Aluminum Capacitors
SMD (Chip) Long Life Vertical

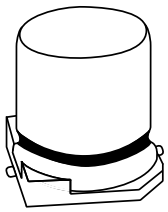
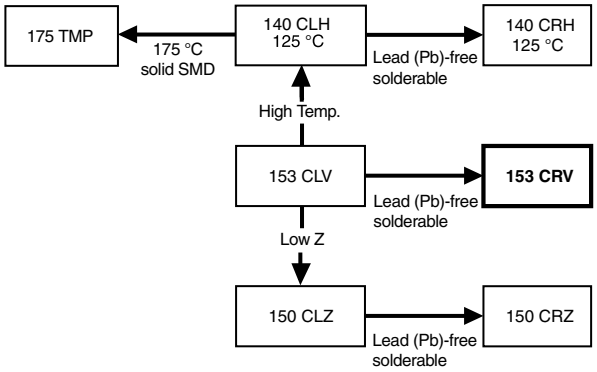


Fig.1 Component outline.



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 µF
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	200 000 hours
case sizes 8.0 × 8.0 × 6.5 to 10 × 10 × 14	300 000 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

FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte, self healing
- SMD-version with base plate, vertical construction requiring minimum board space, lead (Pb)-free 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 and RoHS compliant
- ATTENTION: for maximum safe soldering conditions refer to Fig.4

Pb-free
RoHS
COMPLIANT

APPLICATIONS

- SMD technology, in compliance with RoHS
- Coupling, decoupling, smoothing, filtering, buffering, timing
- Telecommunications, general industrial, EDP, automotive, portable and lightweight equipment

MARKING

- Rated capacitance (in µF)
- Rated voltage (in V)
- Date code
- Black mark or '–' sign indicating the cathode (the anode is identified by bevelled edges)

PACKAGING

Supplied in blister tape on reel

SELECTION CHART FOR C_R, U_R AND RELEVANT NOMINAL CASE SIZES (L × W × H in mm)								
C_R (µF)	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

1. Detailed tape dimensions see section ‘PACKAGING’.

Table 2

DIMENSIONS in millimeters **AND MASS**									
NOMINAL CASE SIZE L × W × H	**CASE CODE**	**L_{MAX}**	**W_{MAX}**	**H_{MAX}**	**∅ D**	**B_{MAX}**	**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

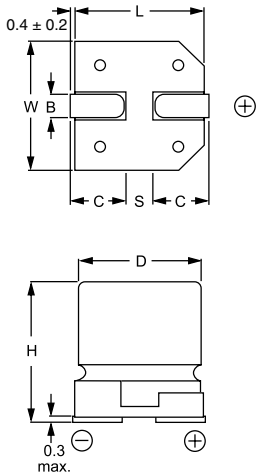


Fig.2 Dimensional outline

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.

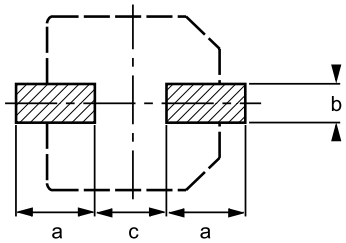


Fig.3 Recommended soldering pad dimensions.

SOLDERING

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

For maximum conditions refer to Fig.4.
max. 2 runs with pause of min. 30 min between.

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

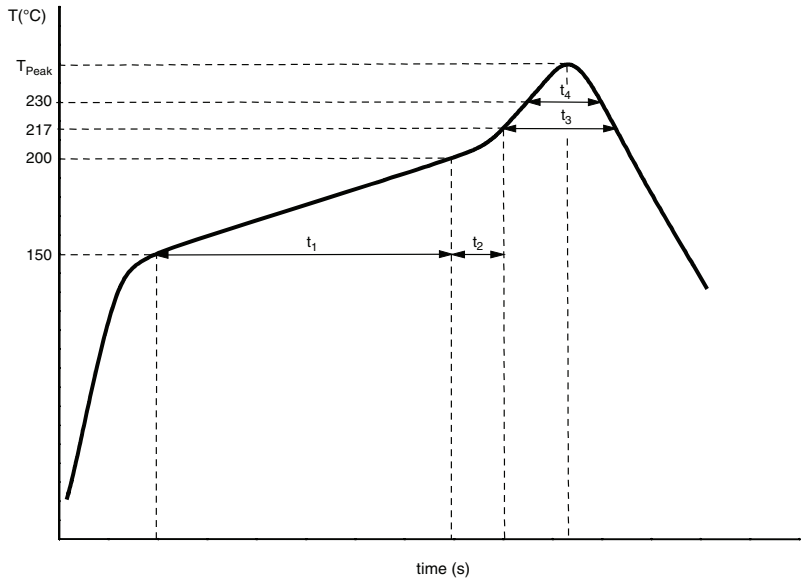


Fig.4 Maximum temperature load during reflow soldering measured on capacitors soldering pad and on top of the case.

REFLOW SOLDERING CONDITIONS				
PROFILE FEATURES	**CASE CODE 0405 to 0605**	**CASE CODE 0807 to 1010**	**CASE CODE 1012 to 1014 ≤ 63 V**	**CASE CODE 1012 to 1014 100 V**
max. time from 25 °C to T_{peak}	240 s	240 s	300 s	270 s
max. ramp-up rate to 150 °C	3 K/s	3 K/s	3 K/s	3 K/s
max. time from 150 °C to 200 °C (t_1)	120 s	120 s	150 s	120 s
ramp up rate from 200 °C to T_{peak}	0.5 K/s to 3 K/s	0.5 K/s to 3 K/s	0.5 K/s to 3 K/s	0.5 K/s to 3 K/s
max. time from 200 °C - 217 °C, (t_2)	20 s	20 s	60 s	60 s
max. time above $T_{Liquidus}$ (217 °C), (t_3)	60 s	60 s	90 s	60 s
max. time above 230 °C (t_4)	30 s	20 s	40 s	30 s
peak temperature T_{peak}	250 °C	240 °C	250 °C	240 °C
max. time above T_{peak} minus 5 °C	5 s	5 s	5 s	10 s
max. ramp-down rate from $T_{Liquidus}$	6 K/s	6 K/s	6 K/s	6 K/s

Temperature measuring point on top of the case and terminals max. 2 runs with pause of 30 minutes in between

ELECTRICAL DATA	
SYMBOL	**DESCRIPTION**
C_R	rated capacitance at 100 or 120 Hz, tolerance ± 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 δ	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 Tamb = 20 °C, P = 86 to 106 kPa, RH = 45 to 75 %.

ORDERING EXAMPLE

Electrolytic capacitor 153 CRV series

100 µF/25 V; ± 20 %

Nominal case size:
8 × 8 × 10 mm; taped on reel

Catalog number: 2222 153 76101

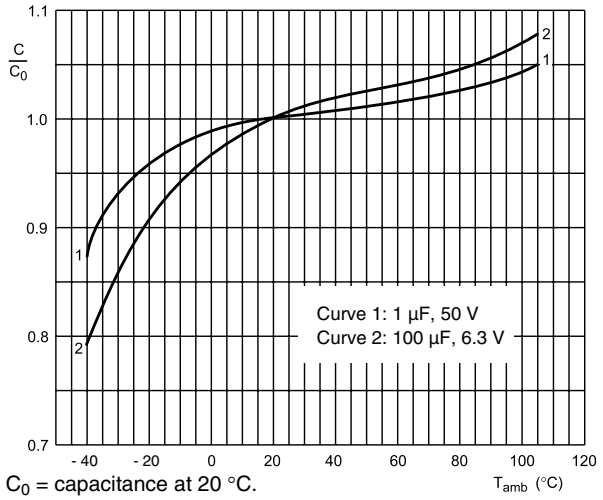
Table 4

ELECTRICAL DATA AND ORDERING INFORMATION

U_R (V)	C_R (µF)	NOMINAL CASE SIZE L × W × H (mm)	I_R 105 °C (mA)	I_{L2} 2 MIN (µA)	TAN δ	ESR 100 kHz (Ω)	CATALOG NUMBER 2222 153 .....
6.3	22	4.0 × 4.0 × 5.3	21	3.0	0.30	8	73229
	47	5.0 × 5.0 × 5.3	36	3.0	0.30	4	73479
	100	6.3 × 6.3 × 5.3	61	6.3	0.30	2	73101
	330	8.0 × 8.0 × 10	180	21	0.30	0.5	73331
	470	10 × 10 × 10	320	30	0.30	0.3	73471
	680	10 × 10 × 12	340	43	0.24	0.29	73681
	1000	10 × 10 × 14	400	63	0.24	0.24	73102
10	33	5.0 × 5.0 × 5.3	31	3.3	0.26	4	74339
	220	8.0 × 8.0 × 10	180	22	0.26	0.5	74221
	330	10 × 10 × 10	320	33	0.26	0.3	74331
	470	10 × 10 × 12	330	47	0.19	0.29	74471
	680	10 × 10 × 14	380	68	0.19	0.24	74681
16	10	4.0 × 4.0 × 5.3	16	3.0	0.22	8	75109
	22	5.0 × 5.0 × 5.3	28	3.5	0.22	4	75229
	47	6.3 × 6.3 × 5.3	47	7.5	0.22	2.2	75479
	100	8.0 × 8.0 × 6.5	110	16	0.22	1.2	75101
	220	10 × 10 × 10	320	35	0.22	0.3	75221
	330	10 × 10 × 12	330	53	0.16	0.29	75331
	470	10 × 10 × 14	370	75	0.16	0.25	75471
25	33	6.3 × 6.3 × 5.3	44	8.3	0.16	2.2	76339
	47	8.0 × 8.0 × 6.5	110	12	0.16	1.2	76479
	100	8.0 × 8.0 × 10	180	22	0.16	0.5	76101
	220	10 × 10 × 12	270	55	0.14	0.29	76221
	330	10 × 10 × 14	300	83	0.14	0.27	76331
35	4.7	4.0 × 4.0 × 5.3	14	3.0	0.13	8	70478
	10	5.0 × 5.0 × 5.3	23	3.5	0.13	4	70109
	22	6.3 × 6.3 × 5.3	50	7.7	0.13	2.2	70229
	33	8.0 × 8.0 × 6.5	110	12	0.13	1.2	70339
	220	10 × 10 × 12	270	77	0.12	0.29	70221
50	0.47	4.0 × 4.0 × 5.3	5	3.0	0.12	12	71477
	1.0	4.0 × 4.0 × 5.3	7	3.0	0.12	12	71108
	2.2	4.0 × 4.0 × 5.3	10	3.0	0.12	12	71228
	3.3	4.0 × 4.0 × 5.3	12	3.0	0.12	12	71338
	4.7	5.0 × 5.0 × 5.3	17	3.0	0.12	6	71478
	10	6.3 × 6.3 × 5.3	26	5.0	0.12	3	71109
	22	8.0 × 8.0 × 6.5	110	11	0.12	1.2	71229
	33	8.0 × 8.0 × 10	180	17	0.12	0.5	71339
	47	8.0 × 8.0 × 10	180	24	0.12	0.5	71479
	100	10 × 10 × 10	320	50	0.12	0.3	71101
	100	10 × 10 × 12	230	50	0.12	0.29	91107
63	47	10 × 10 × 12	220	30	0.09	0.29	78479
	100	10 ×10 × 1	240	63	0.09	0.41	78101
100	10	10 × 10 × 12	150	10	0.07	1.4	79109
	22	10 × 10 × 12	150	25	0.07	1.4	79229
	33	10 × 10 × 14	170	33	0.07	1.3	79339

ADDITIONAL ELECTRICAL DATA		
PARAMETER	**CONDITIONS**	**VALUE**
Voltage		
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
Current		
Leakage current	after 2 minutes at U_R	$I_{L2} \leq 0.01 \times C_R \times U_R$ or 3 µA, whichever is greater
Inductance		
Equivalent series inductance (ESL)	case codes 0405 to 0605	typ. 10 nH
	case codes 0807 to 1014	typ. 15 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)

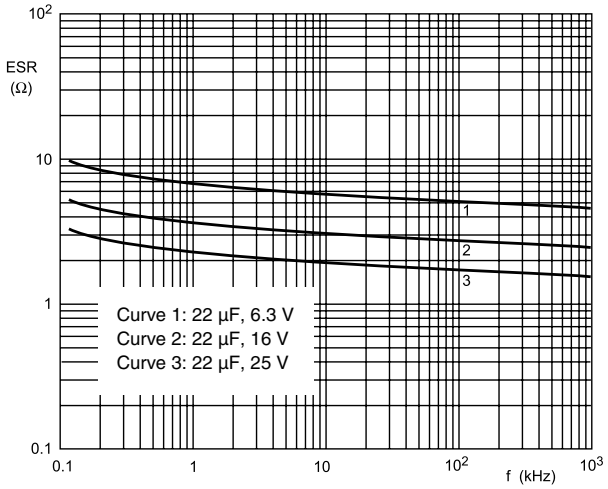


Fig.6 Typical ESR as a function of frequency at 20 °C.

DISSIPATION FACTOR (tan δ)

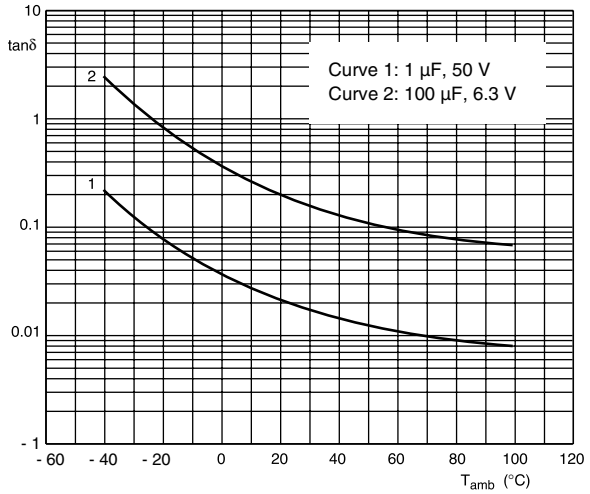


Fig.7 Typical dissipation factor (tan δ) at 100 or 120 Hz as a function of ambient temperature.

IMPEDANCE (Z)

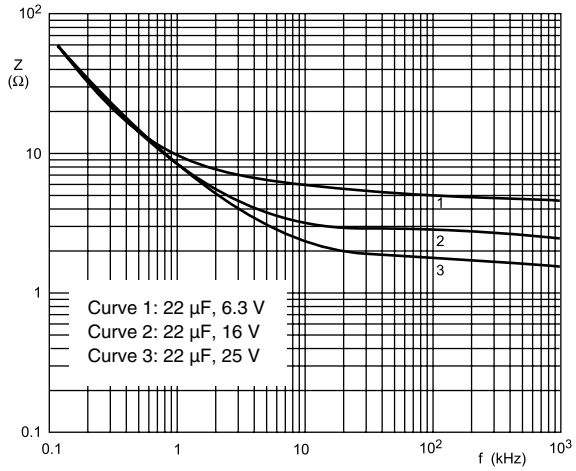
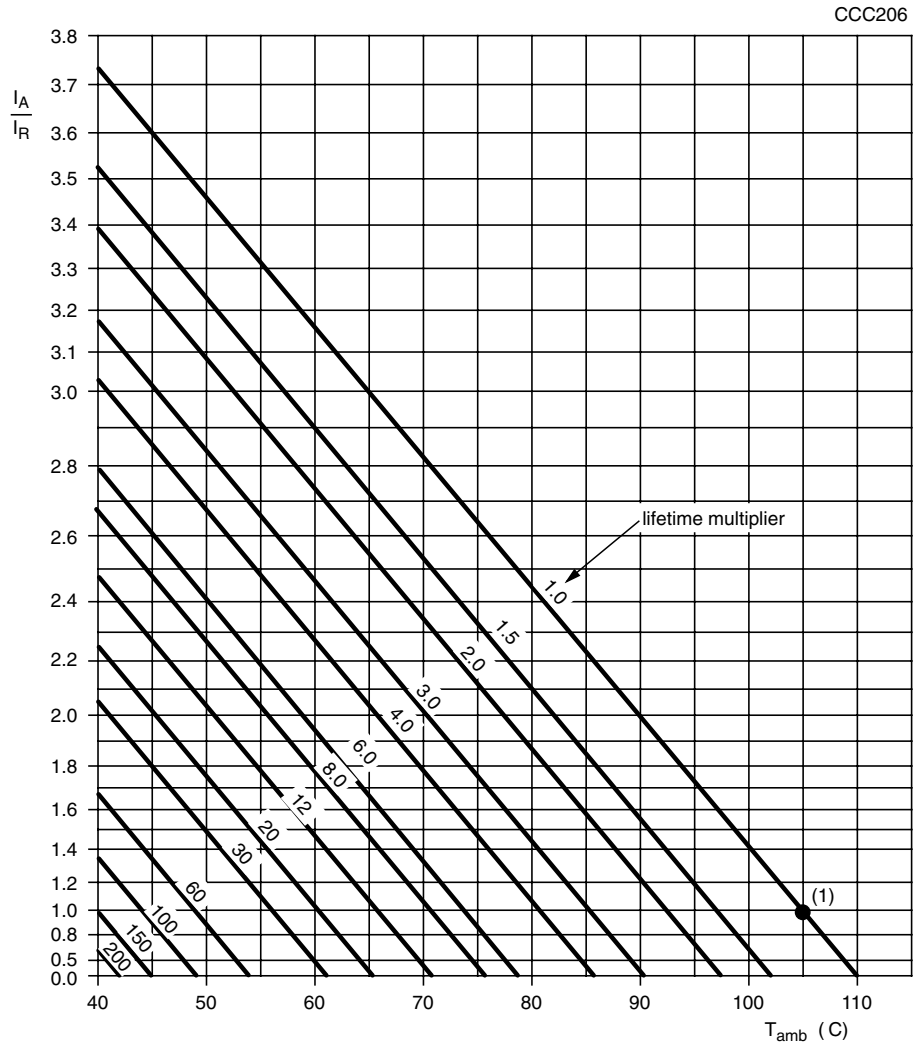


Fig.8 Typical impedance as a function of frequency at 20 °C.

RIPPLE CURRENT AND USEFUL LIFE



I_A = actual ripple current at 100 or 120 Hz
I_R = rated ripple current at 100 or 120 Hz
105 °C
For case codes 0405 to 1010 max I_A/I_R = 2.4
(1) Useful life at 105 °C and I_R 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 (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 V 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
≥ 10 000	1.25	1.40	1.50

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”	$\Delta C/C$: ± 10 % tan $\delta \leq$ spec. limit $I_{L2} \leq$ spec. limit
Endurance	IEC 60384-18/ CECC 32 300, subclause 4.15	T_{amb} = 105 °C; U_R applied; 1000 hours, case codes 0405 to 0605 2000 hours, case codes 0807 to 1014	$\Delta C/C$: ± 20 % tan $\delta \leq 2 \times$ spec. limit $I_{L2} \leq$ spec. limit
Useful life	CECC 30 301, subclause 1.8.1	T_{amb} = 105 °C; U_R and I_R applied; 2000 hours, case codes 0405 to 0605 3000 hours, case codes 0807 to 1014	$\Delta C/C$: ± 50 % tan $\delta \leq 3 \times$ spec. limit $I_{L2} \leq$ spec. limit no short or open circuit total failure percentage: ≤ 1 %
Shelf life (storage at high temperature)	IEC 60384-18/ CECC 32 300, subclause 4.17	T_{amb} = 105 °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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