 1 minute at U_R	$I_{L1} \leq 0.02C_R \times U_R + 3$ μA
	after 5 minutes at U_R	$I_{L5} \leq 0.002C_R \times U_R + 3$ μA
Inductance		
Equivalent series inductance (ESL)	nominal case size $8.8 \times 3.7 \times 3.9$ mm	typ. 11 nH
	nominal case size $11.9 \times 3.7 \times 3.9$ mm	typ. 13 nH

Capacitance (C)



Curve 1: 6.3 V.
Curve 2: 25 V.
Curve 3: 63 V.
C_0 = capacitance at 20 °C, 100 Hz.

Fig.9 Typical multiplier of capacitance as a function of ambient temperature.

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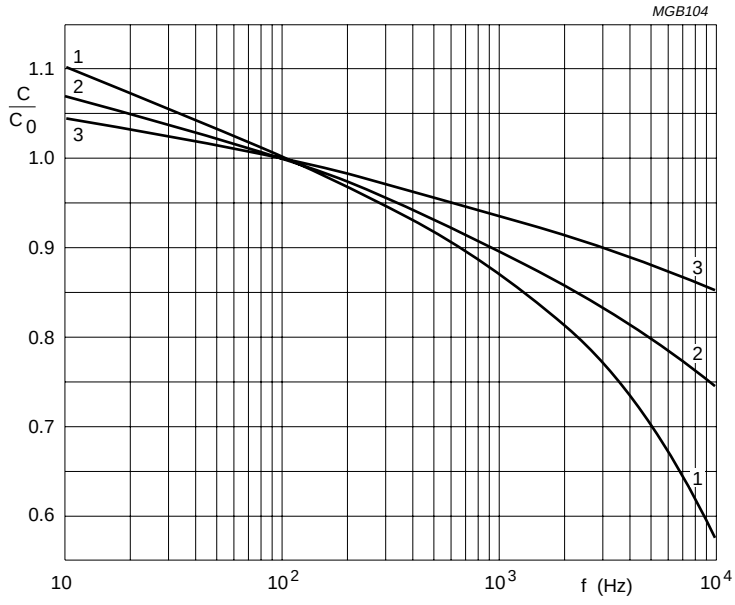
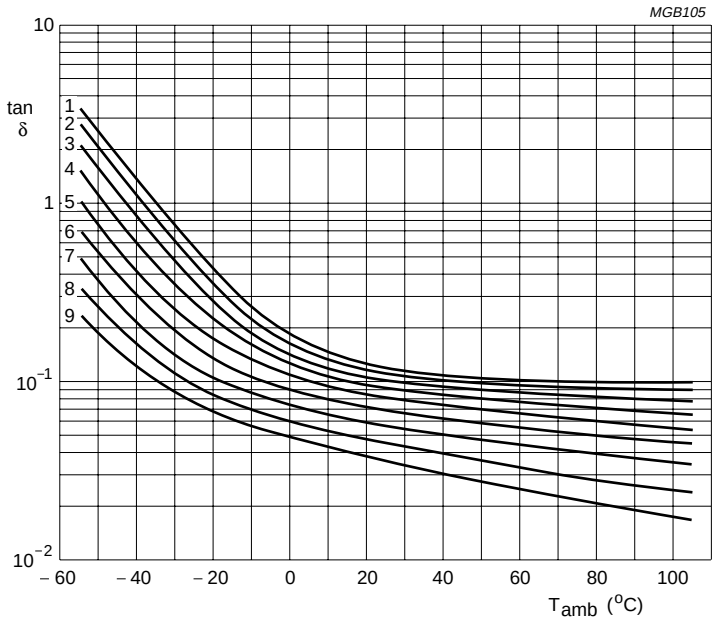


Curve 1: 6.3 V.
Curve 2: 25 V.
Curve 3: 63 V.
C_0 = capacitance at 20 °C, 100 Hz.

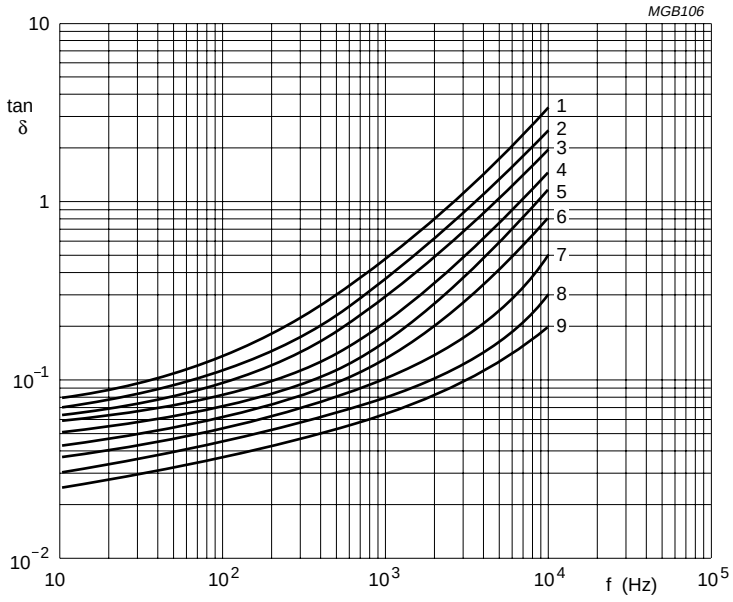
Fig.10 Typical multiplier of capacitance as a function of frequency.

Dissipation factor (tan δ)



Curve 1: 6.3 V.
Curve 2: 10 V.
Curve 3: 16 V.
Curve 4: 25 V.
Curve 5: 40 V.
Curve 6: 63 V, 1.5 μF to 3.3 μF.
Curve 7: 63 V, 1 μF.
Curve 8: 63 V, 0.22 μF to 0.47 μF.
Curve 9: 0.1 μF.
f = 100 Hz.

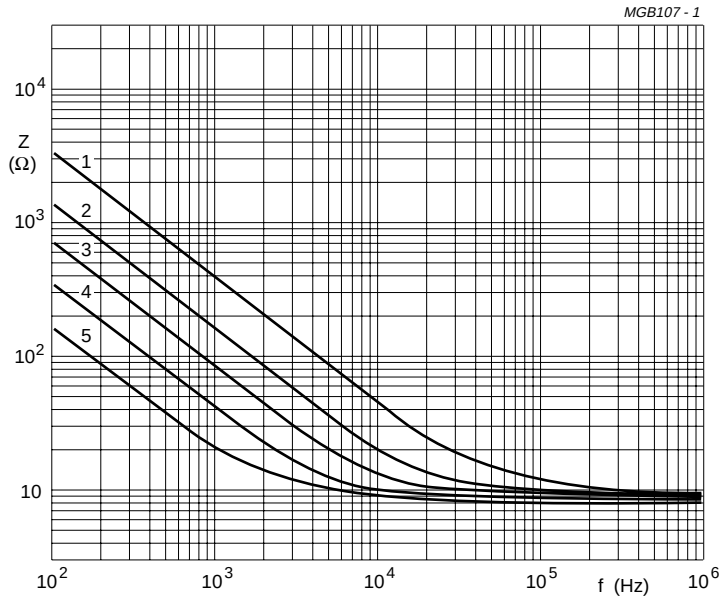
Fig.11 Typical tan δ as a function of ambient temperature.



Curve 1: 6.3 V.
Curve 2: 10 V.
Curve 3: 16 V.
Curve 4: 25 V.
Curve 5: 40 V.
Curve 6: 63 V, 1.5 μF to 3.3 μF.
Curve 7: 63 V, 1 μF.
Curve 8: 63 V, 0.22 μF to 0.47 μF.
Curve 9: 0.1 μF.
T_{amb} = 20 °C.

Fig.12 Typical tan δ as a function of frequency.

Impedance (Z)



Curve 1: 0.1 µF.
Curve 2: 0.22 µF.
Curve 3: 0.47 µF.
Curve 4: 1 µF.
Curve 5: 2.2 µF.
Case size 8.8 × 3.7 × 3.9 mm.
T_{amb} = 20 °C.

Fig.13 Typical impedance as a function of frequency.

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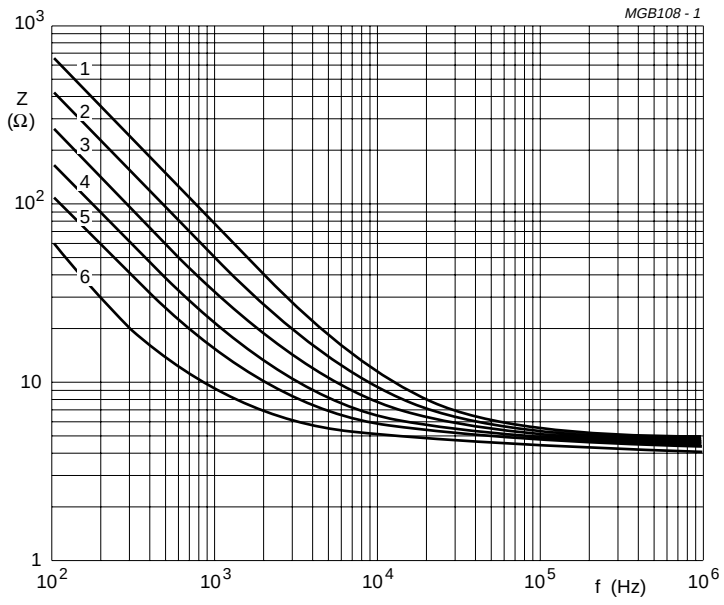


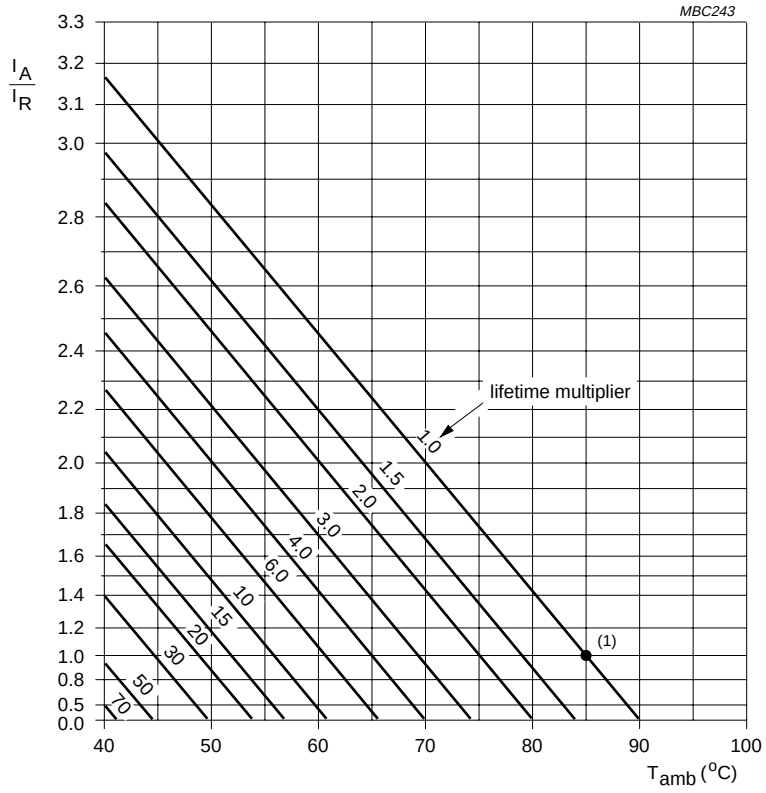
Curve 1: 2.2 µF.
Curve 2: 3.3 µF.
Curve 3: 4.7 µF.
Curve 4: 6.8 µF.
Curve 5: 10 µF.
Curve 6: 15 µF.
Case size 11.9 × 3.7 × 3.9 mm.
T_{amb} = 20 °C.

Fig.14 Typical impedance as a function of frequency.

RIPPLE CURRENT AND USEFUL LIFE

Table 6 Multiplier of ripple current (I_R) as a function of frequency

FREQUENCY (Hz)	I_R MULTIPLIER		
	U_R = 6.3 to 16 V	U_R = 25 to 40 V	U_R = 63 V
50	0.8	0.75	0.7
100	1.0	1.0	1.0
300	1.2	1.3	1.55
1000	1.35	1.55	1.9
3000	1.45	1.7	2.3
≥10000	1.5	1.8	2.5



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: 1500 hours.

Fig.15 Multiplier of useful life as a function of ambient temperature and ripple current load.

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**		
Mounting	IEC 384-18, subclause 4.3	shall be performed prior to tests mentioned below; method: reflow or (double-) wave soldering; for maximum temperature load refer to Chapter "Mounting"	$\Delta C/C$: ±10% tan $\delta \leq$ spec. limit $I_{L5} \leq 2 \times$ spec. limit
Endurance	IEC 384-18/ CECC 32300, subclause 4.15	T_{amb} = 85 °C; U_R applied; 1000 hours	$\Delta C/C$: ±20% tan $\delta \leq 2 \times$ spec. limit $Z \leq 3 \times$ spec. limit $I_{L5} \leq$ spec. limit
Useful life	CECC 30301, subclause 1.8.1	T_{amb} = 85 °C; U_R and I_R applied; 1500 hours	$\Delta C/C$: ±50% tan $\delta \leq 3 \times$ spec. limit $Z \leq 3 \times$ spec. limit $I_{L5} \leq$ spec. limit no short or open circuit total failure percentage: ≤3%
Shelf life (storage at high temperature)	IEC 384-18/ CECC 32300, subclause 4.17	T_{amb} = 85 °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 δ, Z: for requirements see 'Endurance test' above $I_{L5} \leq 2 \times$ spec. limit

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