

Aluminum Capacitors

SMD (Chip) Long Life Vertical

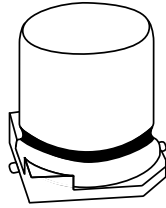
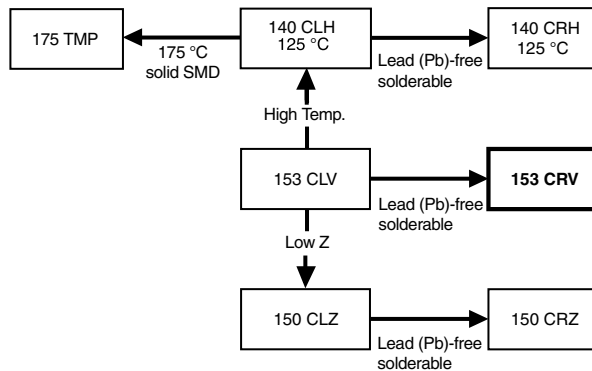


Fig.1 Component outline.



| 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


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

- 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 |

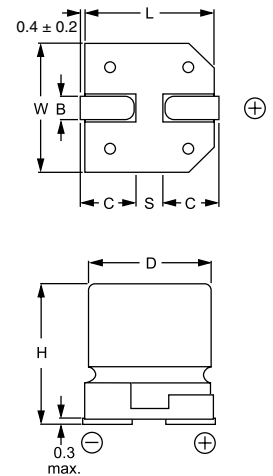


Fig.2 Dimensional outline

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.

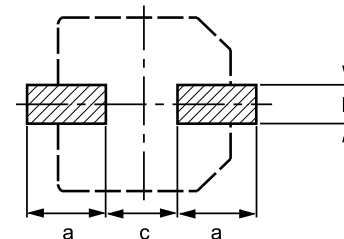


Fig.3 Recommended soldering pad dimensions.

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 |

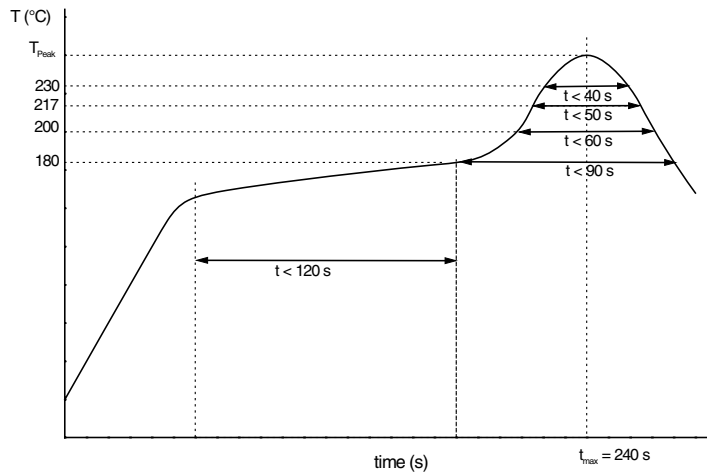


Fig.4 Maximum temperature load during reflow soldering measured on capacitors soldering pad and on top of the case.

| REFLOW SOLDERING CONDITIONS | | |
|---|---------------------------|---------------------------|
| PROFILE FEATURES | CASE CODE 0405 to 0605 | CASE CODE 0807 to 1014 |
| max. time from 25 °C to T_{peak} | 240 s | |
| max. ramp-up rate to 150 °C | 3 K/s | |
| max. time from 160 °C to 180 °C | 120 s | |
| ramp up rate from 180 °C to T_{peak} | 0.5 K/s to 3 K/s | |
| max. time above 180 °C | 90 s | 90 s |
| max. time above 200 °C | 60 s | 60 s |
| max. time above $T_{Liquidus}$ (217 °C) | 50 s | 50 s |
| max. time above 230 °C | 40 s | 40 s |
| peak temperature T_{peak} | 250 °C | 240 °C |
| max. time above T_{peak} minus 5 °C | 10 s | 10 s |
| max. ramp-down rate from $T_{Liquidus}$ | 6 K/s | |

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



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| 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 |

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

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 %.

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 × 14 | 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 | $U_{rev} \leq 1 \text{ V}$ |
| Current | | |
| 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 |
| Inductance | | |
| Equivalent series inductance (ESL) | case codes 0405 to 0605 | typ. 10 nH |
| | case codes 0807 to 1014 | typ. 15 nH |

CAPACITANCE (C)

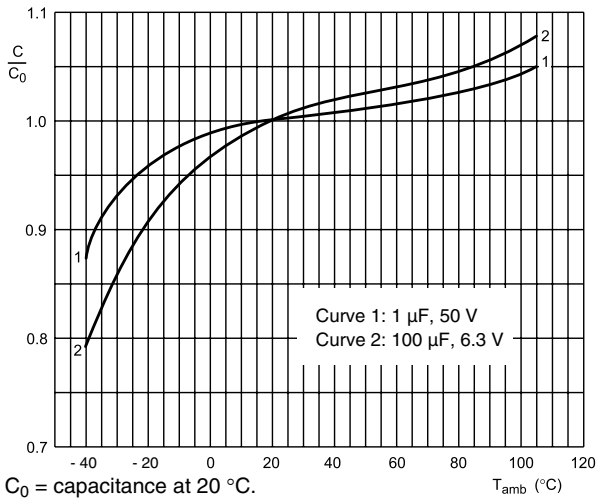


Fig.5 Typical multiplier of capacitance at 100 or 120 Hz as a function of ambient temperature.

EQUIVALENT SERIES RESISTANCE (ESR)

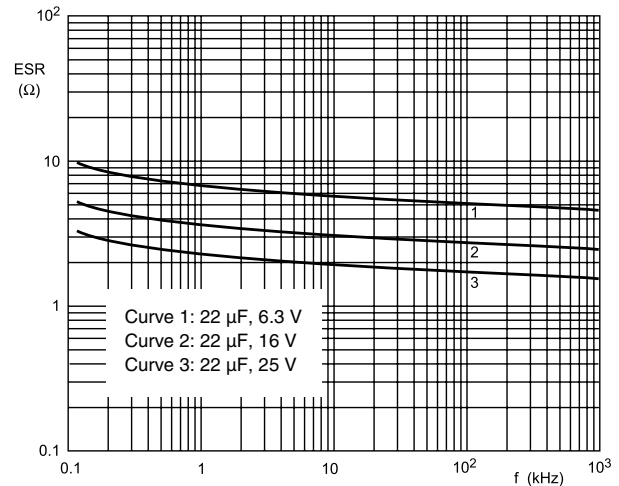


Fig.6 Typical ESR as a function of frequency at 20 °C.

DISSIPATION FACTOR (tan δ)

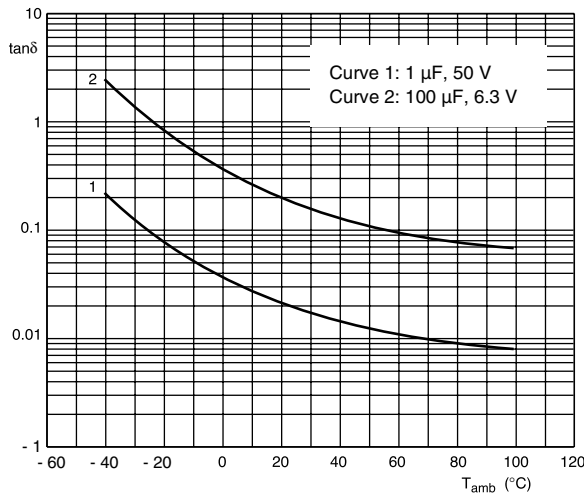


Fig.7 Typical dissipation factor (tan δ) at 100 or 120 Hz as a function of ambient temperature.

IMPEDANCE (Z)

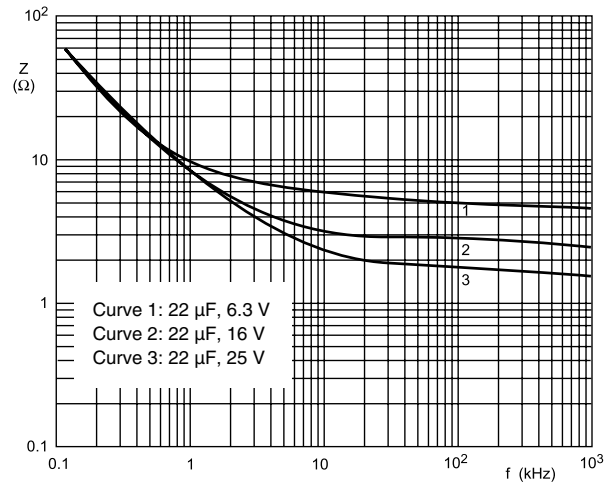
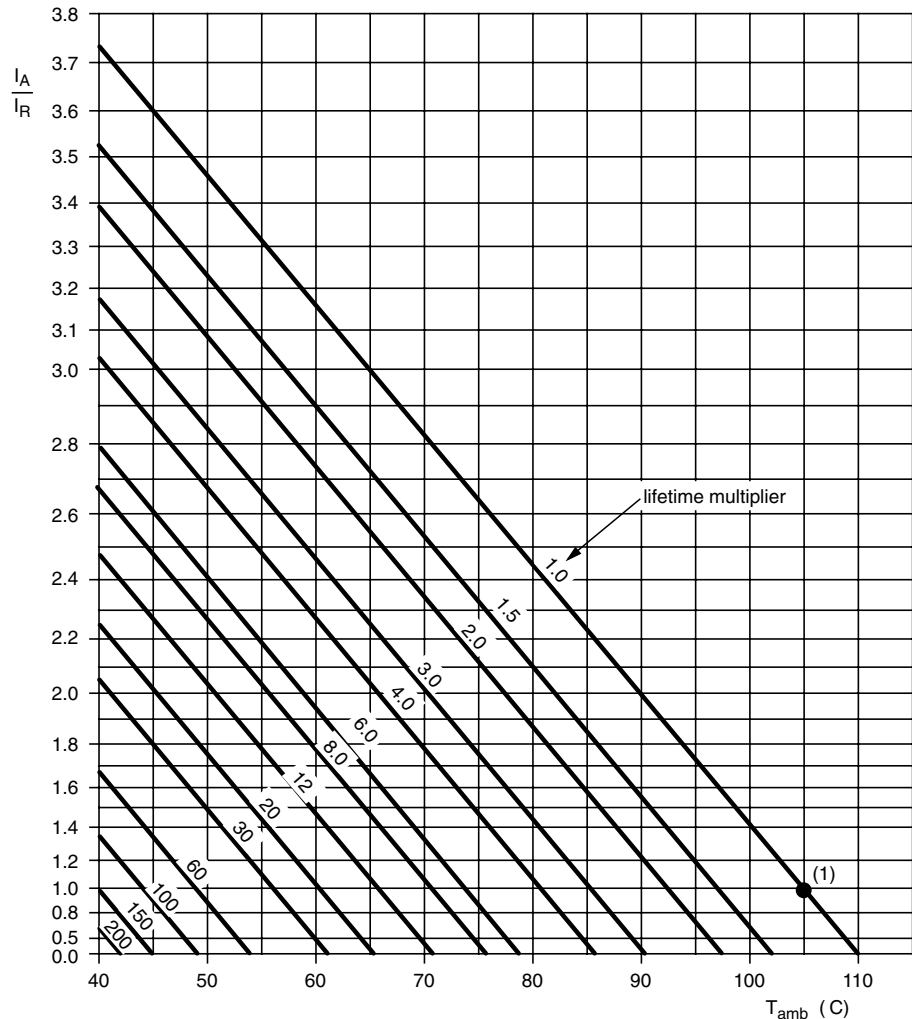


Fig.8 Typical impedance as a function of frequency at 20 °C.

RIPPLE CURRENT AND USEFUL LIFE

CCC206



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 |
| $\geq 10\ 000$ | 1.25 | 1.40 | 1.50 |

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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 32 300, subclause 4.15 | $T_{\text{amb}} = 105 \text{ }^\circ\text{C}$; 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 30 301, subclause 1.8.1 | $T_{\text{amb}} = 105 \text{ }^\circ\text{C}$; 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 32 300, subclause 4.17 | $T_{\text{amb}} = 105 \text{ }^\circ\text{C}$; 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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