

## Aluminum Capacitors SMD (Chip) Long Life Vertical

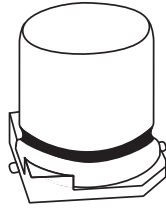
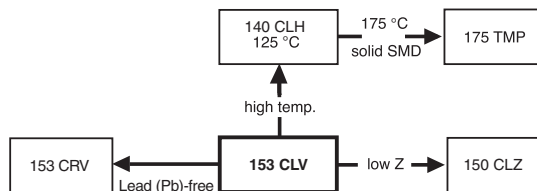


Fig.1 Component outline.


**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.
- Lead (Pb)-free terminations available.
- ATTENTION: for maximum safe soldering conditions refer to fig.4

**APPLICATIONS**

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

**MARKING**

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

**PACKAGING**

Supplied in blister tape on reel.

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, $C_R$	0.47 to 1000 $\mu\text{F}$
Tolerance on $C_R$	±20%
Rated voltage range, $U_R$	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 × $I_R$ 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

SELECTION CHART FOR $C_R$ , $U_R$ AND RELEVANT NOMINAL CASE SIZES (L × W × H in mm)								
$C_R$ ( $\mu$ F)	$U_R$ (V)							
	6.3	10	16	25	35	50	63	100
0.47	–	–	–	–	–	4.0 × 4.0 × 5.3	–	–
1.0	–	–	–	–	–	4.0 × 4.0 × 5.3	–	–
2.2	–	–	–	–	–	4.0 × 4.0 × 5.3	–	–
3.3	–	–	–	–	–	4.0 × 4.0 × 5.3	–	–
4.7	–	–	–	–	4.0 × 4.0 × 5.3	5.0 × 5.0 × 5.3	–	–
10	–	–	4.0 × 4.0 × 5.3	–	5.0 × 5.0 × 5.3	6.3 × 6.3 × 5.3	–	10 × 10 × 12
22	4.0 × 4.0 × 5.3	–	5.0 × 5.0 × 5.3	–	6.3 × 6.3 × 5.3	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	–	6.3 × 6.3 × 5.3	8.0 × 8.0 × 6.5	–	8.0 × 8.0 × 10	10 × 10 × 12	–
100	6.3 × 6.3 × 5.3	–	8.0 × 8.0 × 6.5	8.0 × 8.0 × 10	–	10 × 10 × 10	10 × 10 × 14	–
	–	–	–	–	–	10 × 10 × 12	–	–
220	–	8.0 × 8.0 × 10	10 × 10 × 10	10 × 10 × 12	10 × 10 × 12	–	–	–
330	8.0 × 8.0 × 10	10 × 10 × 10	10 × 10 × 12	10 × 10 × 14	–	–	–	–
470	10 × 10 × 10	10 × 10 × 12	10 × 10 × 14	–	–	–	–	–
680	10 × 10 × 12	10 × 10 × 14	–	–	–	–	–	–
1000	10 × 10 × 14	–	–	–	–	–	–	–

Table 1

TAPE AND REEL DIMENSIONS in millimeters AND PACKAGING QUANTITIES					
CASE CODE	PITCH $P_1$	TAPE WIDTH $W$	TAPE THICKNESS $T_2$	REEL DIA.	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	11.3	380	500
1010	16	24	11.3	380	500
1012	16	24	12.8	330	250
1014	16	24	14.8	330	250

**Note**

- Detailed tape dimensions see section 'PACKAGING'.

Table 2

DIMENSIONS in millimeters AND MASS										
NOMINAL CASE SIZE L × W × H	CASE CODE	L <sub>max</sub>	W <sub>max</sub>	H <sub>max</sub>	∅D	B <sub>max</sub>	S	C	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	

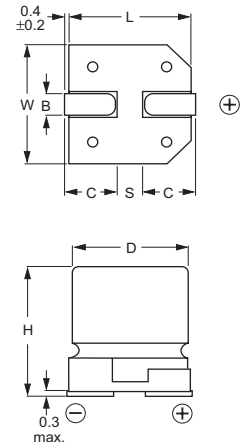


Fig. 2 Dimensional outline.

### 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 layout and/or adjacent components.

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

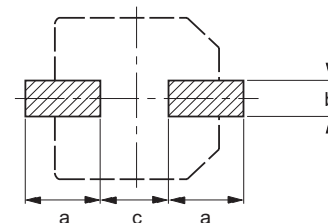


Fig. 3 Recommended soldering pad dimensions.

### 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. HOWEVER, THE SPECIFIED MAXIMUM CURVES SHOULD NEVER BE EXCEEDED.

Table 3

RECOMMENDED SOLDERING PAD DIMENSIONS in millimeters			
CASE CODE	a	b	c
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

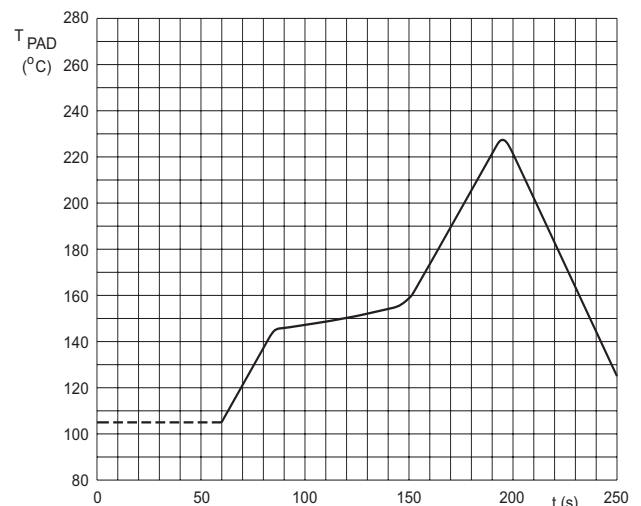


Fig. 4 Maximum temperature load during infrared reflow soldering measured on the soldering pad.

ELECTRICAL DATA	
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 °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

**Note**

1. 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  $75\%$ .

Table 4

ELECTRICAL DATA AND ORDERING INFORMATION							
$U_R$ (V)	$C_R$ ( $\mu\text{F}$ )	NOMINAL CASE SIZE L x W x H (mm)	$I_R$ 105 °C (mA)	$I_{L2}$ 2 min ( $\mu\text{A}$ )	$\tan \delta$	ESR 100 kHz ( $\Omega$ )	CATALOG NUMBER 2222 153 .....
6.3	22	4.0 x 4.0 x 5.3	21	3.0	0.30	8	63229
	47	5.0 x 5.0 x 5.3	36	3.0	0.30	4	63479
	100	6.3 x 6.3 x 5.3	61	6.3	0.30	2	63101
	330	8.0 x 8.0 x 10	180	21	0.30	0.5	63331
	470	10 x 10 x 10	320	30	0.30	0.3	63471
	680	10 x 10 x 12	340	43	0.24	0.29	63681
	1000	10 x 10 x 14	400	63	0.24	0.24	63102
10	33	5.0 x 5.0 x 5.3	31	3.3	0.26	4	64339
	220	8.0 x 8.0 x 10	180	22	0.26	0.5	64221
	330	10 x 10 x 10	320	33	0.26	0.3	64331
	470	10 x 10 x 12	330	47	0.19	0.29	64471
	680	10 x 10 x 14	380	68	0.19	0.24	64681
16	10	4.0 x 4.0 x 5.3	16	3.0	0.22	8	65109
	22	5.0 x 5.0 x 5.3	28	3.5	0.22	4	65229
	47	6.3 x 6.3 x 5.3	47	7.5	0.22	2.2	65479
	100	8.0 x 8.0 x 6.5	110	16	0.22	1.2	65101
	220	10 x 10 x 10	320	35	0.22	0.3	65221
	330	10 x 10 x 12	330	53	0.16	0.29	65331
	470	10 x 10 x 14	370	75	0.16	0.25	65471
25	33	6.3 x 6.3 x 5.3	44	8.3	0.16	2.2	66339
	47	8.0 x 8.0 x 6.5	110	12	0.16	1.2	66479
	100	8.0 x 8.0 x 10	180	25	0.16	0.5	66101
	220	10 x 10 x 12	270	55	0.14	0.29	66221
	330	10 x 10 x 14	300	83	0.14	0.27	66331
35	4.7	4.0 x 4.0 x 5.3	14	3.0	0.13	8	60478
	10	5.0 x 5.0 x 5.3	23	3.5	0.13	4	60109
	22	6.3 x 6.3 x 5.3	50	7.7	0.13	2.2	60229
	33	8.0 x 8.0 x 6.5	110	12	0.13	1.2	60339
	220	10 x 10 x 12	270	77	0.12	0.29	60221
50	0.47	4.0 x 4.0 x 5.3	5	3.0	0.12	12	61477
	1.0	4.0 x 4.0 x 5.3	7	3.0	0.12	12	61108
	2.2	4.0 x 4.0 x 5.3	10	3.0	0.12	12	61228
	3.3	4.0 x 4.0 x 5.3	12	3.0	0.12	12	61338
	4.7	5.0 x 5.0 x 5.3	17	3.0	0.12	6	61478
	10	6.3 x 6.3 x 5.3	26	5.0	0.12	3	61109
	22	8.0 x 8.0 x 6.5	110	11	0.12	1.2	61229
	33	8.0 x 8.0 x 10	180	17	0.12	0.5	61339
	47	8.0 x 8.0 x 10	180	24	0.12	0.5	61479
	100	10 x 10 x 10	320	50	0.12	0.3	61101
	100	10 x 10 x 12	230	50	0.12	0.29	91106
63	47	10 x 10 x 12	220	30	0.09	0.29	68479
	100	10 x 10 x 14	240	63	0.09	0.41	68101
100	10	10 x 10 x 12	150	10	0.07	0.9	69109
	22	10 x 10 x 12	150	25	0.07	0.9	69229
	33	10 x 10 x 14	170	33	0.07	0.65	69339

**ORDERING EXAMPLE\***

Electrolytic capacitor 153 series

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

Nominal case size:

8 x 8 x 10 mm; taped on reel

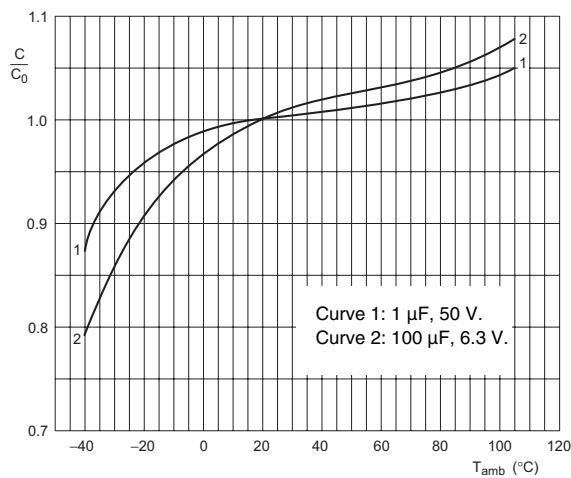
Catalog number: 2222 153 66101.

\* To ensure delivery of lead (Pb)-free parts during the transition period, please contact your Vishay sales agent.



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	$U_{rev} \leq 1 \text{ V}$
<b>Current</b>		
Leakage current	after 2 minutes at $U_R$	$I_{L2} \leq 0.01 \times C_R \times U_R$ or $3 \mu\text{A}$ , 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

**CAPACITANCE (C)**



$C_0$  = capacitance at 20 °C.

Fig.5 Typical multiplier of capacitance at 100 or 120 Hz as a function of ambient temperature.

**EQUIVALENT SERIES RESISTANCE (ESR)**

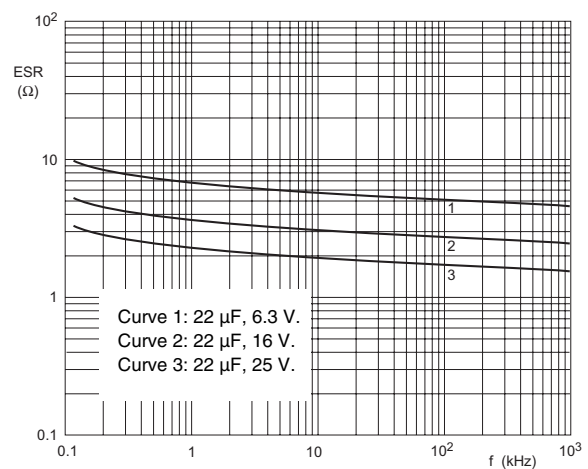


Fig.6 Typical ESR as a function of frequency at 20 °C.

**DISSIPATION FACTOR (tan δ)**

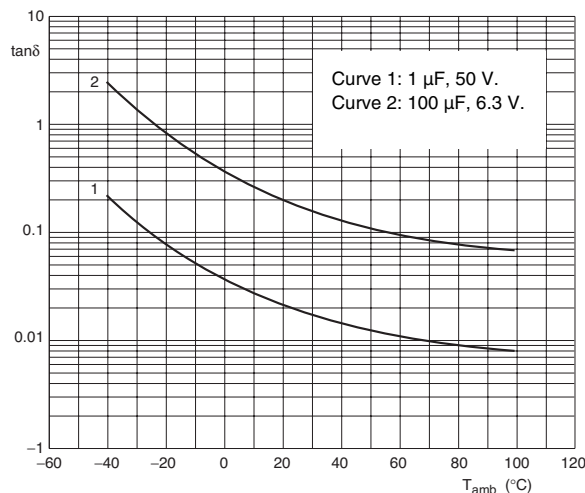


Fig.7 Typical dissipation factor (tan δ) at 100 or 120 Hz as a function of ambient temperature.

**IMPEDANCE (Z)**

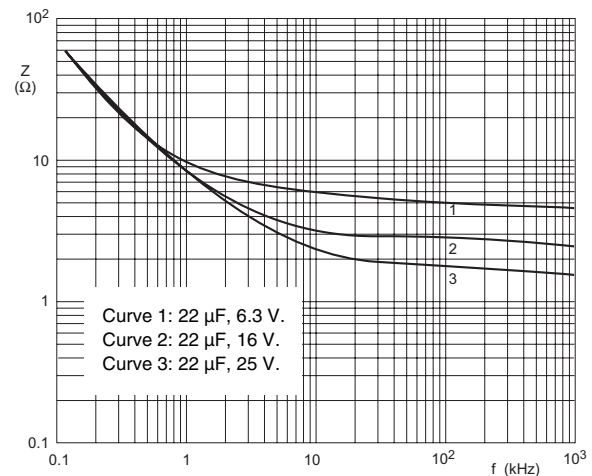
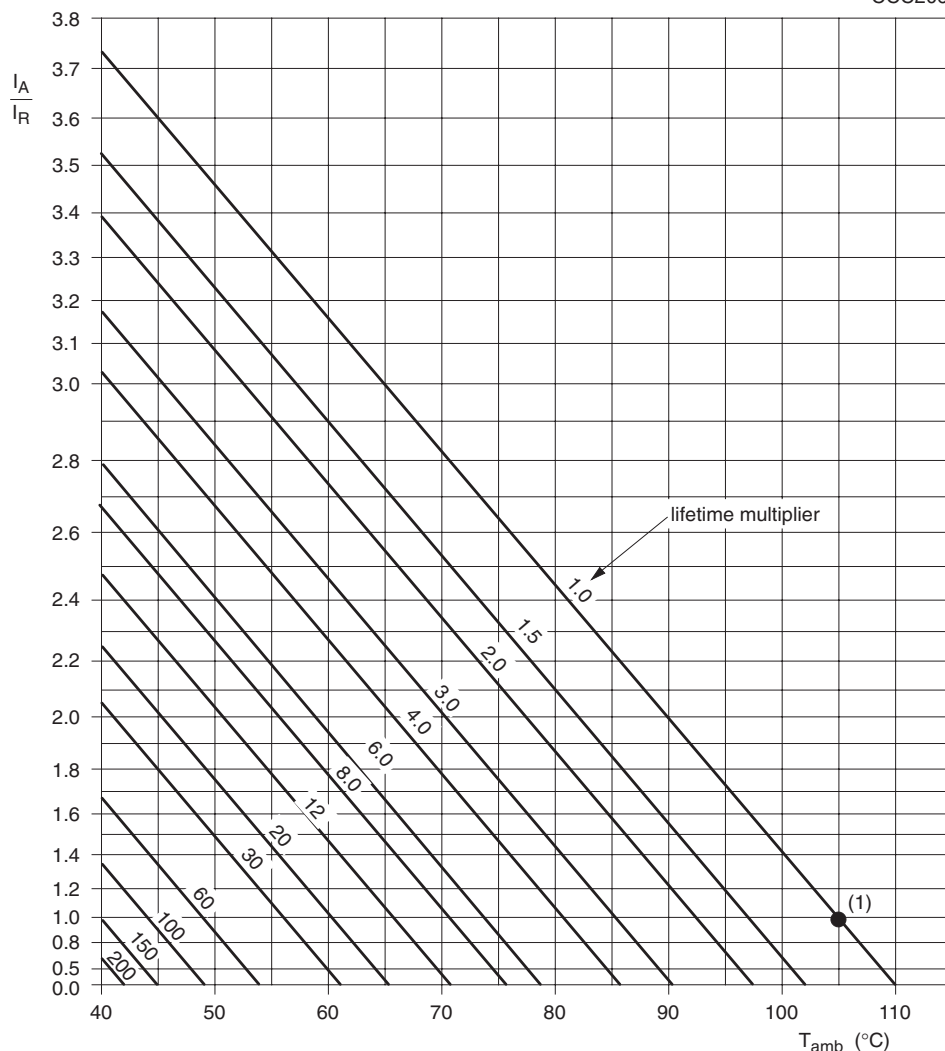


Fig.8 Typical impedance as a function of frequency at 20 °C.



**RIPPLE CURRENT AND USEFUL LIFE**

CCC206



IA = actual ripple current at 100 or 120 Hz.  
IR = rated ripple current at 100 or 120 Hz, 105 °C.  
For case codes 0405 to 1010 max. IA/IR = 2.4.

(1) Useful life at 105 °C and IR applied:  
case codes 0405 to 0605: 2000 hours  
case codes 0807 to 1014: 3000 hours

Fig.9 Multiplier of useful life as a function of ambient temperature and ripple current load.

Table 5

MULTIPLIER OF RIPPLE CURRENT (IR) AS A FUNCTION OF FREQUENCY			
FREQUENCY (Hz)	IR MULTIPLIER		
	UR = 6.3 to 16 V	UR = 25 or 35 V	UR = 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
≥10000	1.25	1.40	1.50



Table 6

<b>TEST PROCEDURES AND REQUIREMENTS</b>			
<b>TEST</b>		<b>PROCEDURE (quick reference)</b>	<b>REQUIREMENTS</b>
<b>NAME OF TEST</b>	<b>REFERENCE</b>		
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	$T_{amb} = 105 \text{ }^\circ\text{C}$ ; $U_R$ applied; 1000 hours, case codes 0405 to 0605 2000 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	$T_{amb} = 105 \text{ }^\circ\text{C}$ ; $U_R$ and $I_R$ applied; 2000 hours, case codes 0405 to 0605 3000 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	$T_{amb} = 105 \text{ }^\circ\text{C}$ ; no voltage applied; 1000 hours  after test: $U_R$ to be applied for 30 minutes, 24 to 48 hours before measurement	for requirements see 'Endurance test' above



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