DATA SHEET

128 SAL-RPM
Aluminum electrolytic capacitors
Solid Al, Radial Pearl Miniature

Product specification
Supersedes data of April 1999
File under BCcomponents, BC01

2000 Jan 18

BC COMPONENTS

Aluminum electrolytic capacitors Solid Al, Radial Pearl Miniature

128 SAL-RPM

FEATURES

- Polarized aluminum electrolytic capacitors, solid electrolyte MnO_2
- Radial leads, max. height 9.5 mm, resin dipped, orange coloured
- Extremely long useful life, 20000 hours/125 °C
- Extended usable temperature range up to 175 °C
- Excellent low temperature, impedance and ESR behaviour
- Charge and discharge proof, application with 0 Ω resistance allowed
- Reverse DC voltage up to $0.3 \times U_R$ allowed
- AC voltage up to $0.8 \times U_R$ allowed
- Advanced technology to achieve high reliability and high stability.

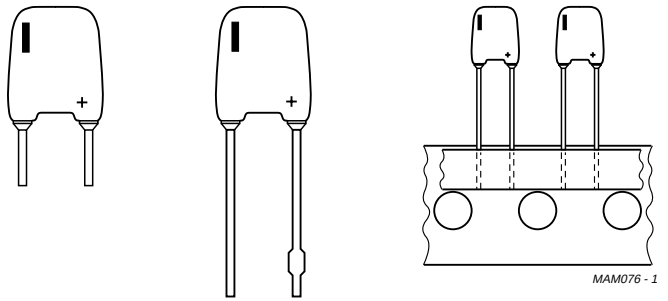
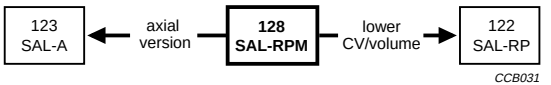


Fig.1 Component outlines.



APPLICATIONS

- EDP, telecommunication, general industrial, automotive and audio-video
- Smoothing, filtering and buffering
- For small power supplies, DC/DC converters.

QUICK REFERENCE DATA

DESCRIPTION	VALUE
Case sizes ($H_{max} \times W_{max} \times T_{max}$ in mm)	$9.5 \times 7 \times 3$ to $9.5 \times 8 \times 6$
Rated capacitance range (E6 series), C_R	0.1 to 68 μF
Tolerance on C_R	±20%
Rated voltage range, U_R	6.3 to 40 V
Category temperature range:	
U_R = 6.3 to 40 V	–55 to +85 °C
U_C = 6.3 to 25 V	–55 to +125 °C
Endurance test at 125 °C	10000 hours
Useful life at 125 °C	20000 hours
Useful life at 175 °C	2000 hours
Useful life at 40 °C, I_R applied	>300000 hours
Shelf life at 0 V, 125 °C	500 hours
Based on sectional specification	IEC 60384-4/EN130300
Climatic category IEC 60068	55/125/56

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Selection chart for C_R, U_R, U_C and relevant maximum case sizes (H × W × T in mm)

Preferred types in **bold**.

C_R (µF)	U_R (V) at T_{amb} = 85 °C					
	6.3	**10**	**16**	**25**	**35**	**40**
	U_C (V) at T_{amb} = 125 °C					
	6.3	**10**	**16**	**25**	**25**	**25**
0.1	–	–	–	–	–	**9.5 × 7 × 3**
0.15	–	–	–	–	–	9.5 × 7 × 3
0.22	–	–	–	–	–	**9.5 × 7 × 3.5**
0.33	–	–	–	–	9.5 × 7 × 3.5	9.5 × 7 × 4
0.47	–	–	–	–	**9.5 × 7 × 4**	**9.5 × 7 × 5**
0.68	–	–	–	9.5 × 7 × 3.5	9.5 × 7 × 4	9.5 × 7 × 5
1	–	–	–	**9.5 × 7 × 3.5**	**9.5 × 7 × 5**	**9.5 × 8 × 5**
1.5	–	–	–	9.5 × 7 × 3.5	9.5 × 8 × 5	9.5 × 8 × 6
2.2	–	–	**9.5 × 7 × 3.5**	**9.5 × 7 × 4**	**9.5 × 8 × 6**	**9.5 × 8 × 6**
3.3	–	–	9.5 × 7 × 3.5	9.5 × 7 × 5	9.5 × 8 × 6	–
4.7	–	**9.5 × 7 × 3.5**	**9.5 × 7 × 4**	**9.5 × 8 × 5**	–	–
6.8	–	9.5 × 7 × 3.5	9.5 × 7 × 4	9.5 × 8 × 6	–	–
10	**9.5 × 7 × 3.5**	**9.5 × 7 × 4**	**9.5 × 7 × 5**	**9.5 × 8 × 6**	–	–
15	–	9.5 × 7 × 4	9.5 × 8 × 5	–	–	–
22	**9.5 × 7 × 4**	**9.5 × 7 × 5**	**9.5 × 8 × 6**	–	–	–
33	9.5 × 7 × 5	9.5 × 8 × 5	–	–	–	–
47	**9.5 × 8 × 5**	**9.5 × 8 × 6**	–	–	–	–
68	9.5 × 8 × 6	–	–	–	–	–

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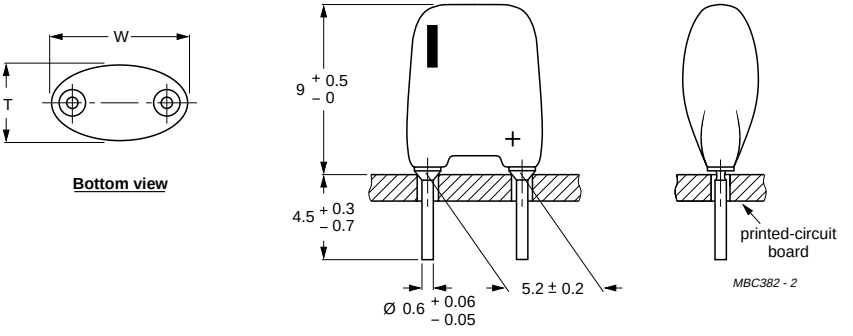
MECHANICAL DATA, AVAILABLE FORMS AND PACKAGING QUANTITIES



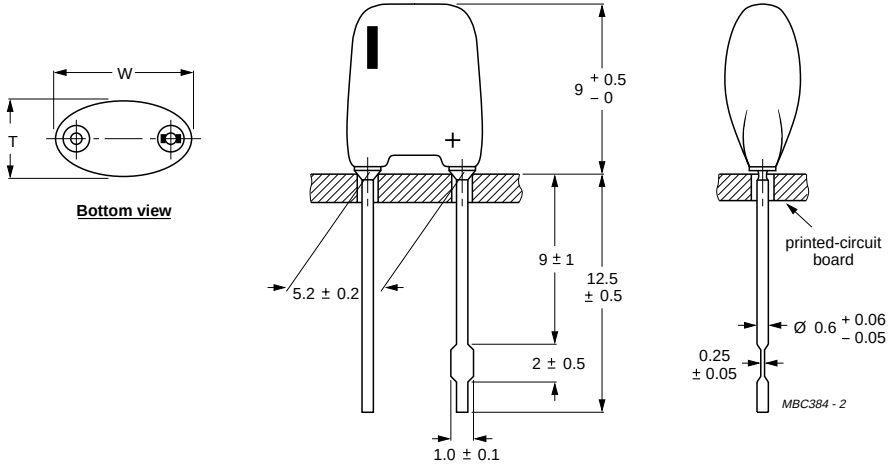
Dimensions in mm.

For dimensions see Table 1.

The diameter of the mounting holes in the printed-circuit board is 0.8 ±0.1 mm.

Flanges are provided with degassing grooves.

Fig.2 **Form CB**: Short leads, in boxes.



Dimensions in mm.

For dimensions see Table 1.

The diameter of the mounting holes in the printed-circuit board is 0.8 ±0.1 mm, except for the hole of the anode lead of Form CA capacitors: 1.3 −0.2 mm.

Flanges are provided with degassing grooves.

Fig.3 **Form CA**: Long leads with keyed polarity, in boxes.

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

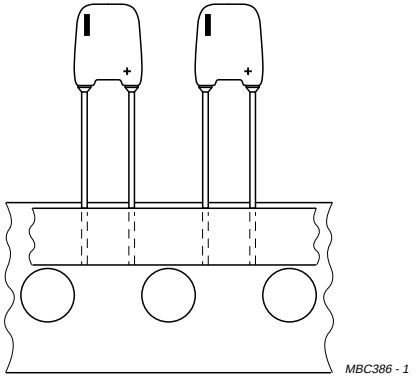
MAXIMUM CASE SIZE H × W × T (mm)	CASE CODE	MASS (g)	PACKAGING QUANTITIES			
			FORM CA (note 1)	FORM CB (note 1)	FORM TR+	FORM TFA
9.5 × 7 × 3	10	≈0.22	1000	1000	2000	1000
9.5 × 7 × 3.5	20	≈0.25	1000	1000	2000	1000
9.5 × 7 × 4	30	≈0.30	1000	1000	2000	1000
9.5 × 7 × 5	40	≈0.35	1000	1000	1000	1000
9.5 × 8 × 5	50	≈0.50	1000	1000	1000	1000
9.5 × 8 × 6	60	≈0.60	1000	1000	1000	1000

Note

1. In plastic bags of 200 units each.

TAPED PRODUCTS

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



Form TR+: Taped on reel, positive leading.
Form TFA: Taped in ammopack.

Fig.4 Taped versions.

MARKING

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

- Rated capacitance (in μF)
- Tolerance code on rated capacitance (M for ±20%)
- Rated voltage (in V) and category voltage if applicable
- Date code in accordance with *"IEC 60062"*
- Name of manufacturer
- '+' sign to indicate the anode terminal
- '▮' sign to indicate the cathode terminal.

MOUNTING

When bending, cutting or straightening the leads, ensure that the capacitor body is relieved of stress.

Bending after soldering must be avoided.

ELECTRICAL DATA AND ORDERING INFORMATION

Unless otherwise specified, all electrical values in Table 2 apply at T_{amb} = 20 to 25 °C, P = 86 to 106 kPa, RH = 45 to 75%.

C_R	rated capacitance at 100 Hz, tolerance ±20%
I_R	max. RMS ripple current no necessary DC applied
I_{L5}	max. leakage current after 5 minutes at U_R
Tan δ	max. dissipation factor at 100 Hz; note 1
ESR	max./typ. equivalent series resistance at 100 Hz
Z	max. impedance at 100 kHz

Ordering example

Electrolytic capacitors 128 series

10 µF/16 V; ±20%

Maximum case size: 9.5 × 7 × 5 mm; Form CB

Catalogue number: 2222 128 55109.

Table 2 Electrical data and ordering information **128** series; preferred types in **bold**

U_C (V)	U_R (V)	C_R 100 Hz (µF)	MAXIMUM CASE SIZE H × W × T (mm)	CASE CODE	I_R 100 Hz 125 °C (mA)	I_R 10 kHz 85 °C (mA)	I_R 100 kHz 40 °C (mA)	I_{L5} 5 min (µA)	MAX. ESR 100 Hz (Ω)	TYP. ESR 100 Hz (Ω)	Z 100 kHz (Ω)	CATALOGUE NUMBER 2222 128.....			
												FORM CB	FORM CA	FORM TR+ REEL	FORM TFA AMMO
6.3	6.3	**10**	**9.5 × 7 × 3.5**	**20**	22.4	320	595	2	20	8	2.0	53109	73109	23109	**33109**
		22	**9.5 × 7 × 4**	**30**	32.9	470	870	4	9	3.5	1.0	53229	73229	23229	**33229**
		33	9.5 × 7 × 5	40	65.4	595	1100	5	6.1	2	0.70	53339	73339	23339	33339
		47	**9.5 × 8 × 5**	**50**	118.4	740	1360	7	4.3	2	0.50	53479	73479	23479	**33479**
		68	9.5 × 8 × 6	60	153.0	800	1650	11	3.0	1.5	0.40	53689	73689	23689	33689
10	10	**4.7**	**9.5 × 7 × 3.5**	**20**	16.1	230	425	2	43	16	3.00	54478	74478	24478	**34478**
		6.8	9.5 × 7 × 3.5	20	18.9	270	500	2	30	12	2.20	54688	74688	24688	34688
		10	**9.5 × 7 × 4**	**30**	21.7	310	573	3	20	9	1.70	54109	74109	24109	**34109**
		15	9.5 × 7 × 4	30	27.3	390	720	4	14	7	1.20	54159	74159	24159	34159
		22	**9.5 × 7 × 5**	**40**	51.7	470	870	6	9	3.5	0.90	54229	74229	24229	**34229**
		33	9.5 × 8 × 5	50	81.6	510	940	8	6.1	2	0.60	54339	74339	24339	34339
		47	**9.5 × 8 × 6**	**60**	105.4	620	1140	12	4.3	1.5	0.40	54479	74479	24479	**34479**
16	16	**2.2**	**9.5 × 7 × 3.5**	**20**	14.0	200	370	2	91	25	4.50	55228	75228	25228	**35228**
		3.3	9.5 × 7 × 3.5	20	16.1	230	425	2	61	26	3.30	55338	75338	25338	35338
		4.7	**9.5 × 7 × 4**	**30**	18.9	270	500	2	43	14	2.30	55478	75478	25478	**35478**
		6.8	9.5 × 7 × 4	30	22.4	320	590	3	30	11	1.65	55688	75688	25688	35688
		10	**9.5 × 7 × 5**	**40**	42.9	390	720	4	20	6	1.10	55109	75109	25109	**35109**
		15	9.5 × 8 × 5	50	71.2	445	820	6	14	5	0.85	55159	75159	25159	35159
		22	**9.5 × 8 × 6**	**60**	86.7	510	940	9	9	3.5	0.65	55229	75229	25229	**35229**

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U_C (V)	U_R (V)	C_R 100 Hz (μF)	MAXIMUM CASE SIZE H × W × T (mm)	CASE CODE	I_R 100 Hz 125 °C (mA)	I_R 10 kHz 85 °C (mA)	I_R 100 kHz 40 °C (mA)	I_{L5} 5 min (μA)	MAX. ESR 100 Hz (Ω)	TYP. ESR 100 Hz (Ω)	Z 100 kHz (Ω)	CATALOGUE NUMBER 2222 128.....			
												FORM CB	FORM CA	FORM TR+ REEL	FORM TFA AMMO
25	25	0.68	9.5 × 7 × 3.5	20	7.7	110	200	2	295	85	17.00	56687	76687	26687	36687
		1	**9.5 × 7 × 3.5**	**20**	9.1	130	240	2	200	71	12.50	56108	76108	26108	**36108**
		1.5	9.5 × 7 × 3.5	20	10.8	155	285	2	135	48	9.50	56158	76158	26158	36158
		2.2	**9.5 × 7 × 4**	**30**	13.6	195	360	2	91	34	7.00	56228	76228	26228	**36228**
		3.3	9.5 × 7 × 5	40	16.1	230	425	2	61	19	5.20	56338	76338	26338	36338
		4.7	**9.5 × 8 × 5**	**50**	25.3	270	500	3	43	14	3.50	56478	76478	26478	**36478**
		6.8	9.5 × 8 × 6	60	52.7	310	570	4	30	11	2.70	56688	76688	26688	36688
		10	**9.5 × 8 × 6**	**60**	64.8	360	660	6	20	9	2.00	56109	76109	26109	**36109**
25	35	0.33	9.5 × 7 × 3.5	20	5.6	80	145	2	610	185	27.00	50337	70337	20337	30337
		0.47	**9.5 × 7 × 4**	**30**	6.3	90	165	2	430	130	20.00	50477	70477	20477	**30477**
		0.68	9.5 × 7 × 4	30	7.7	110	205	2	295	89	15.00	50687	70687	20687	30687
		1	**9.5 × 7 × 5**	**40**	13.7	125	230	2	200	49	10.00	50108	70108	20108	**30108**
		1.5	9.5 × 8 × 5	50	24.8	155	285	2	135	41	7.00	50158	70158	20158	30158
		2.2	**9.5 × 8 × 6**	**60**	33.1	195	360	2	91	28	4.50	50228	70228	20228	**30228**
		3.3	9.5 × 8 × 6	60	39.9	235	435	3	61	28	3.50	50338	70338	20338	30338
25	40	**0.1**	**9.5 × 7 × 3**	**10**	2.0	40	75	2	1990	950	45.00	57107	77107	27107	**37107**
		0.15	9.5 × 7 × 3	10	2.5	50	95	2	1330	400	35.00	57157	77157	27157	37157
		0.22	**9.5 × 7 × 3.5**	**20**	4.2	60	115	2	910	275	27.00	57227	77227	27227	**37227**
		0.33	9.5 × 7 × 4	30	5.3	75	140	2	610	172	20.00	57337	77337	27337	37337
		0.47	**9.5 × 7 × 5**	**40**	10.4	95	175	2	430	114	15.00	57477	77477	27477	**37477**
		0.68	9.5 × 7 × 5	40	12.1	110	205	2	295	89	10.00	57687	77687	27687	37687
		1	**9.5 × 8 × 5**	**50**	20.0	125	230	2	200	45	7.00	57108	77108	27108	**37108**
		1.5	9.5 × 8 × 6	60	25.5	150	280	2	135	35	5.50	57158	77158	27158	37158
		2.2	**9.5 × 8 × 6**	**60**	33.1	195	360	2	91	28	4.20	57228	77228	27228	**37228**

Note

1. Tan δ at 100 Hz for all types <0.10.

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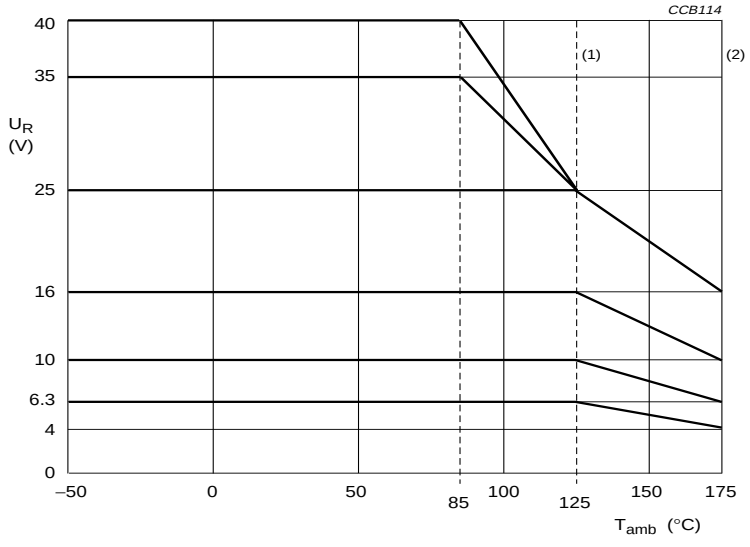
Additional electrical data

PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage		$U_s \leq 1.15 \times U_R$
Reverse voltage		$U_{rev} < 0.3 \times U_R$
Maximum peak AC voltage	reverse voltage applied	≤2 V
Maximum peak AC voltage, without reverse voltage applied	$T_{amb} \leq 85$ °C:	
	at $f \leq 0.1$ Hz	$0.30 \times U_R$
	at $0.1 \text{ Hz} < f \leq 1$ Hz	$0.45 \times U_R$
	at $1 \text{ Hz} < f \leq 10$ Hz	$0.60 \times U_R$
	at $10 \text{ Hz} < f \leq 50$ Hz	$0.65 \times U_R$
	at $f > 50$ Hz	$0.80 \times U_R$
	85 °C < $T_{amb} \leq 125$ °C:	
	at $f \leq 0.1$ Hz	$0.15 \times U_R$
	at $0.1 \text{ Hz} < f \leq 1$ Hz	$0.22 \times U_R$
	at $1 \text{ Hz} < f \leq 10$ Hz	$0.30 \times U_R$
	at $10 \text{ Hz} < f \leq 50$ Hz	$0.32 \times U_R$
	at $f > 50$ Hz	$0.40 \times U_R$
Inductance		
Equivalent series inductance (ESL)	case sizes $9.5 \times 7 \times 3$ to $9.5 \times 7 \times 5$ mm	typ. 9 to 14 nH
	case sizes $9.5 \times 8 \times 5$ and $9.5 \times 8 \times 6$ mm	typ. 11 to 16 nH
	all case sizes	max. 20 nH
Dissipation		
Maximum power dissipation	case sizes $9.5 \times 7 \times 3$ to $9.5 \times 7 \times 5$ mm	P_{125} = 88 mW
	case sizes $9.5 \times 8 \times 5$ and $9.5 \times 8 \times 6$ mm	P_{125} = 104 mW
Current		
Maximum leakage current	after 5 minutes at U_R and T_{amb} = 25 °C	$I_{L5} \leq 0.025 C_R \times U_R$ or 2 μA whichever is greater; see Table 2
Typical leakage current	15 s at U_R and T_{amb} = 25 °C:	
	U_R = 6.3 to 16 V	≈0.2 × value stated in Table 2
	U_R = 25 to 40 V	≈0.1 × value stated in Table 2

Voltage



(1) U_C = 125 °C.
(2) U_C = 175 °C.

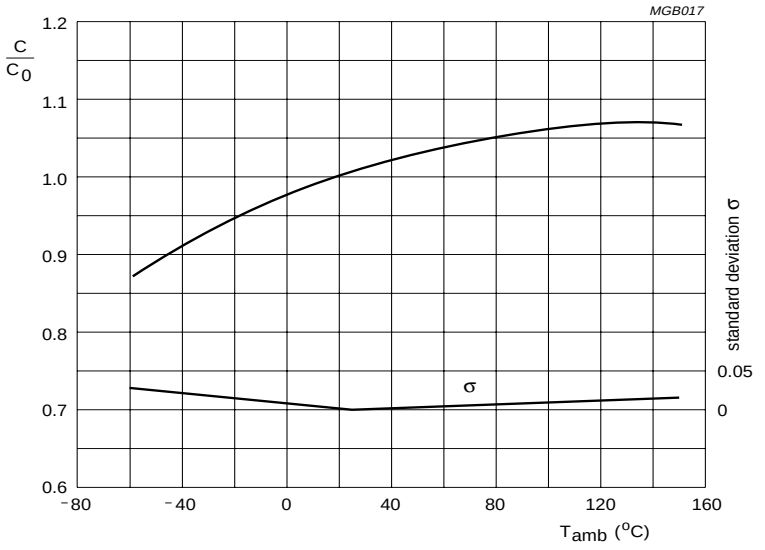
Fig.5 Maximum permissible voltage up to T_{amb} = 175 °C.

Ripple current (I_R)

Applying the maximum RMS ripple current given in Table 2 will cause a device temperature of 138 °C.
The 100 kHz values in Table 2 for other temperatures are to be calculated with the following I_R multipliers:

PARAMETER	T_{amb}					
	25 °C	**40 °C**	**65 °C**	**85 °C**	**105 °C**	**125 °C**
I_R multiplier	1.1	1.0	0.88	0.75	0.59	0.37

Capacitance (C)



C_0 = capacitance at 25 °C and 100 Hz.

Fig.6 Typical multiplier of capacitance and standard deviation as functions of ambient temperature.

Typical capacitance change after endurance test at T_{amb} = 125 °C

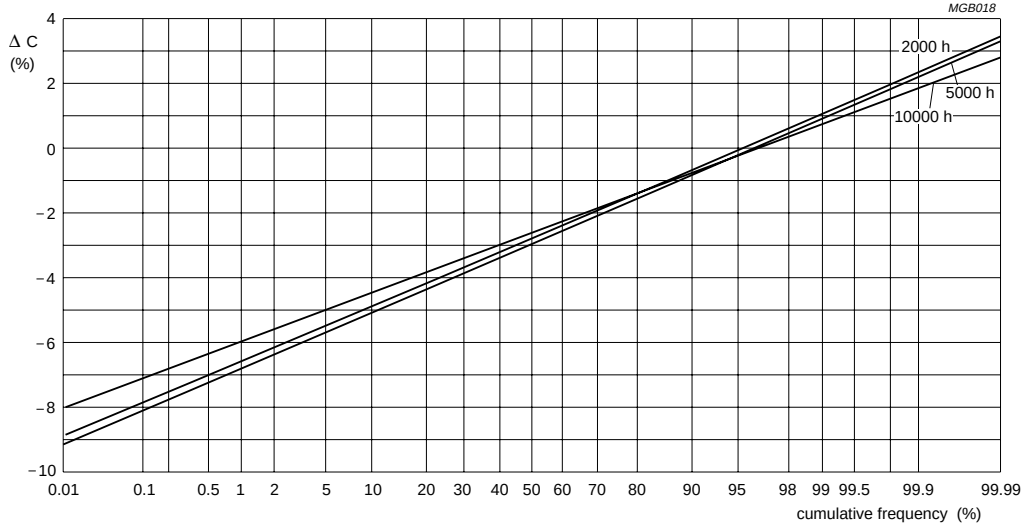


Fig.7 Change of capacitance as a function of cumulative frequency after endurance test.

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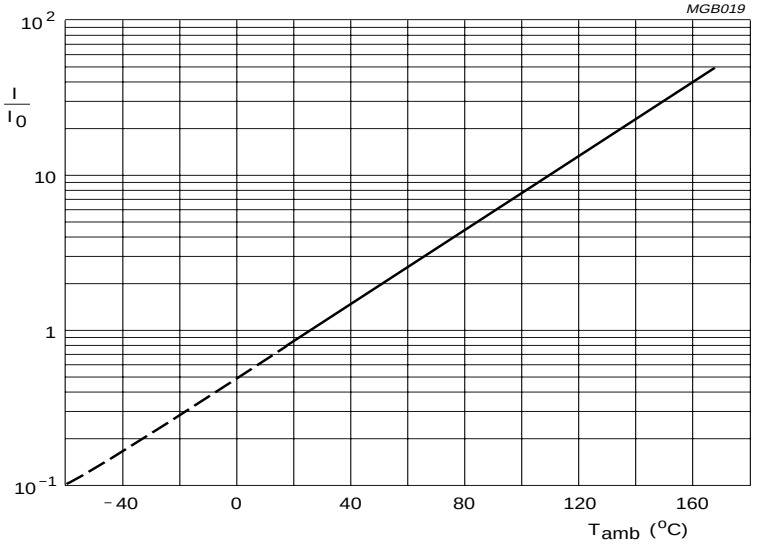
Leakage current



I_0 = leakage current during continuous operation at U_R and T_{amb} = 25 °C.

Fig.8 Typical multiplier of leakage current as a function of ambient temperature.

Typical leakage current change after endurance test at T_{amb} = 125 °C

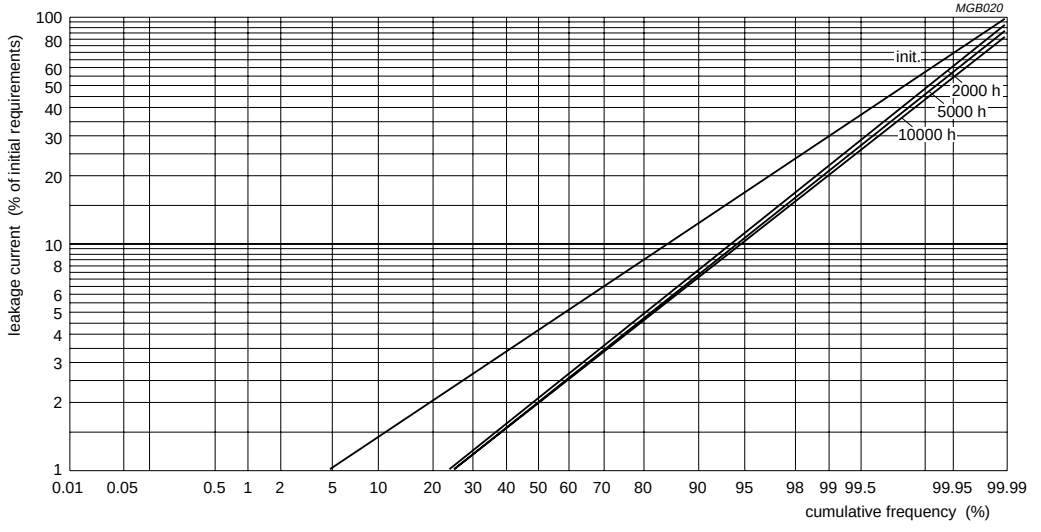
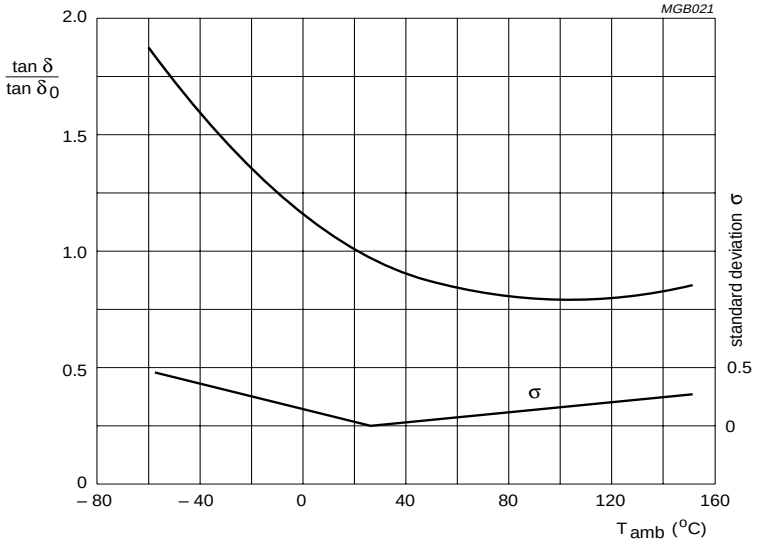


Fig.9 Leakage current change as a function of cumulative frequency after endurance test.

Dissipation factor (tan δ)



Tan δ_0 = dissipation factor at T_{amb} = 25 °C and 100 Hz.

Fig.10 Typical multiplier of dissipation factor and standard deviation as functions of ambient temperature.

Typical tan δ change after endurance test at T_{amb} = 125 °C

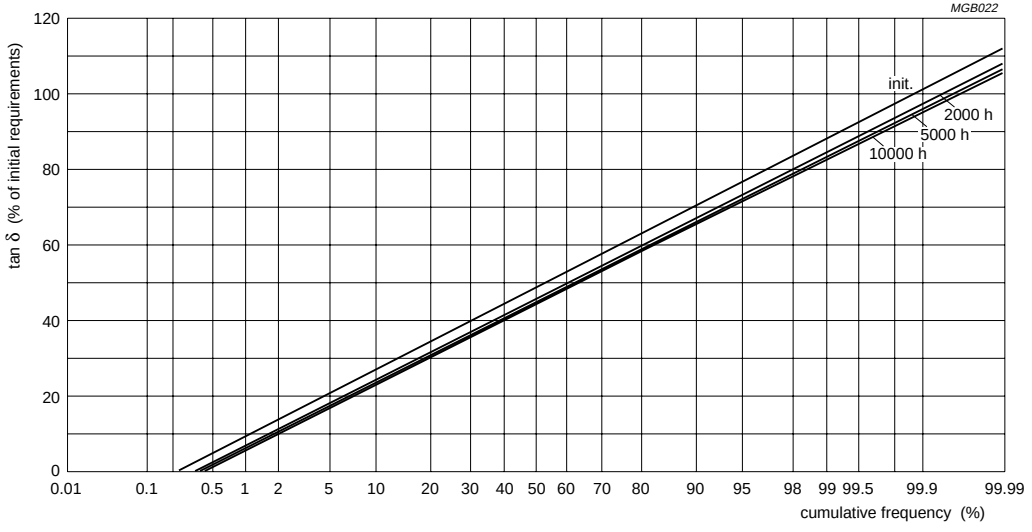
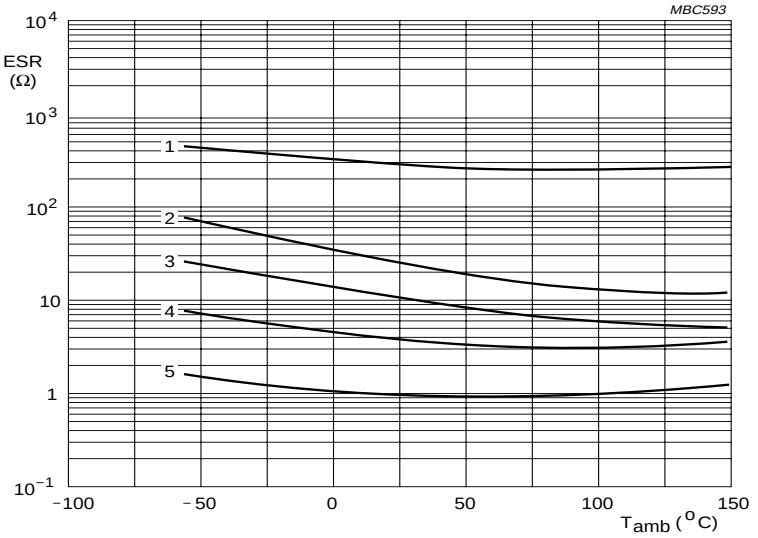


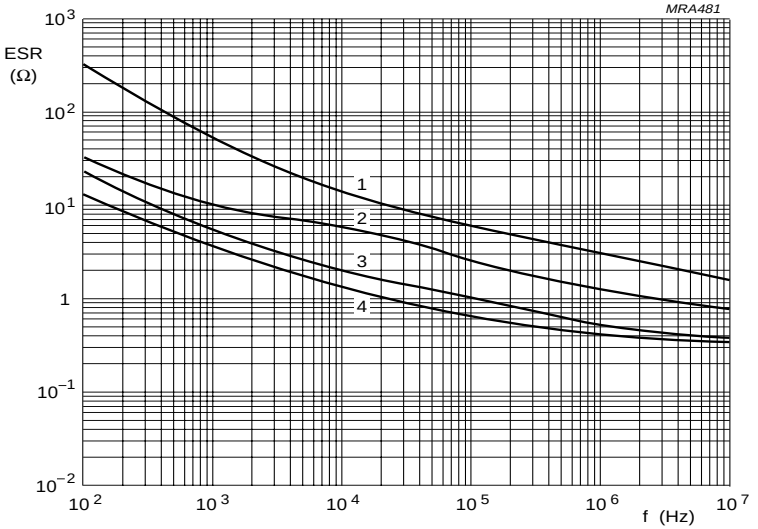
Fig.11 Tan δ change as a function of cumulative frequency after endurance test.

Equivalent series resistance (ESR)



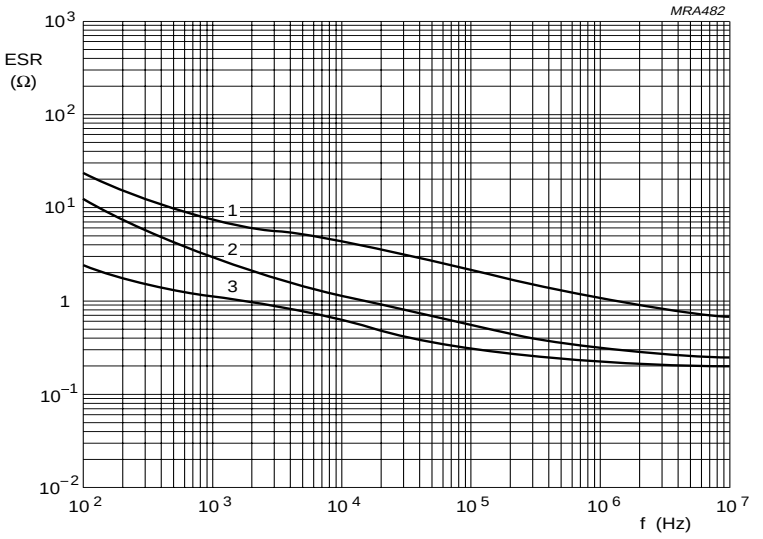
Curve 1: 0.1 µF, 40 V.
Curve 2: 1.5 µF, 40 V.
Curve 3: 3.3 µF, 25 V.
Curve 4: 10 µF, 6.3 V.
Curve 5: 22 µF, 10 V.
ESR at 100 Hz.

Fig.12 Typical ESR as a function of ambient temperature.



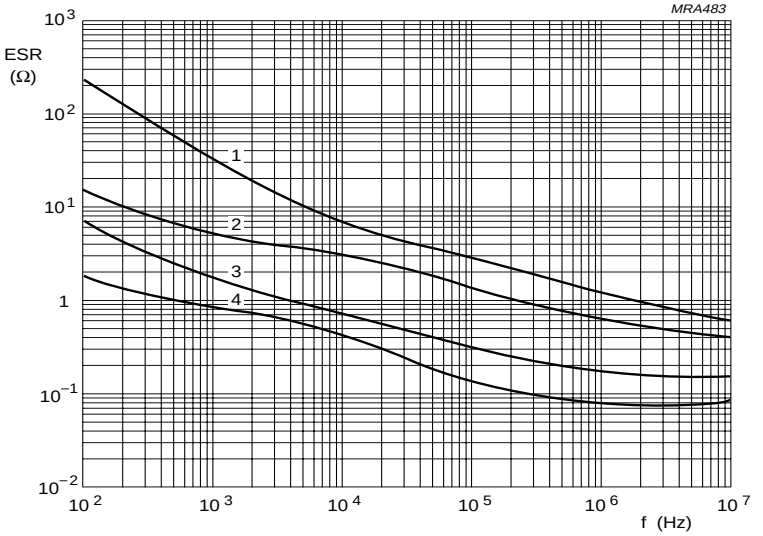
Curve 1: 0.22 µF, 40 V.
Curve 2: 1.5 µF, 25 V.
Curve 3: 2.2 µF, 16 V.
Curve 4: 10 µF, 6.3 V.
Case size H × W × T = 9.5 × 7 × 3.5 mm.
T_{amb} = 25 °C.

Fig.13 Typical ESR as a function of frequency.



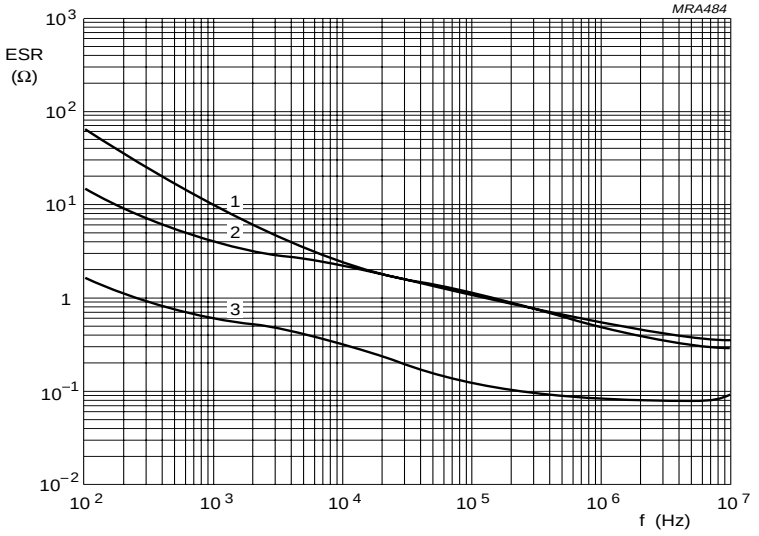
Curve 1: 2.2 µF, 25 V.
Curve 2: 4.7 µF, 16 V.
Curve 3: 22 µF, 6.3 V.
Case size H × W × T = 9.5 × 7 × 4 mm.
T_{amb} = 25 °C.

Fig.14 Typical ESR as a function of frequency.



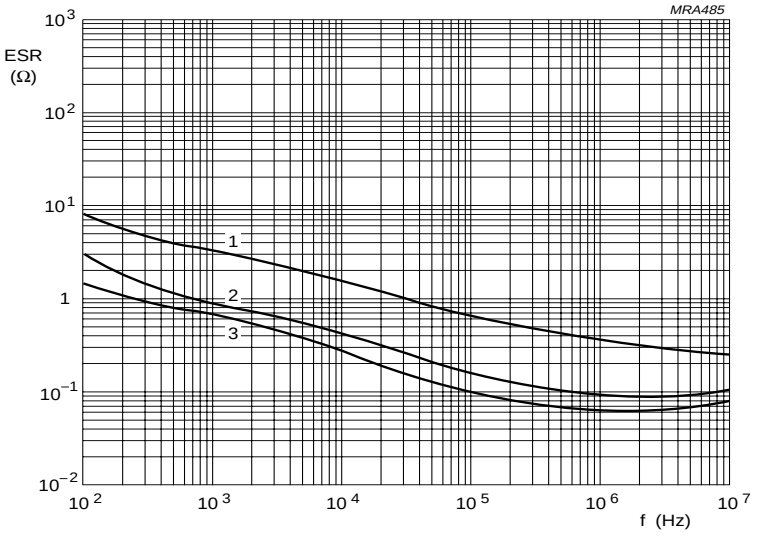
Curve 1: 0.47 µF, 40 V.
Curve 2: 3.3 µF, 25 V.
Curve 3: 10 µF, 16 V.
Curve 4: 33 µF, 6.3 V.
Case size H × W × T = 9.5 × 7 × 5 mm.
T_{amb} = 25 °C.

Fig.15 Typical ESR as a function of frequency.



Curve 1: 1 µF, 40 V.
Curve 2: 4.7 µF, 25 V.
Curve 3: 47 µF, 6.3 V.
Case size H × W × T = 9.5 × 8 × 5 mm.
T_{amb} = 25 °C.

Fig.16 Typical ESR as a function of frequency.



Curve 1: 10 µF, 25 V.
Curve 2: 22 µF, 16 V.
Curve 3: 68 µF, 6.3 V.
Case size H × W × T = 9.5 × 8 × 6 mm.
T_{amb} = 25 °C.

Fig.17 Typical ESR as a function of frequency.

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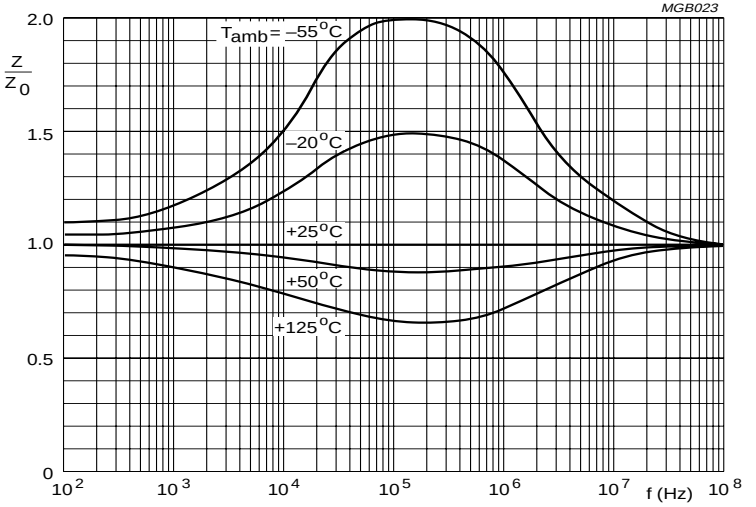
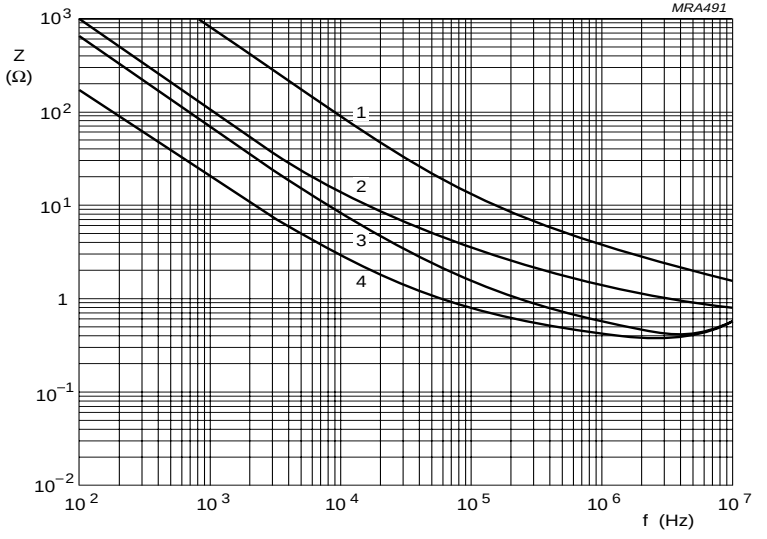
Impedance (Z)



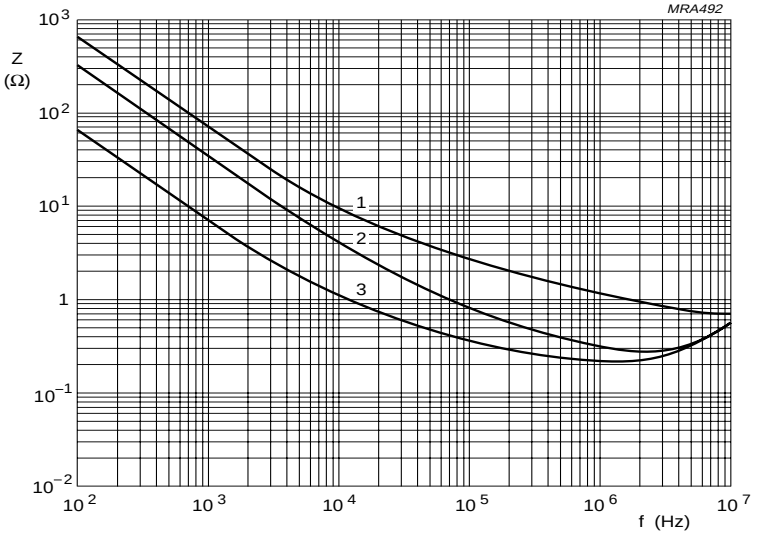
Z_0 = initial impedance value at T_{amb} = 25 °C.

Fig.18 Typical multiplier of impedance as a function of frequency at different ambient temperatures.



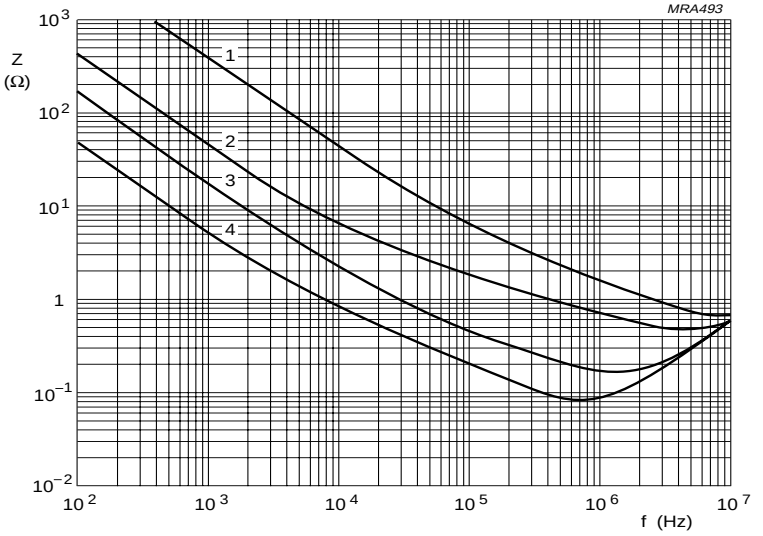
Curve 1: 0.22 µF, 40 V.
Curve 2: 1.5 µF, 25 V.
Curve 3: 2.2 µF, 16 V.
Curve 4: 10 µF, 6.3 V.
Case size H × W × T = 9.5 × 7 × 3.5 mm.
T_{amb} = 25 °C.

Fig.19 Typical impedance as a function of frequency.



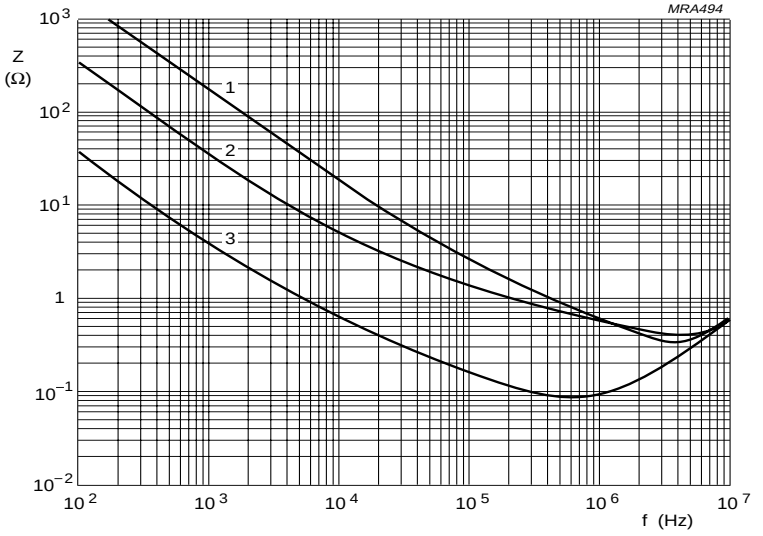
Curve 1: 2.2 µF, 25 V.
Curve 2: 4.7 µF, 16 V.
Curve 3: 22 µF, 6.3 V.
Case size H × W × T = 9.5 × 7 × 4 mm.
T_{amb} = 25 °C.

Fig.20 Typical impedance as a function of frequency.



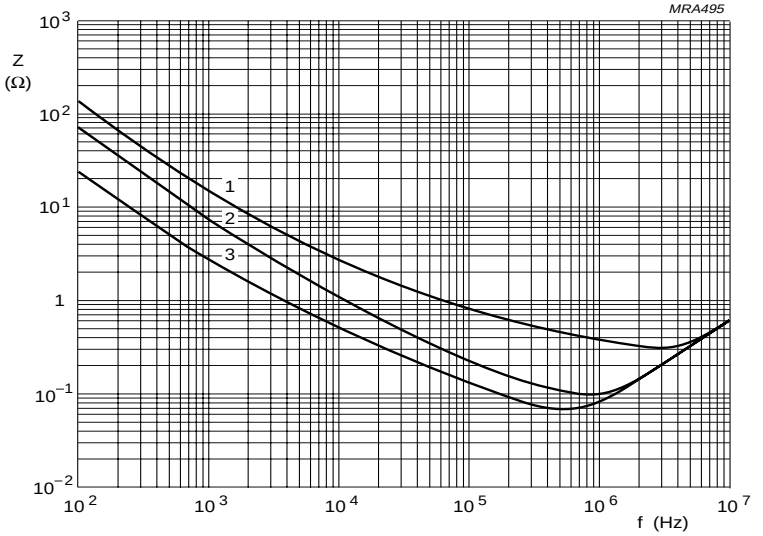
Curve 1: 0.47 µF, 40 V.
Curve 2: 3.3 µF, 25 V.
Curve 3: 10 µF, 16 V.
Curve 4: 33 µF, 6.3 V.
Case size H × W × T = 9.5 × 7 × 5 mm.
T_{amb} = 25 °C.

Fig.21 Typical impedance as a function of frequency.



Curve 1: 1 µF, 40 V.
Curve 2: 4.7 µF, 25 V.
Curve 3: 47 µF, 6.3 V.
Case size H × W × T = 9.5 × 8 × 5 mm.
T_{amb} = 25 °C.

Fig.22 Typical impedance as a function of frequency.



Curve 1: 10 µF, 25 V.
Curve 2: 22 µF, 16 V.
Curve 3: 68 µF, 6.3 V.
Case size H × W × T = 9.5 × 8 × 6 mm.
T_{amb} = 25 °C.

Fig.23 Typical impedance as a function of frequency at T_{amb} = 25 °C.

SPECIFIC TESTS AND REQUIREMENTS

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

Table 3 Test procedures and requirements

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4/ EN130300 subclause 4.13	T_{amb} = 125 °C; U_R = 6.3 to 25 V with U_R applied; U_R = 35 and 40 V with U_C applied; 10000 hours	ΔC/C: ±10% tan δ ≤ 1.2 × spec. limit Z ≤ 1.2 × spec. limit I_{L5} ≤ spec. limit
Useful life	CECC 30302 subclause 1.8.1	T_{amb} = 125 °C; I_R applied and: U_R = 6.3 to 25 V with U_R applied; U_R = 35 and 40 V with U_C applied; 20000 hours	ΔC/C: ±15% tan δ ≤ 1.5 × spec. limit Z ≤ 1.5 × spec. limit I_{L5} ≤ spec. limit no short or open circuit, no visible damage total failure percentage: <1%
Shelf life (storage at high temperature)	IEC 60384-4/ EN130300 subclause 4.17	T_{amb} = 125 °C; no voltage applied; 500 hours	ΔC/C: ±10% tan δ ≤ 1.2 × spec. limit I_{L5} ≤ 1 × spec. limit
Charge and discharge	IEC 60384-4-2 subclause 9.21	10^6 cycles without series resistance: 0.5 s to U_R; 0.5 s to ground	ΔC/C: ±5% no short or open circuit, no visible damage
Solvent resistance	IEC 60068-2-45, test XA IEC 60653	immersion: 5 ±0.5 minutes with or without ultrasonic at 55 ±5 °C solvents: demineralized water and/or calgonite solution (20 g/l)	visual appearance not affected

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TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Extended vibration	IEC 60068-2-6 test Fc	10 to 2000 Hz; 1.5 mm or 20 g; 1 octave/minute; 3 directions; 1 sweep per direction; no voltage applied	no intermittent contacts no breakdown no open circuiting no mechanical damage $\Delta C/C$: ±5% tan $\delta \leq 1.2 \times$ spec. limit $Z \leq 1.2 \times$ spec. limit $I_{L5} \leq 1.5 \times$ spec. limit
Shock	IEC 60068-2-27 test Ea	half-sine or sawtooth pulse shape; 50 g; 11 ms; 3 successive shocks in each direction of 3 mutually perpendicular axes; no voltage applied	no intermittent contacts no breakdown no open circuiting no mechanical damage $\Delta C/C$: ±5% tan $\delta \leq 1.2 \times$ spec. limit $Z \leq 1.2 \times$ spec. limit $I_{L5} \leq 1.5 \times$ spec. limit
Passive flammability	IEC 60695-2-2	capacitor mounted to a vertical printed-circuit board, one flame on capacitor body; T_{amb} = 20 to 25 °C; test duration = 20 s	after removing the test flame from the capacitor, the capacitor must not continue to burn for more than 15 s; no burning particles must drop from the sample