

Conductive Polymer Aluminum Capacitors SMD (Chip), Low Impedance

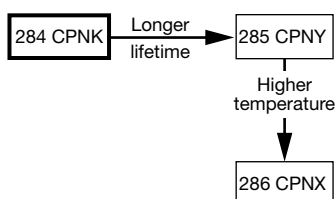


Fig. 1

FEATURES

- Useful life: up to 2000 h at 105 °C
- Very low ESR and high ripple current
- High voltages up to 100 V
- SMD-version with base plate, lead (Pb)-free reflow solderable
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912


RoHS
COMPLIANT

APPLICATIONS

- Industrial and professional applications
- Telecommunications and IT
- Portable and mobile equipment

MARKING

- Rated capacitance (in μF)
- Rated voltage (in V)
- Date code, in accordance with IEC 60062
- Black mark or “-” sign indicating the cathode (the anode is identified by beveled edges)
- Code indicating group number (84)

PACKAGING

Supplied in blister tape on reel

QUICK REFERENCE DATA	
DESCRIPTION	VALUE
Nominal case sizes (L x W x H in mm)	5.0 x 5.0 x 5.7 to 10.0 x 10.0 x 13.2
Rated capacitance range, C_R	4.7 μF to 2200 μF
Tolerance on C_R	$\pm 20 \%$
Rated voltage range, U_R	2.5 V to 100 V
Category temperature range	-55 °C to +105 °C
Endurance test at 105 °C	2000 h
Useful life at 105 °C	2000 h
Shelf life at 0 V, 105 °C	1000 h
Based on sectional specification	IEC 60384-25 / CECC 32300
Climatic category IEC 60068	55 / 105 / 56

**SELECTION CHART FOR C_R , U_R (2.5 V TO 20 V), AND RELEVANT NOMINAL CASE SIZES**

(L x W x H in mm)

C_R (μF)	U_R (V)					
	2.5	4.0	6.3	10	16	20
4.7	→	→	→	→	→	→
5.6	→	→	→	→	→	→
8.2	→	→	→	→	→	→
10	→	→	→	→	→	→
12	→	→	→	→	→	→
15	→	→	→	→	→	→
22	→	→	→	5 x 5 x 5.7	5 x 5 x 5.7	6.3 x 6.3 x 5.7
33	→	→	→	→	6.3 x 6.3 x 5.7	→
47	→	→	5 x 5 x 5.7	6.3 x 6.3 x 5.7	6.3 x 6.3 x 5.7	8 x 8 x 6.7
56	→	→	→	→	→	→
68	→	→	→	→	6.3 x 6.3 x 5.7	→
100	→	6.3 x 6.3 x 5.7	6.3 x 6.3 x 5.7	5 x 5 x 5.7 6.3 x 6.3 x 5.7	6.3 x 6.3 x 7.7	8 x 8 x 7.7
120	→	→	→	→	→	6.3 x 6.3 x 5.7
150	→	→	→	→	→	→
220	6.3 x 6.3 x 5.7	→	6.3 x 6.3 x 5.7	6.3 x 6.3 x 9	8 x 8 x 6.7 10 x 10 x 10	8 x 8 x 7.7
270	→	→	→	→	→	→
330	6.3 x 6.3 x 5.7	6.3 x 6.3 x 5.7	6.3 x 6.3 x 5.7 8 x 8 x 6.7	8 x 8 x 7.7	10 x 10 x 12	→
390	→	→	→	→	→	→
470	6.3 x 6.3 x 5.7	6.3 x 6.3 x 7.7	8 x 8 x 11.2	8 x 8 x 9.7	10 x 10 x 12	→
560	→	→	→	→	8 x 8 x 11.2	-
680	→	→	10 x 10 x 10	-	-	-
820	→	→	10 x 10 x 8	-	-	-
1000	→	→	8 x 8 x 9.7	8 x 8 x 12.7	10 x 10 x 12	-
1200	→	10 x 10 x 12	-	-	-	-
1500	8 x 8 x 9.7	10 x 10 x 10	10 x 10 x 13.2	-	-	-
2200	→	→	10 x 10 x 12	-	-	-

SELECTION CHART FOR C_R , U_R (25 V TO 100 V), AND RELEVANT NOMINAL CASE SIZES

(L x W x H in mm)

C_R (μF)	U_R (V)					
	25	35	50	63	80	100
4.7	→	→	→	→	→	6.3 x 6.3 x 7.7
5.6	→	→	→	6.3 x 6.3 x 5.7	-	-
8.2	→	→	6.3 x 6.3 x 5.7	6.3 x 6.3 x 5.7	-	-
10	6.3 x 6.3 x 5.7	→	8 x 8 x 11.2	→	→	8 x 8 x 7.7
12	→	→	6.3 x 6.3 x 5.7	→	8 x 8 x 11.2	-
15	→	→	6.3 x 6.3 x 5.7	-	-	-
22	6.3 x 6.3 x 4.3	6.3 x 6.3 x 5.7	8 x 8 x 9.7	8 x 8 x 9.7	10 x 10 x 12	10 x 10 x 10
33	6.3 x 6.3 x 5.7	→	8 x 8 x 11.2	8 x 8 x 9.7	-	-
47	6.3 x 6.3 x 5.7 8 x 8 x 6.7	8 x 8 x 6.7	8 x 8 x 9.7	8 x 8 x 12.7	10 x 10 x 10	-
56	→	→	6.3 x 6.3 x 9	-	-	-
68	→	→	→	8 x 8 x 9.7	-	-
100	8 x 8 x 9.7	10 x 10 x 12	10 x 10 x 12	-	-	-
120	-	-	-	-	-	-
150	→	8 x 8 x 12.7	-	-	-	-
220	10 x 10 x 10	10 x 10 x 12	-	-	-	-
270	6.3 x 6.3 x 9	-	-	-	-	-
330	→	10 x 10 x 12	-	-	-	-
390	10 x 10 x 13.2	-	-	-	-	-
470	10 x 10 x 12	-	-	-	-	-
560	-	-	-	-	-	-
680	-	-	-	-	-	-
820	-	-	-	-	-	-
1000	-	-	-	-	-	-
1200	-	-	-	-	-	-
1500	-	-	-	-	-	-
2200	-	-	-	-	-	-

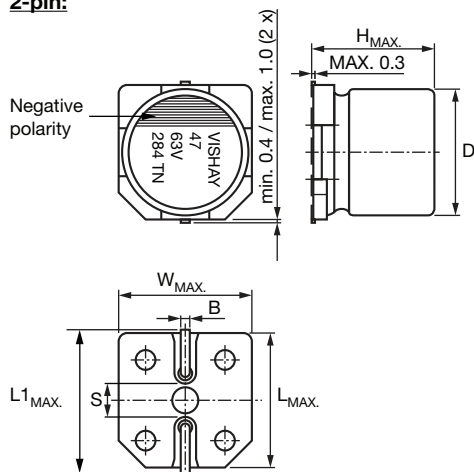
2-pin:


Fig. 2 - Dimensional outline

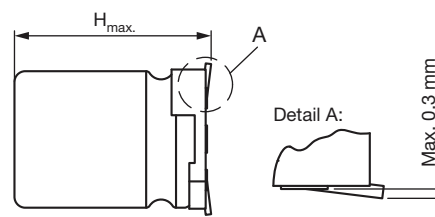


Fig. 3 - Coplanarity of pins

Table 1

DIMENSIONS in millimeters AND MASS									
NOMINAL CASE SIZE L x W x H	CASE CODE	L _{MAX.}	W _{MAX.}	H _{MAX.}	Ø D	B _{MAX.}	S	L1 _{MAX.}	MASS (g)
5.0 x 5.0 x 5.7	0506	5.5	5.5	6.0	5.3	0.8	1.4	6.1	0.2
6.3 x 6.3 x 4.3	0604	6.8	6.8	4.7	6.3	0.8	2.1	7.5	0.2
6.3 x 6.3 x 5.7	0606	6.8	6.8	6.0	6.3	0.8	2.1	7.5	0.3
6.3 x 6.3 x 7.7	0608	6.8	6.8	8.0	6.3	0.8	2.1	7.5	0.4
6.3 x 6.3 x 9.0	0609	6.8	6.8	10.0	6.3	1.1	2.1	7.5	0.4
8.0 x 8.0 x 6.7	0807	8.5	8.5	7.0	8.0	0.8	3.2	9.2	0.5
8.0 x 8.0 x 7.7	0808	8.5	8.5	8.0	8.0	1.1	3.2	9.2	0.6
8.0 x 8.0 x 9.7	0810	8.5	8.5	10.2	8.0	1.1	3.2	9.2	0.7
8.0 x 8.0 x 11.2	0811	8.5	8.5	11.7	8.0	1.1	3.2	9.2	0.8
8.0 x 8.0 x 12.7	0813	8.5	8.5	13.2	8.0	1.1	3.2	9.2	0.9
10.0 x 10.0 x 8.0	1009	10.5	10.5	9.0	10.0	1.1	4.6	11.2	0.9
10.0 x 10.0 x 10.0	1010	10.5	10.5	10.5	10.0	1.1	4.6	11.2	1.1
10.0 x 10.0 x 12.0	1012	10.5	10.5	12.5	10.0	1.1	4.6	11.2	1.3
10.0 x 10.0 x 13.2	1013	10.5	10.5	13.7	10.0	1.1	4.6	11.2	1.5

Table 2

TAPE AND REEL DIMENSIONS in millimeters, PACKAGING QUANTITIES						
NOMINAL CASE SIZE L x W x H	CASE CODE	PITCH P ₁	TAPE WIDTH W	TAPE THICKNESS T ₂	REEL DIAMETER	PACKAGING QUANTITY PER REEL
5.0 x 5.0 x 5.7	0506	12.0	16.0	6.6	380	1200
6.3 x 6.3 x 4.3	0604	12.0	16.0	5.2	380	1500
6.3 x 6.3 x 5.7	0606	12.0	16.0	6.7	380	1200
6.3 x 6.3 x 7.7	0608	12.0	16.0	8.6	380	900
6.3 x 6.3 x 9.0	0609	12.0	16.0	10.4	380	700
8.0 x 8.0 x 6.7	0807	12.0	24.0	7.6	380	1000
8.0 x 8.0 x 7.7	0808	12.0	24.0	8.5	380	900
8.0 x 8.0 x 9.7	0810	16.0	24.0	10.3	380	600
8.0 x 8.0 x 11.2	0811	16.0	24.0	12.0	380	500
8.0 x 8.0 x 12.7	0813	16.0	24.0	13.3	380	400
10.0 x 10.0 x 8.0	1009	16.0	24.0	9.0	380	500
10.0 x 10.0 x 10.0	1010	16.0	24.0	10.9	380	500
10.0 x 10.0 x 12.0	1012	16.0	24.0	12.6	380	400
10.0 x 10.0 x 13.2	1013	16.0	24.0	14.2	380	400

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. 4 and Table 3.

SOLDERING

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

For maximum conditions refer to Fig. 5.

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.

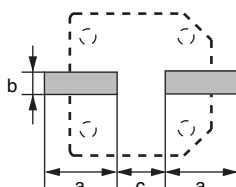
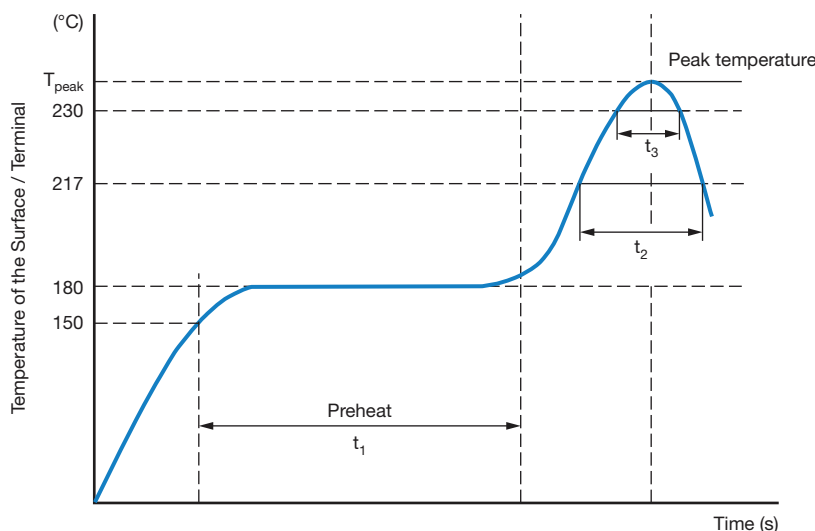

Fig. 4 - Recommended soldering pad dimensions

Table 3

RECOMMENDED SOLDERING PAD DIMENSIONS in millimeters				
NOMINAL CASE SIZE L x W x H	CASE CODE	a	b	c
5.0 x 5.0 x 5.7	0506	3.0	1.6	1.4
6.3 x 6.3 x 4.3	0604	3.5	1.6	2.1
6.3 x 6.3 x 5.7	0606	3.5	1.6	2.1
6.3 x 6.3 x 7.7	0608	3.5	1.6	2.1
6.3 x 6.3 x 9.0	0609	3.5	1.6	2.1
8.0 x 8.0 x 6.7	0807	4.2	1.9	2.8
8.0 x 8.0 x 7.7	0808	4.2	1.9	2.8
8.0 x 8.0 x 9.7	0810	4.2	1.9	2.8
8.0 x 8.0 x 11.2	0811	4.2	1.9	2.8
8.0 x 8.0 x 12.7	0813	4.2	1.9	2.8
10.0 x 10.0 x 8.0	1009	4.4	1.9	4.3
10.0 x 10.0 x 10.0	1010	4.4	1.9	4.3
10.0 x 10.0 x 12.0	1012	4.4	1.9	4.3
10.0 x 10.0 x 13.2	1013	4.4	1.9	4.3

SOLDERING PROFILE FOR LEAD (Pb)-FREE REFLOW PROCESS

Fig. 5 - Maximum temperature load during reflow soldering
Table 4

REFLOW SOLDERING CONDITIONS for MAL2284xxxxxE3		
PROFILE FEATURES		
Maximum time between 150 °C to 180 °C (t_1)	120 s	
Ramp up rate from 217 °C to T_{peak}	0.5 K/s to 3 K/s	
Maximum time above 217 °C (t_2)	50 s	
Maximum time above 230 °C (t_3)	40 s	
Peak temperature T_{Peak}	250 °C	260 °C
Maximum reflow cycles	2	1
Ramp down rate T_{Peak} to 217 °C	6 K/s max.	
Time 25 °C to T_{Peak}	8 min max.	

Notes

- Temperature measuring point on top of the case and on terminals
- MSL level 3 according to IPC/JEDEC® J-STD-20 MSL classifications



ELECTRICAL DATA	
SYMBOL	DESCRIPTION
C_R	Rated capacitance at 120 Hz, tolerance $\pm 20\%$
I_R 105 °C	Max. allowed ripple current at 100 kHz
I_{L2}	Max. leakage current after 2 min at U_R
$\tan \delta$	Max. dissipation factor at 120 Hz
ESR	Max. ESR at 100 kHz

Note

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

Table 5

ELECTRICAL DATA AND ORDERING INFORMATION							
U_R (V)	C_R (μF)	NOMINAL CASE SIZE L x W x H (mm)	I_R 105 °C 100 kHz (mA)	I_{L2} 2 min (μA)	$\tan \delta$ 120 Hz	ESR 100 kHz 20 °C (m Ω)	ORDERING CODE MAL2284...
2.5	220	6.3 x 6.3 x 5.7	2500	300	0.12	25	97251E3
	330	6.3 x 6.3 x 5.7	3500	500	0.12	17	97252E3
	470	6.3 x 6.3 x 5.7	3500	235	0.12	16	97253E3
	1500	8 x 8 x 9.7	5220	750	0.12	10	97254E3
4	100	6.3 x 6.3 x 5.7	2450	300	0.12	26	97351E3
	330	6.3 x 6.3 x 5.7	3160	396	0.12	15	97352E3
	470	6.3 x 6.3 x 7.7	3900	564	0.12	9	97353E3
	1200	10 x 10 x 12	5500	1440	0.12	12	97354E3
	1500	10 x 10 x 10	5000	1200	0.12	10	97355E3
6.3	47	5 x 5 x 5.7	1380	300	0.12	35	97301E3
	100	6.3 x 6.3 x 5.7	2400	300	0.12	27	97302E3
	220	6.3 x 6.3 x 5.7	3160	416	0.12	15	97303E3
	330	6.3 x 6.3 x 5.7	3600	624	0.12	17	97304E3
	330	8 x 8 x 6.7	4500	700	0.12	9	97305E3
	470	8 x 8 x 11.2	3950	888	0.12	15	97306E3
	680	10 x 10 x 10	5500	856	0.12	15	97307E3
	820	10 x 10 x 8	5000	1033	0.12	9	97308E3
	1000	8 x 8 x 9.7	4770	1260	0.12	12	97309E3
	2200	10 x 10 x 12	5000	2772	0.12	12	97311E3
10	22	5 x 5 x 5.7	1200	300	0.12	45	97401E3
	47	6.3 x 6.3 x 5.7	2100	300	0.12	40	97402E3
	100	5 x 5 x 5.7	1800	300	0.12	35	97403E3
	100	6.3 x 6.3 x 5.7	2320	300	0.12	27	97404E3
	220	6.3 x 6.3 x 9	3300	440	0.12	22	97405E3
	330	8 x 8 x 7.7	3390	660	0.12	19	97406E3
	470	8 x 8 x 9.7	3950	940	0.12	15	97407E3
	1000	8 x 8 x 12.7	5800	2000	0.12	10	97408E3
16	1500	10 x 10 x 13.2	4500	3000	0.12	21	97409E3
	22	5 x 5 x 5.7	1100	300	0.12	45	97501E3
	33	6.3 x 6.3 x 5.7	2050	300	0.12	37	97502E3
	47	6.3 x 6.3 x 5.7	2070	300	0.12	35	97503E3
	68	6.3 x 6.3 x 5.7	2440	300	0.12	25	97504E3
	100	6.3 x 6.3 x 7.7	2700	320	0.12	24	97505E3
	220	8 x 8 x 6.7	2373	704	0.12	18	97506E3
	220	10 x 10 x 10	5050	704	0.12	14	97507E3
	330	10 x 10 x 12	4800	1584	0.12	16	97508E3
	470	10 x 10 x 12	6100	1504	0.12	10	97509E3
	560	8 x 8 x 11.2	4950	1792	0.12	14	97511E3
	1000	10 x 10 x 12	5400	3200	0.12	12	97512E3

ORDERING EXAMPLE

Conductive polymer 284 CPNK series

100 μF / 16 V; $\pm 20\%$ Nominal case size: 6.3 mm x 6.3 mm x 7.7 mm;
taped on reel

Ordering code: MAL228497517E3

ELECTRICAL DATA AND ORDERING INFORMATION							
U_R (V)	C_R (μ F)	NOMINAL CASE SIZE L x W x H (mm)	I_R 105 °C 100 kHz (mA)	I_{L2} 2 min (μ A)	$\tan \delta$ 120 Hz	ESR 100 kHz 20 °C (m Ω)	ORDERING CODE MAL2284...
20	22	6.3 x 6.3 x 5.7	1700	300	0.12	50	97551E3
	47	8 x 8 x 6.7	2000	188	0.10	45	97552E3
	100	8 x 8 x 7.7	3320	400	0.12	24	97553E3
	120	6.3 x 6.3 x 5.7	2900	500	0.12	25	97554E3
	220	8 x 8 x 7.7	3300	880	0.12	23	97555E3
25	10	6.3 x 6.3 x 5.7	2100	250	0.12	40	97601E3
	22	6.3 x 6.3 x 4.3	2350	275	0.12	45	97602E3
	33	6.3 x 6.3 x 5.7	2700	247.5	0.12	40	97603E3
	47	6.3 x 6.3 x 5.7	2500	588	0.12	30	97604E3
	47	8 x 8 x 6.7	4210	235	0.08	15	97605E3
	100	8 x 8 x 9.7	3300	500	0.12	24	97606E3
	220	10 x 10 x 10	3800	1100	0.12	20	97607E3
	270	6.3 x 6.3 x 9	3500	1350	0.12	30	97608E3
	390	10 x 10 x 13.2	5000	1950	0.12	18	97609E3
35	470	10 x 10 x 12	2500	2350	0.12	17	97611E3
	22	6.3 x 6.3 x 5.7	1450	300	0.12	80	97001E3
	47	8 x 8 x 6.7	1900	329	0.12	35	97002E3
	100	10 x 10 x 12	2600	700	0.12	29	97003E3
	150	8 x 8 x 12.7	2800	1050	0.12	25	97004E3
	220	10 x 10 x 12	2600	1540	0.12	28	97005E3
50	330	10 x 10 x 12	4400	2310	0.12	20	97006E3
	8.2	6.3 x 6.3 x 5.7	800	600	0.12	80	97101E3
	10	8 x 8 x 11.2	1800	100	0.12	40	97102E3
	12	6.3 x 6.3 x 5.7	800	600	0.12	80	97103E3
	15	6.3 x 6.3 x 5.7	800	600	0.12	80	97104E3
	22	8 x 8 x 9.7	1500	300	0.12	50	97105E3
	33	8 x 8 x 11.2	2000	300	0.12	35	97106E3
	47	8 x 8 x 9.7	3300	470	0.12	29	97107E3
	56	6.3 x 6.3 x 9	1800	560	0.12	50	97108E3
63	100	10 x 10 x 12	3600	1000	0.12	27	97109E3
	5.6	6.3 x 6.3 x 5.7	700	600	0.12	100	97801E3
	8.2	6.3 x 6.3 x 5.7	700	600	0.12	100	97802E3
	22	8 x 8 x 9.7	1700	300	0.12	35	97803E3
	33	8 x 8 x 9.7	1950	415	0.12	42	97804E3
	47	8 x 8 x 12.7	1800	592	0.12	40	97805E3
80	68	8 x 8 x 9.7	1800	857	0.12	40	97806E3
	12	8 x 8 x 11.2	1800	192	0.12	40	97701E3
	22	10 x 10 x 12	2300	352	0.12	38	97702E3
100	47	10 x 10 x 10	3100	300	0.12	45	97703E3
	4.7	6.3 x 6.3 x 7.7	1060	600	0.12	100	97901E3
	10	8 x 8 x 7.7	1700	200	0.12	45	97902E3
	22	10 x 10 x 10	2100	440	0.12	40	97903E3

Table 6

ADDITIONAL ELECTRICAL DATA		
PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage for short periods	IEC 60384-25, subclause 4.14	$U_S \leq 1.15 \times U_R$

USEFUL LIFE AND ENDURANCE

Table 7

ENDURANCE TEST AND USEFUL LIFE							
SERIES	CASE CODE	USEFUL LIFE AT 105 °C (h) ⁽¹⁾	ENDURANCE AT 105 °C (h)	ENDURANCE AT 95 °C (h)	ENDURANCE AT 85 °C (h)	ENDURANCE AT 75 °C (h)	ENDURANCE AT 65 °C (h)
284 CPNK	0406 to 1012	2000	2000	6000	20 000	63 000	200 000

Note

⁽¹⁾ Identical with endurance for this series

Endurance can be calculated by formula below:

$$L = L_{T_{max.}} \times 10^{\frac{T_{max.} - T_a}{20}}$$

L: estimated lifetime (h)

$L_{T_{max.}}$: base lifetime specified at maximum operating temperature with applied DC voltage (h)

$T_{max.}$: rated maximum operating temperature (°C)

T_a : actual ambient temperature (°C)

Table 8

MULTIPLIER OF RIPPLE CURRENT (I_R) AS A FUNCTION OF FREQUENCY			
FREQUENCY (Hz)			
120	1000	10 000	≥ 100 000
I_R MULTIPLIER			
0.05	0.3	0.7	1

Table 9

TEST PROCEDURES AND REQUIREMENTS			
TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Mounting	IEC 60384-25, subclause 4.3	Shall be performed prior to tests mentioned below; reflow soldering; for maximum temperature load refer to chapter "Mounting"	$\Delta C/C: \pm 5 \%$ $\tan \delta \leq \text{spec. limit}$ $I_{L2} \leq \text{spec. limit}$
Endurance	IEC 60384-25 / CECC 32300, subclause 4.15	$T_{amb} = 105 \text{ °C}$; U_R applied; for test duration see Table 7	$\Delta C/C: \pm 20 \%$ $\tan \delta \leq 1.5 \times \text{spec. limit}$ $I_{L2} \leq \text{spec. limit}$ $ESR \leq 1.5 \times \text{spec. limit}$
Useful life	CECC 30301, subclause 1.8.1	$T_{amb} = 105 \text{ °C}$; U_R and I_R applied; for test duration see Table 7	$\Delta C/C: \pm 20 \%$ $\tan \delta \leq 1.5 \times \text{spec. limit}$ $I_{L2} \leq \text{spec. limit}$ $ESR \leq 1.5 \times \text{spec. limit}$
Shelf life (storage at high temperature)	IEC 60384-25 / CECC 32300, subclause 4.16	$T_{amb} = 105 \text{ °C}$; no voltage applied; 1000 h after test: U_R to be applied for 30 min, 24 h to 48 h before measurement	For requirements see "Endurance test" above

Statements about product lifetime are based on calculations and internal testing. They should only be interpreted as estimations. Also due to external factors, the lifetime in the field application may deviate from the calculated lifetime. In general, nothing stated herein shall be construed as a guarantee of durability.



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