

# DATA SHEET

153 CLV

**Aluminum electrolytic capacitors  
SMD (Chip) Long Life Vertical**

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

2000 Apr 07

# Aluminum electrolytic capacitors

## SMD (Chip) Long Life Vertical

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### FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte, self healing
- SMD-version with base plate, vertical construction requiring minimum board space, reflow solderable
- High CV per unit volume
- Long useful life: 2000 to 3000 hours at 105 °C
- Charge and discharge proof, no peak current limitation
- Supplied in blister tape on reel.

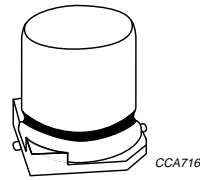
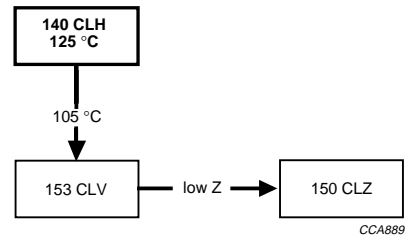


Fig.1 Component outline.

### APPLICATIONS

- SMD technology, for high mounting density
- Coupling, decoupling, smoothing, filtering, buffering, timing
- Telecommunications, general industrial, EDP, automotive, portable and lightweight equipment.



### QUICK REFERENCE DATA

DESCRIPTION	VALUE
Nominal case sizes (L × W × H in mm)	4.0 × 4.0 × 5.3 to 10 × 10 × 14
Rated capacitance range, C <sub>R</sub>	0.47 to 1000 μF
Tolerance on C <sub>R</sub>	±20%
Rated voltage range, U <sub>R</sub>	6.3 to 100 V
Category temperature range	-55 to +105 °C
Endurance test at 105 °C:	
case sizes 4.0 × 4.0 × 5.3 to 6.3 × 6.3 × 5.3	1000 hours
case sizes 8.0 × 8.0 × 6.5 to 10 × 10 × 14	2000 hours
Useful life at 105 °C:	
case sizes 4.0 × 4.0 × 5.3 to 6.3 × 6.3 × 5.3	2000 hours
case sizes 8.0 × 8.0 × 6.5 to 10 × 10 × 14	3000 hours
Useful life at 40 °C; 1.3 × I <sub>R</sub> applied:	
case sizes 4.0 × 4.0 × 5.3 to 6.3 × 6.3 × 5.3	200000 hours
case sizes 8.0 × 8.0 × 6.5 to 10 × 10 × 14	300000 hours
Shelf life at 0 V, 105 °C	1000 hours
Based on sectional specification	IEC 60384-18/CECC 32300
Climatic category IEC 60068	55/105/56

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

Preferred types in **bold**.

$C_R$ ( $\mu\text{F}$ )	$U_R$ (V)							
	6.3	10	16	25	35	50	63	100
0.47	–	–	–	–	–	4.0 × 4.0 × 5.3	–	–
1.0	–	–	–	–	–	<b>4.0 ×</b> <b>4.0 × 5.3</b>	–	–
2.2	–	–	–	–	–	4.0 × 4.0 × 5.3	–	–
3.3	–	–	–	–	–	4.0 × 4.0 × 5.3	–	–
4.7	–	–	–	–	<b>4.0 ×</b> <b>4.0 × 5.3</b>	<b>5.0 ×</b> <b>5.0 × 5.3</b>	–	–
10	–	–	<b>4.0 ×</b> <b>4.0 × 5.3</b>	–	5.0 × 5.0 × 5.3	<b>6.3 ×</b> <b>6.3 × 5.3</b>	–	10 × 10 × 12
22	4.0 × 4.0 × 5.3	–	5.0 × 5.0 × 5.3	–	<b>6.3 ×</b> <b>6.3 × 5.3</b>	8.0 × 8.0 × 6.5	–	10 × 10 × 12
33	–	5.0 × 5.0 × 5.3	–	6.3 × 6.3 × 5.3	8.0 × 8.0 × 6.5	8.0 × 8.0 × 10	–	10 × 10 × 14
47	5.0 × 5.0 × 5.3	–	<b>6.3 ×</b> <b>6.3 × 5.3</b>	8.0 × 8.0 × 6.5	–	<b>8.0 ×</b> <b>8.0 × 10</b>	10 × 10 × 12	–
100	<b>6.3 ×</b> <b>6.3 × 5.3</b>	–	8.0 × 8.0 × 6.5	<b>8.0 ×</b> <b>8.0 × 10</b>	–	<b>10 ×</b> <b>10 × 10</b>	<b>10 ×</b> <b>10 × 14</b>	–
	–	–	–	–	–	10 × 10 × 12	–	–
220	–	<b>8.0 ×</b> <b>8.0 × 10</b>	10 × 10 × 10	10 × 10 × 12	<b>10 ×</b> <b>10 × 12</b>	–	–	–
330	8.0 × 8.0 × 10	10 × 10 × 10	10 × 10 × 12	10 × 10 × 14	–	–	–	–
470	10 × 10 × 10	10 × 10 × 12	<b>10 ×</b> <b>10 × 14</b>	–	–	–	–	–
680	10 × 10 × 12	10 × 10 × 14	–	–	–	–	–	–
1000	10 × 10 × 14	–	–	–	–	–	–	–

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### PACKAGING

Supplied in blister tape on reel. For general packaging information refer to this data handbook, section "Packaging".

**Table 1** Tape and reel dimensions

CASE CODE	PITCH P <sub>1</sub> (mm)	TAPE WIDTH W (mm)	TAPE THICKNESS T <sub>2</sub> (mm)	REEL DIA. (mm)	PACKAGING QUANTITY PER REEL
0405	8	12	5.8	380	2000
0505	12	12	5.8	380	1000
0605	12	16	5.8	380	1000
0807	12	16	6.8	380	1000
0810	16	24	11	380	500
1010	16	24	11	380 <sup>(1)</sup>	500
				330 <sup>(1)</sup>	250
1012	16	24	13	330	250
1014	16	24	15	330	250

### Note

1. Depending on production location.

### MARKING

- Rated capacitance (in  $\mu\text{F}$ )
- Rated voltage (in V)
- Black mark or '-' sign indicating the cathode (the anode is identified by bevelled edges)
- Code indicating group number (V)
- Date code, in accordance with "IEC 60062".

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## MECHANICAL DATA

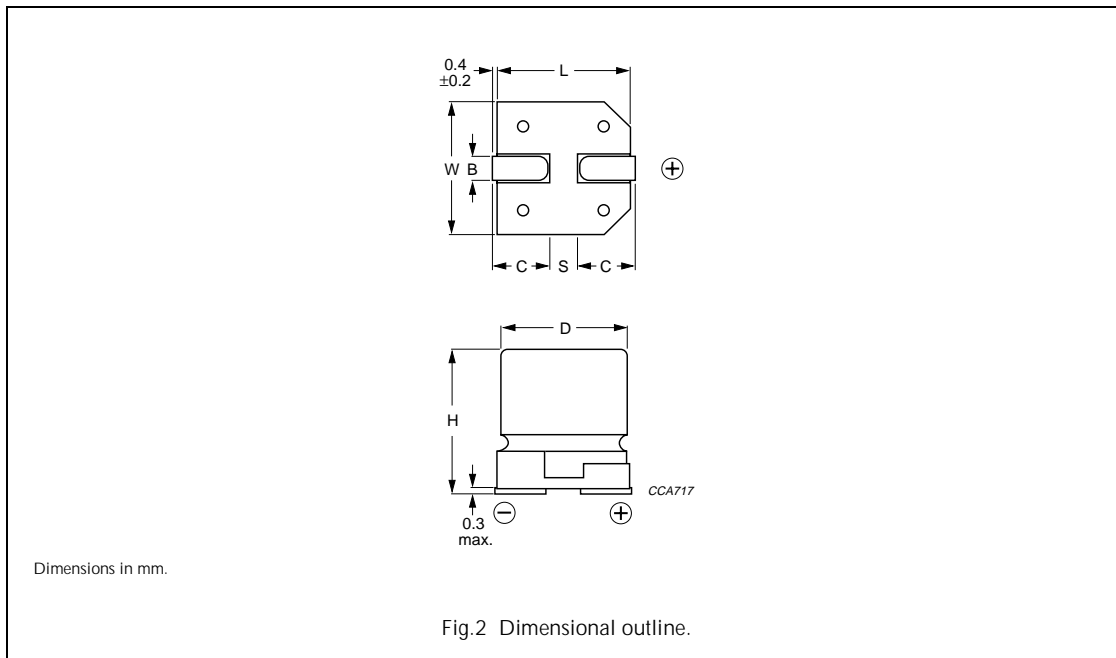


Table 2 Physical dimensions, mass and packaging quantities; see Fig.2

NOMINAL CASE SIZE L × W × H (mm)	CASE CODE	L <sub>max</sub> (mm)	W <sub>max</sub> (mm)	H <sub>max</sub> (mm)	ØD (mm)	B <sub>max</sub> (mm)	S (mm)	C (mm)	MASS (g)
4.0 × 4.0 × 5.3	0405	4.5	4.5	5.5	4.0	0.8	1.0	2.0 ± 0.2	≈ 0.13
5.0 × 5.0 × 5.3	0505	5.5	5.5	5.5	5.0	0.8	1.4	2.3 ± 0.2	≈ 0.20
6.3 × 6.3 × 5.3	0605	6.8	6.8	5.5	6.3	0.8	2.0	2.7 ± 0.2	≈ 0.30
8.0 × 8.0 × 6.5	0807	8.6	8.6	6.8	8.0	0.8	2.3	3.4 ± 0.2	≈ 0.50
8.0 × 8.0 × 10	0810	8.6	8.6	10.5	8.0	1.1	3.1	3.0 ± 0.2	≈ 1.00
10 × 10 × 10	1010	10.6	10.6	10.5	10.0	1.1	4.7	3.3 ± 0.2	≈ 1.30
10 × 10 × 12	1012	10.6	10.6	12.3	10.0	1.2	4.5	3.9 ± 0.2	≈ 1.40
10 × 10 × 14	1014	10.6	10.6	14.3	10.0	1.2	4.5	3.9 ± 0.2	≈ 1.50

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## MOUNTING

The capacitors are designed for automatic placement on to printed-circuit boards.

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

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

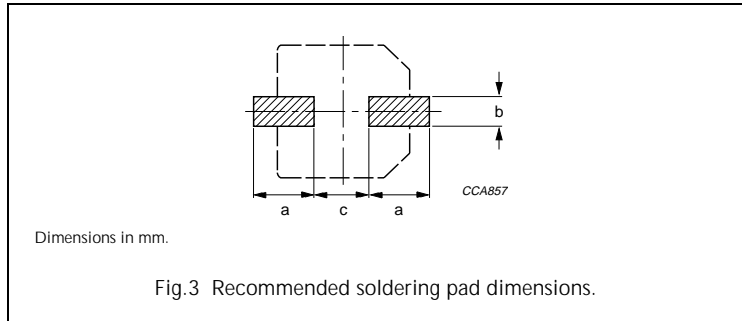
## Soldering

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

For maximum conditions refer to Fig.4.

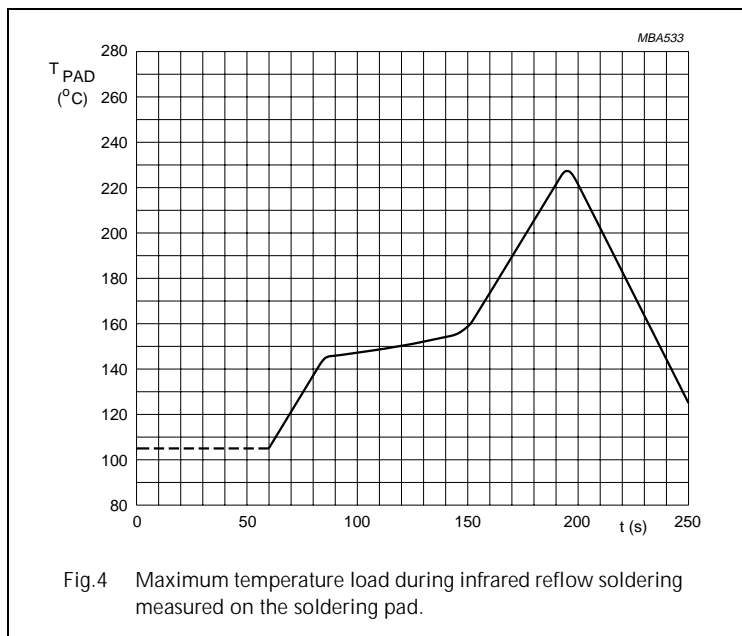
Any temperature versus time curve which does not exceed the specified maximum curves may be applied.

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



**Table 3** Recommended soldering pad dimensions

CASE CODE	a (mm)	b (mm)	c (mm)
0405	2.6	1.6	1.0
0505	3.0	1.6	1.4
0605	3.5	1.6	1.9
0807	4.0	1.6	2.1
0810	3.5	2.5	3.0
1010	4.0	2.5	4.0
1012	4.3	2.5	4.0
1014	4.3	2.5	4.0



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#### ELECTRICAL DATA AND ORDERING INFORMATION

Unless otherwise specified, all electrical values in Table 4 apply at  $T_{amb} = 20\text{ °C}$ ,  
 $P = 86$  to  $106\text{ kPa}$ ,  $RH = 45$  to  $75\%$ .

SYMBOL	DESCRIPTION
$C_R$	rated capacitance at 100 or 120 Hz, tolerance $\pm 20\%$
$I_R$	rated RMS ripple current at 100 or 120 Hz, $105\text{ °C}$
$I_{L2}$	max. leakage current after 2 minutes at $U_R$
$\tan \delta$	max. dissipation factor at 100 or 120 Hz
ESR	equivalent series resistance at 100 kHz

#### Ordering example

Electrolytic capacitor 153 series

100  $\mu\text{F}/25\text{ V}$ ;  $\pm 20\%$

Nominal case size:

8 × 8 × 10 mm; taped on reel

Catalogue number: 2222 153 66101.

**Table 4** Electrical data and ordering information; preferred types in **bold**

$U_R$ (V)	$C_R$ ( $\mu\text{F}$ )	NOMINAL CASE SIZE L × W × H (mm)	CASE CODE	$I_R$ 105 °C (mA)	$I_{L2}$ 2 min ( $\mu\text{A}$ )	$\tan \delta$	ESR 100 kHz ( $\Omega$ )	CATALOGUE NUMBER 2222 ... ..
6.3	22	4.0 × 4.0 × 5.3	0405	21	3.0	0.30	8	153 63229
	47	5.0 × 5.0 × 5.3	0505	36	3.0	0.30	4	153 63479
	<b>100</b>	<b>6.3 × 6.3 × 5.3</b>	<b>0605</b>	61	6.3	0.30	2	<b>153 63101</b>
	330	8.0 × 8.0 × 10	0810	180	21	0.30	0.5	153 63331
	470	10 × 10 × 10	1010	320	30	0.30	0.3	153 63471
	680	10 × 10 × 12	1012	340	43	0.24	0.29	153 63681
1000	10 × 10 × 14	1014	400	63	0.24	0.24	153 63102	
10	33	5.0 × 5.0 × 5.3	0505	31	3.3	0.26	4	153 64339
	<b>220</b>	<b>8.0 × 8.0 × 10</b>	<b>0810</b>	180	22	0.26	0.5	<b>153 64221</b>
	330	10 × 10 × 10	1010	320	33	0.26	0.3	153 64331
	470	10 × 10 × 12	1012	330	47	0.19	0.29	153 64471
	680	10 × 10 × 14	1014	380	68	0.19	0.24	153 64681
16	<b>10</b>	<b>4.0 × 4.0 × 5.3</b>	<b>0405</b>	16	3.0	0.22	8	<b>153 65109</b>
	22	5.0 × 5.0 × 5.3	0505	28	3.5	0.22	4	153 65229
	<b>47</b>	<b>6.3 × 6.3 × 5.3</b>	<b>0605</b>	47	7.5	0.22	2.2	<b>153 65479</b>
	100	8.0 × 8.0 × 6.5	0807	110	16	0.22	1.2	153 65101
	220	10 × 10 × 10	1010	320	35	0.22	0.3	153 65221
	330	10 × 10 × 12	1012	330	53	0.16	0.29	153 65331
	<b>470</b>	<b>10 × 10 × 14</b>	<b>1014</b>	370	75	0.16	0.25	<b>153 65471</b>
	330	10 × 10 × 14	1014	300	83	0.14	0.27	153 66331
25	33	6.3 × 6.3 × 5.3	0605	44	8.3	0.16	2.2	153 66339
	47	8.0 × 8.0 × 6.5	0807	110	12	0.16	1.2	153 66479
	<b>100</b>	<b>8.0 × 8.0 × 10</b>	<b>0810</b>	180	25	0.16	0.5	<b>153 66101</b>
	220	10 × 10 × 12	1012	270	55	0.14	0.29	153 66221
	330	10 × 10 × 14	1014	300	83	0.14	0.27	153 66331

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$U_R$ (V)	$C_R$ ( $\mu$ F)	NOMINAL CASE SIZE L × W × H (mm)	CASE CODE	$I_R$ 105 °C (mA)	$I_{L2}$ 2 min ( $\mu$ A)	Tan $\delta$	ESR 100 kHz ( $\Omega$ )	CATALOGUE NUMBER 2222 ... ..
35	4.7	4.0 × 4.0 × 5.3	0405	14	3.0	0.13	8	153 60478
	10	5.0 × 5.0 × 5.3	0505	23	3.5	0.13	4	153 60109
	22	6.3 × 6.3 × 5.3	0605	50	7.7	0.13	2.2	153 60229
	33	8.0 × 8.0 × 6.5	0807	110	12	0.13	1.2	153 60339
	220	10 × 10 × 12	1012	270	77	0.12	0.29	153 60221
50	0.47	4.0 × 4.0 × 5.3	0405	5	3.0	0.12	12	153 61477
	1.0	4.0 × 4.0 × 5.3	0405	7	3.0	0.12	12	153 61108
	2.2	4.0 × 4.0 × 5.3	0405	10	3.0	0.12	12	153 61228
	3.3	4.0 × 4.0 × 5.3	0405	12	3.0	0.12	12	153 61338
	4.7	5.0 × 5.0 × 5.3	0505	17	3.0	0.12	6	153 61478
	10	6.3 × 6.3 × 5.3	0605	26	5.0	0.12	3	153 61109
	22	8.0 × 8.0 × 6.5	0807	110	11.0	0.12	1.2	153 61229
	33	8.0 × 8.0 × 10	0810	180	17	0.12	0.5	153 61339
	47	8.0 × 8.0 × 10	0810	180	24	0.12	0.5	153 61479
	100	10 × 10 × 10	1010	320	50	0.12	0.3	153 61101
63	47	10 × 10 × 12	1012	220	30	0.09	0.29	153 68479
	100	10 × 10 × 14	1014	240	63	0.09	0.41	153 68101
100	10	10 × 10 × 12	1012	150	10	0.07	0.9	153 69109
	22	10 × 10 × 12	1012	150	25	0.07	0.9	153 69229
	33	10 × 10 × 14	1014	170	33	0.07	0.65	153 69339

### Additional electrical data

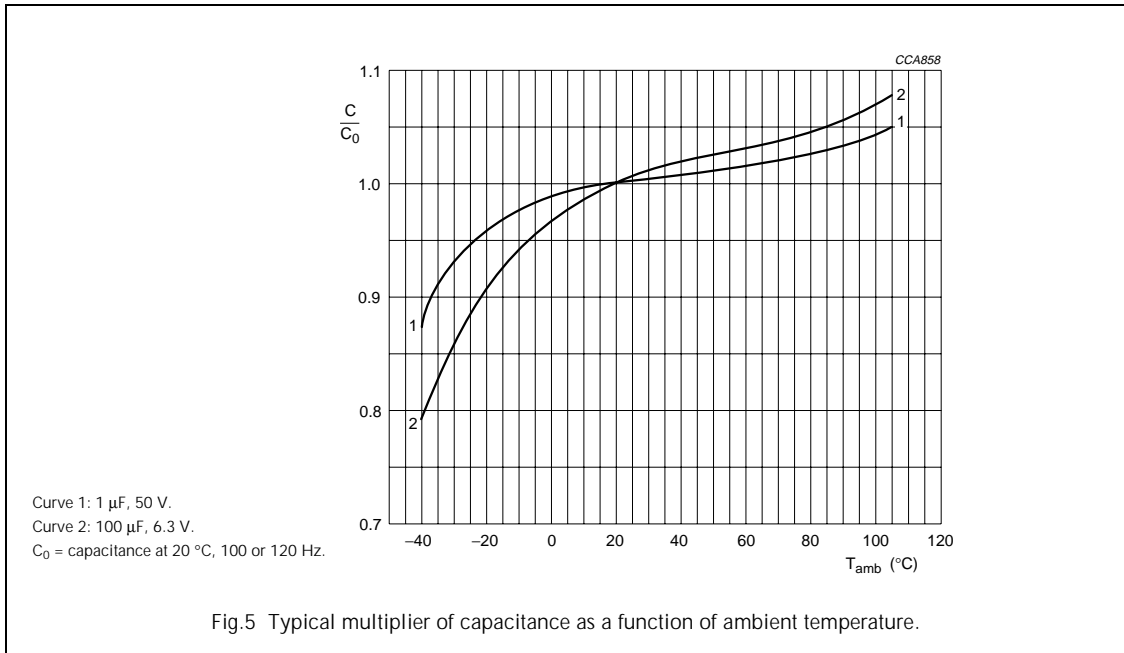
PARAMETER	CONDITIONS	VALUE
<b>Voltage</b>		
Surge voltage	IEC 60384-18, subclause 4.14	$U_s \leq 1.15 \times U_R$
Reverse voltage	IEC 60384-18, subclause 4.16	$U_{rev} \leq 1$ V
<b>Current</b>		
Leakage current	after 2 minutes at $U_R$	$I_{L2} \leq 0.01 \times C_R \times U_R$ or 3 $\mu$ A, whichever is greater
<b>Inductance</b>		
Equivalent series inductance (ESL)	case codes 0405 to 0605	typ. 10 nH
	case codes 0807 to 1010	typ. 15 nH
	case codes 1012 and 1014	typ. 16 nH



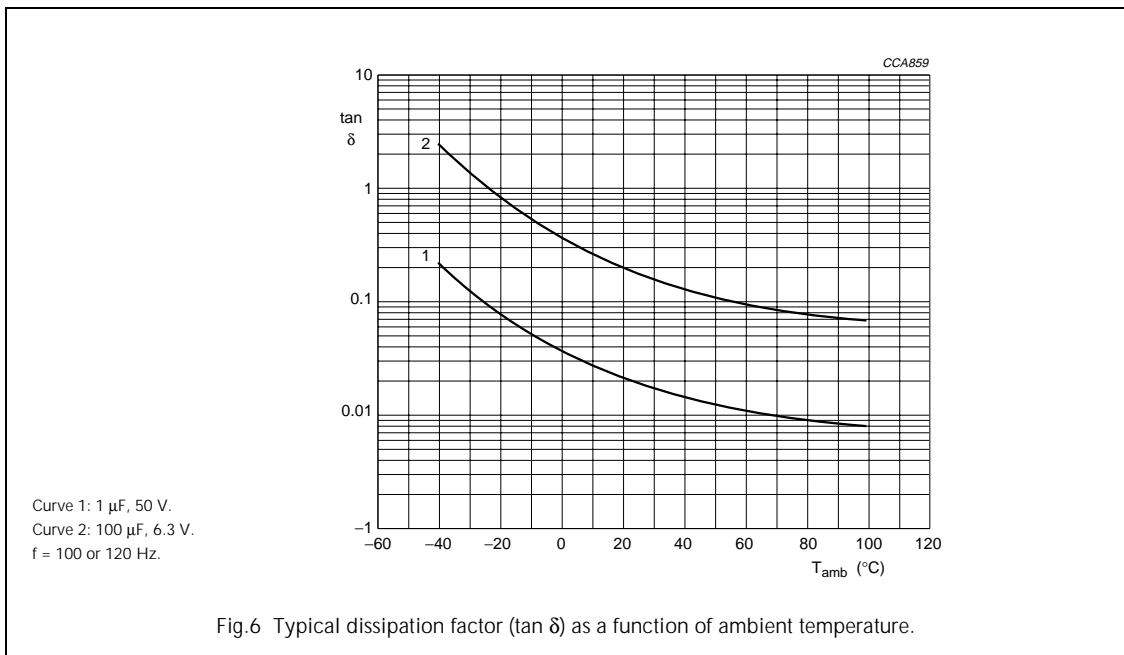
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## Capacitance (C)



## Dissipation factor ( $\tan \delta$ )



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## Equivalent series resistance (ESR)

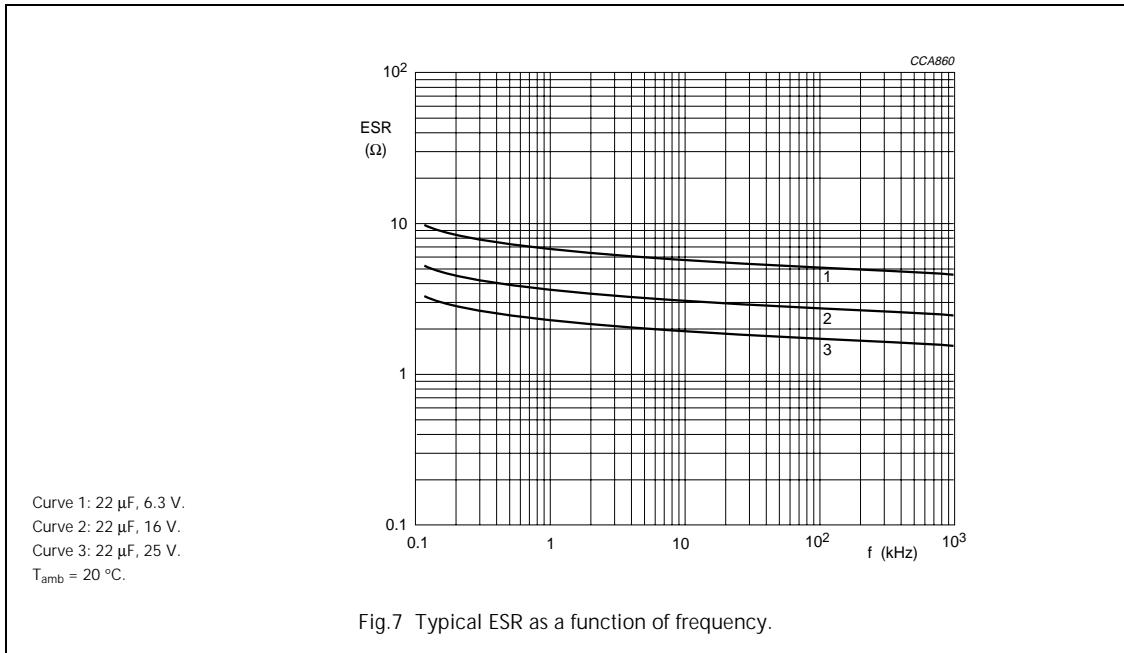


Fig.7 Typical ESR as a function of frequency.

## Impedance (Z)

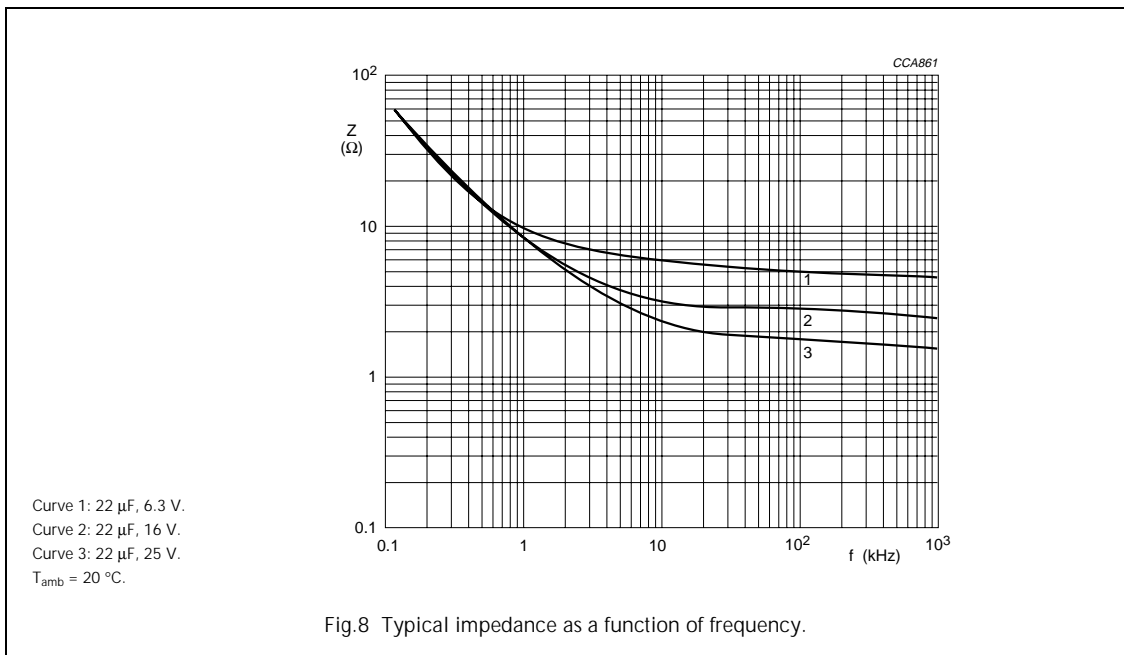


Fig.8 Typical impedance as a function of frequency.

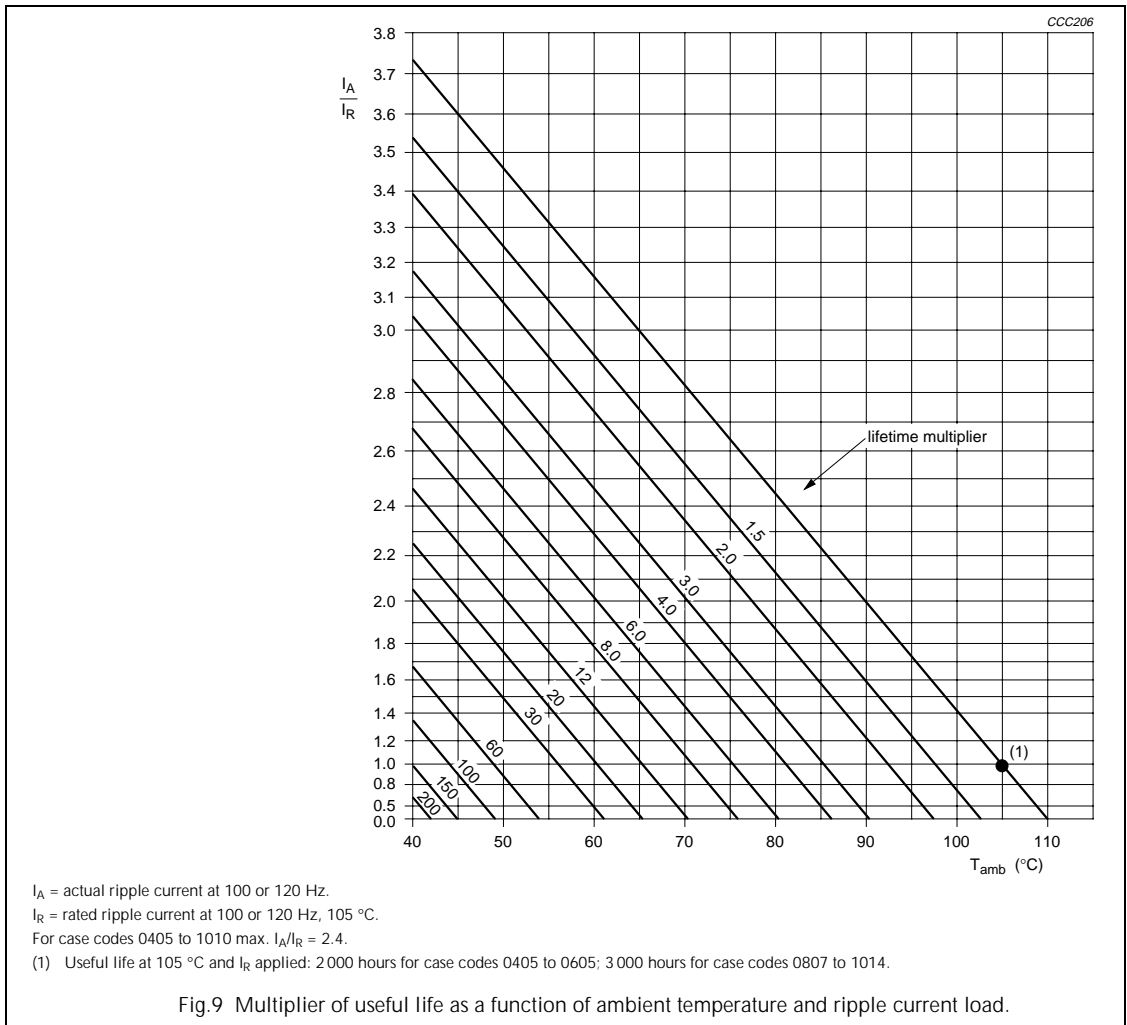
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## RIPPLE CURRENT AND USEFUL LIFE

**Table 5** Multiplier of ripple current ( $I_R$ ) as a function of frequency

FREQUENCY (Hz)	$I_R$ MULTIPLIER		
	$U_R = 6.3$ to $16$ V	$U_R = 25$ or $35$ V	$U_R = 50$ to $100$ V
50 or 60	0.80	0.80	0.80
100 or 120	1.00	1.00	1.00
300	1.10	1.15	1.20
1000	1.15	1.25	1.35
3000	1.20	1.35	1.45
$\geq 10000$	1.25	1.40	1.50



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### SPECIFIC TESTS AND REQUIREMENTS

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

**Table 6** Test procedures and requirements

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Mounting	IEC 60384-18, subclause 4.3	shall be performed prior to tests mentioned below; reflow soldering; for maximum temperature load refer to chapter "Mounting"	$\Delta C/C: \pm 10\%$ $\tan \delta \leq \text{spec. limit}$ $I_{L2} \leq \text{spec. limit}$
Endurance	IEC 60384-18/ CECC 32300, subclause 4.15	$T_{\text{amb}} = 105\text{ }^{\circ}\text{C}$ ; $U_R$ applied; 1 000 hours, case codes 0405 to 0605 2 000 hours, case codes 0807 to 1014	$\Delta C/C: \pm 20\%$ $\tan \delta \leq 2 \times \text{spec. limit}$ $I_{L2} \leq \text{spec. limit}$
Useful life	CECC 30301, subclause 1.8.1	$T_{\text{amb}} = 105\text{ }^{\circ}\text{C}$ ; $U_R$ and $I_R$ applied; 2 000 hours, case codes 0405 to 0605 3 000 hours, case codes 0807 to 1014	$\Delta C/C: \pm 50\%$ $\tan \delta \leq 3 \times \text{spec. limit}$ $I_{L2} \leq \text{spec. limit}$ no short or open circuit total failure percentage: $\leq 1\%$
Shelf life (storage at high temperature)	IEC 60384-18/ CECC 32300, subclause 4.17	$T_{\text{amb}} = 105\text{ }^{\circ}\text{C}$ ; no voltage applied; 1 000 hours  after test: $U_R$ to be applied for 30 minutes, 24 to 48 hours before measurement	for requirements see 'Endurance test' above