# Aluminium electrolytic capacitors
# SMD (Chip) Long Life Vertical

# 153 CLV

## FEATURES

- Polarized aluminium electrolytic capacitors, non-solid, 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.

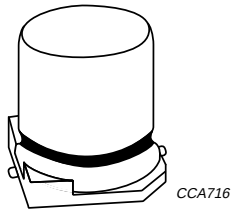
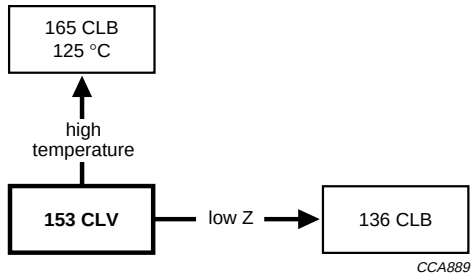



Fig.1 Component outline.

## 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, $C_R$ | 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 | 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 (without approval) | IEC 384-18/CECC 32300 |
| Climatic category IEC 68 | 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**.

| $C_R$ (μF) | $U_R$ (V) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **6.3** | **10** | **16** | **25** | **35** | **50** | **63** | **100** |
| 0.47[1] | – | – | – | – | – | 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 | – | – | – | – | – | – | – |

**Note**

1. For lower CV-values, see *"data handbook PA06, Ceramic Capacitors"*.

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## PACKAGING

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

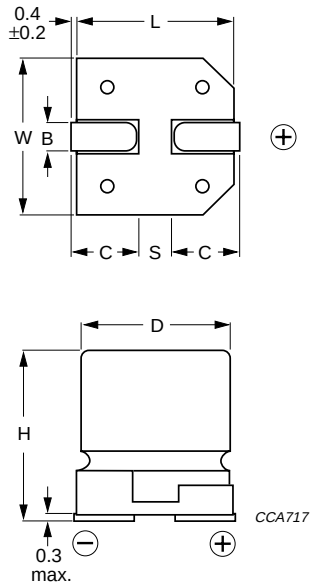
**Table 1** Tape and reel dimensions

| CASE CODE | PITCH $P_1$ (mm) | TAPE WIDTH W (mm) | TAPE THICKNESS $T_2$ (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 | 500 |
| 1012 | 16 | 24 | 13 | 330 | 250 |
| 1014 | 16 | 24 | 15 | 330 | 250 |

## MARKING

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

**MECHANICAL DATA**




Dimensions in mm.

Fig.2 Dimensional outline.

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

| NOMINAL CASE SIZE L × W × H (mm) | CASE CODE | $L_{max}$ (mm) | $W_{max}$ (mm) | $H_{max}$ (mm) | ∅D (mm) | $B_{max}$ (mm) | S (mm) | C (mm) | MASS (g) | PACKAGING QUANTITIES PER REEL |
|---|---|---|---|---|---|---|---|---|---|---|
| 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 | 2000 |
| 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 | 1000 |
| 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 | 1000 |
| 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 | 1000 |
| 8.0 × 8.0 × 10 | 0810 | 8.6 | 8.6 | 10.5 | 8.0 | 1.1 | 3.1 | 3.0 ±0.2 | ≈1.00 | 500 |
| 10 × 10 × 10 | 1010 | 10.6 | 10.6 | 10.5 | 10.0 | 1.1 | 4.7 | 3.3 ±0.2 | ≈1.30 | 500 |
| 10 × 10 × 12 | 1012 | 10.6 | 10.6 | 12.3 | 10.0 | 1.2 | 4.5 | 3.9 ±0.2 | ≈1.40 | 250 |
| 10 × 10 × 14 | 1014 | 10.6 | 10.6 | 14.3 | 10.0 | 1.2 | 4.5 | 3.9 ±0.2 | ≈1.50 | 250 |

## 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.

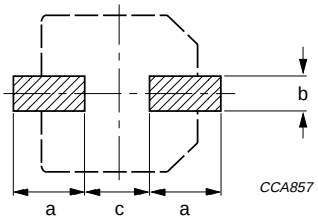
### Soldering

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.




Dimensions in mm.

Fig.3 Recommended soldering pad dimensions.

**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 |

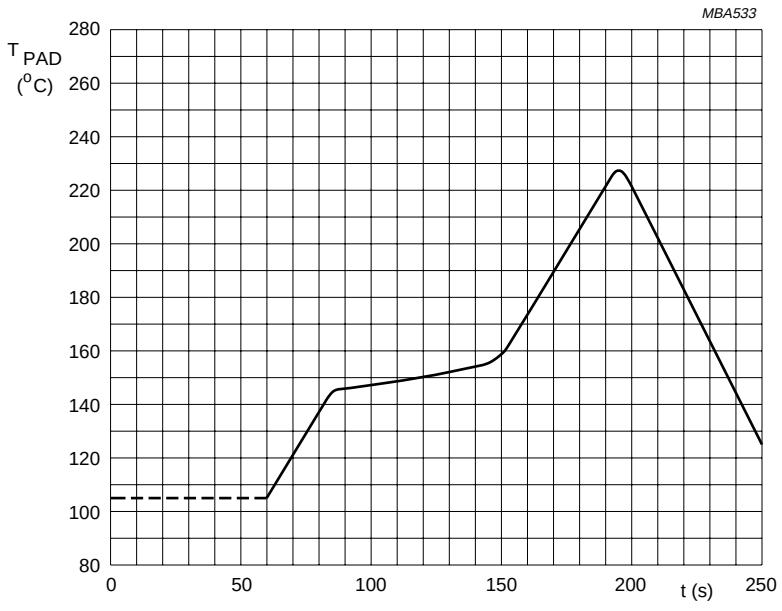



Fig.4 Maximum temperature load during infrared reflow soldering measured on the soldering pad.

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## ELECTRICAL DATA AND ORDERING INFORMATION

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

| 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 series

100 μF/25 V; ±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) | $C_R$ (μF) | NOMINAL CASE SIZE L × W × H (mm) | CASE CODE | $I_R$ 105 °C (mA) | $I_{L2}$ 2 min (μA) | Tan δ | ESR 100 kHz (Ω) | 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 |
| | **100** | **6.3 × 6.3 × 5.3** | **0605** | 61 | 6.3 | 0.30 | 2 | **153 63101** |
| | 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 |
| | **220** | **8.0 × 8.0 × 10** | **0810** | 180 | 22 | 0.26 | 0.5 | **153 64221** |
| | 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 | **10** | **4.0 × 4.0 × 5.3** | **0405** | 16 | 3.0 | 0.22 | 8 | **153 65109** |
| | 22 | 5.0 × 5.0 × 5.3 | 0505 | 28 | 3.5 | 0.22 | 4 | 153 65229 |
| | **47** | **6.3 × 6.3 × 5.3** | **0605** | 47 | 7.5 | 0.22 | 2.2 | **153 65479** |
| | 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 |
| | **470** | **10 × 10 × 14** | **1014** | 370 | 75 | 0.16 | 0.25 | **153 65471** |
| 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 |
| | **100** | **8.0 × 8.0 × 10** | **0810** | 180 | 25 | 0.16 | 0.5 | **153 66101** |
| | 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) | $C_R$ (μF) | NOMINAL CASE SIZE L × W × H (mm) | CASE CODE | $I_R$ 105 °C (mA) | $I_{L2}$ 2 min (μA) | Tan δ | ESR 100 kHz (Ω) | 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** |
| | 100 | 10 × 10 × 12 | 1012 | 230 | 50 | 0.12 | 0.29 | 153 91106 |
| 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 |

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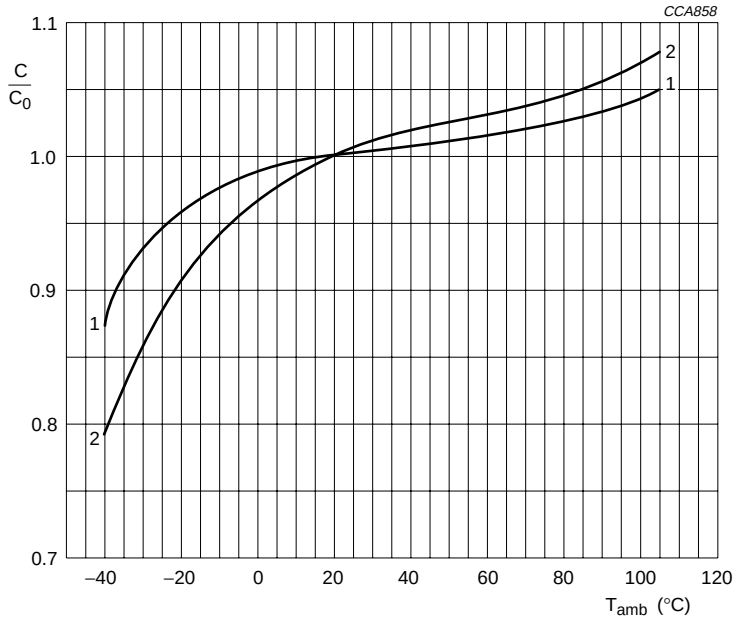
**Additional electrical data**

| PARAMETER | CONDITIONS | VALUE |
|---|---|---|
| **Voltage** | | |
| Surge voltage for short periods | IEC 384-18, subclause 4.14 | $U_s \leq 1.15 \times U_R$ |
| Reverse voltage for short periods | IEC 384-18, 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 1010 | typ. 15 nH |
| | case codes 1012 and 1014 | typ. 16 nH |

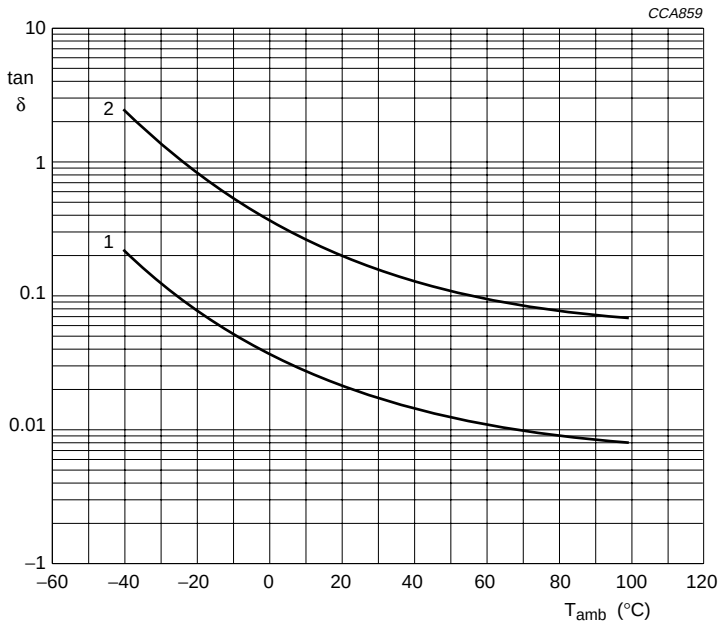
**Capacitance (C)**




Curve 1: 1 µF, 50 V.
Curve 2: 100 µF, 6.3 V.
$C_0$ = capacitance at 20 °C, 100 or 120 Hz.

Fig.5 Typical multiplier of capacitance as a function of ambient temperature.

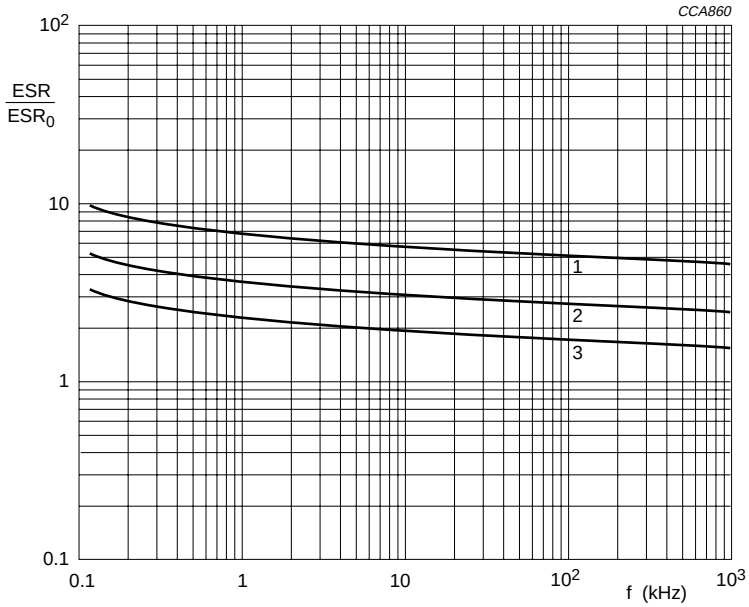
**Dissipation factor (tan δ)**




Curve 1: 1 µF, 50 V.
Curve 2: 100 µF, 6.3 V.
f = 100 or 120 Hz.

Fig.6 Typical dissipation factor (tan δ) as a function of ambient temperature.

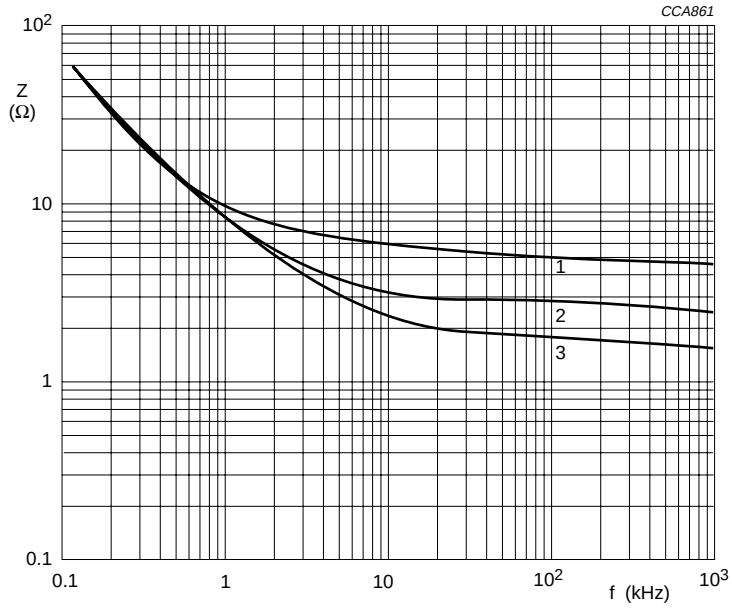
**Equivalent series resistance (ESR)**




Curve 1: 22 µF, 6.3 V.
Curve 2: 22 µF, 16 V.
Curve 3: 22 µF, 25 V.
$T_{amb}$ = 20 °C.

Fig.7 Typical ESR as a function of frequency.

**Impedance (Z)**




Curve 1: 22 µF, 6.3 V.
Curve 2: 22 µF, 16 V.
Curve 3: 22 µF, 25 V.
$T_{amb}$ = 20 °C.

Fig.8 Typical impedance as a function of frequency.

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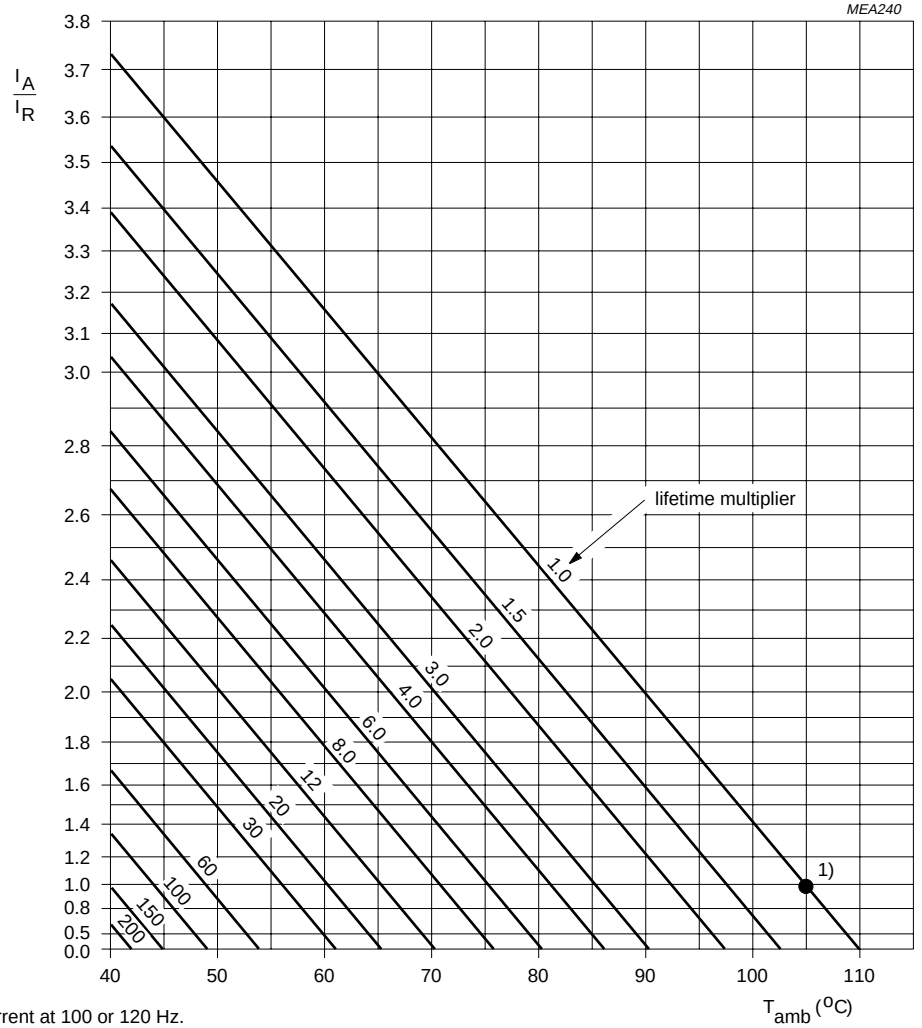
### RIPPLE CURRENT AND USEFUL LIFE

**Table 5** Multiplier of ripple current ($I_R$) as a function of frequency; $I_{RO}$ = ripple current at 100 or 120 Hz

| 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 |
| ≥10000 | 1.25 | 1.40 | 1.50 |




$I_A$ = 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: 2000 hours for case codes 0405 to 0605; 3000 hours for case codes 0807 to 1014.

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

**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 384-18, subclause 4.3 | shall be performed prior to tests mentioned below;<br>reflow soldering;<br>for maximum temperature load refer to Chapter "Mounting" | $\Delta C/C$: ±10%<br>tan $\delta \leq$ spec. limit<br>$I_{L2} \leq$ spec. limit |
| Endurance | IEC 384-18/ CECC 32300, subclause 4.15 | $T_{amb}$ = 105 °C; $U_R$ applied;<br>1000 hours, case codes 0405 to 0605<br>2000 hours, case codes 0807 to 1014 | $\Delta C/C$: ±20%<br>tan $\delta \leq 2 \times$ spec. limit<br>$I_{L2} \leq$ spec. limit |
| Useful life | CECC 30301, subclause 1.8.1 | $T_{amb}$ = 105 °C; $U_R$ and $I_R$ applied;<br>2000 hours, case codes 0405 to 0605<br>3000 hours, case codes 0807 to 1014 | $\Delta C/C$: ±50%<br>tan $\delta \leq 3 \times$ spec. limit<br>$I_{L2} \leq$ spec. limit<br>no short or open circuit<br>total failure percentage: ≤1% |
| Shelf life (storage at high temperature) | IEC 384-18/ CECC 32300, subclause 4.17 | $T_{amb}$ = 105 °C; no voltage applied;<br>1000 hours<br>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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