# Aluminum Capacitors
# SMD (Chip), Very Low Z

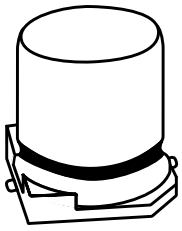
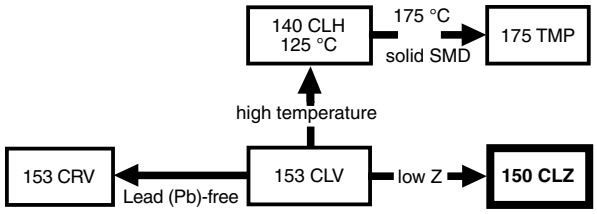


Fig.1 Component outline




## FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte, self healing
- SMD-version with base plate, reflow solderable
- Very low impedance, very high ripple current
- Very long useful life: 3000 hours at 105 °C
- Charge and discharge proof, no peak current limitation
- Lead (Pb)-free
- ATTENTION: for maximum safe soldering conditions refer to fig.4

## APPLICATIONS

- SMD technology, for high mounting density
- Industrial and professional applications
- Automotive, general industrial
- Smoothing, filtering, buffering.

## 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 bevelled edges)
- Code indicating group number (Z)

## PACKAGING

- Supplied in blister tape on reel

## QUICK REFERENCE DATA

| DESCRIPTION | VALUE |
|---|---|
| Nominal case sizes (L x W x H in mm) | 8 x 8 x 10 to 10 x 10 x 14 |
| Rated capacitance range, $C_R$ | 33 to 1000 µF |
| Tolerance on $C_R$ | ± 20 % |
| Rated voltage range, $U_R$ | 6.3 to 63 V |
| Category temperature range | - 55 to + 105 °C |
| Endurance test at 105 °C: | 2000 hours |
| Useful life at 105 °C:<br>case size ≤ 10 x 10 x 10<br>case size 10 x 10 x 14 | <br>2500 hours<br>3000 hours |
| Useful life at 40 °C; 1.8 x $I_R$ applied:<br>case size ≤ 10 x 10 x 10<br>case size 10 x 10 x 14 | <br>125 000 hours<br>150 000 hours |
| Shelf life at 0 V, 105 °C | 1000 hours |
| Based on sectional specification | IEC 60384-18/CECC32300 |
| Climatic category IEC 60068 | 55/105/56 |

## SELECTION CHART FOR $C_R$, $U_R$ AND RELEVANT NOMINAL CASE SIZES (L x W x H in mm)

| $C_R$ (mF) | $U_R$ (V) | | | | | | |
|---|---|---|---|---|---|---|---|
| | 6.3 | 10 | 16 | 25 | 35 | 50 | 63 |
| 33 | - | - | - | - | - | - | 8 x 8 x 10 |
| 47 | - | - | - | - | - | - | 8 x 8 x 10 |
| | - | - | - | - | - | - | 10 x 10 x 10 |
| 68 | - | - | - | - | - | 8 x 8 x 10 | 10 x 10 x 10 |
| 100 | - | - | - | - | 8 x 8 x 10 | 10 x 10 x 10 | 10 x 10 x 14 |
| 150 | - | - | - | 8 x 8 x 10 | - | - | - |
| 220 | - | - | 8 x 8 x 10 | 8 x 8 x 10 | 10 x 10 x 10 | 10 x 10 x 14 | - |
| 330 | - | 8 x 8 x 10 | 8 x 8 x 10 | 10 x 10 x 10 | 10 x 10 x 14 | - | - |
| 470 | 8 x 8 x 10 | 8 x 8 x 10 | 10 x 10 x 10 | 10 x 10 x 14 | - | - | - |
| 680 | - | 10 x 10 x 10 | 10 x 10 x 14 | - | - | - | - |
| 1000 | 10 x 10 x 10 | 10 x 10 x 14 | - | - | - | - | - |

**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** | **$L_{1\ max.}$** | **MASS (g)** |
| 8 x 8 x 10 | 0810 | 8.5 | 8.5 | 10.5 | 8.0 | 1.0 | 3.1 | 9.9 | ≈ 1.0 |
| 10 x 10 x 10 | 1010 | 10.5 | 10.5 | 10.5 | 10.0 | 1.0 | 4.5 | 11.8 | ≈ 1.3 |
| 10 x 10 x 14 | 1014 | 10.5 | 10.5 | 14.3 | 10.0 | 1.0 | 4.5 | 11.8 | ≈ 1.5 |

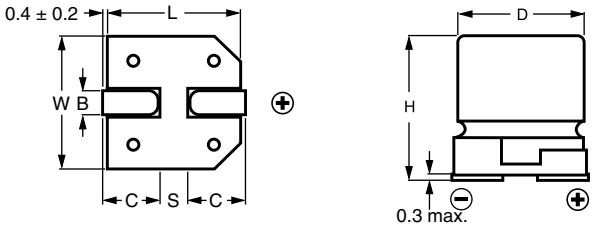



Fig. 2 Dimensional outline

**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 DIA.** | **PACKAGING QUANTITY PER REEL** |
| 8 x 8 x 10 | 0810 | 16 | 24 | 11.3 | 380 | 500 |
| 10 x 10 x 10 | 1010 | 16 | 24 | 11.3 | 380 | 500 |
| 10 x 10 x 14 | 1014 | 16 | 24 | 14.8 | 330 | 250 |

**Note**
1. Detailed tape dimensions see section “PACKAGING”.

## 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.

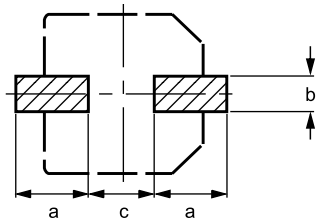



Fig.3 Recommended solder pad dimensions

## 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** |
| 0810 | 3.5 | 2.5 | 3.0 |
| 1010 | 4.3 | 2.5 | 4.0 |
| 1014 | 4.3 | 2.5 | 4.0 |

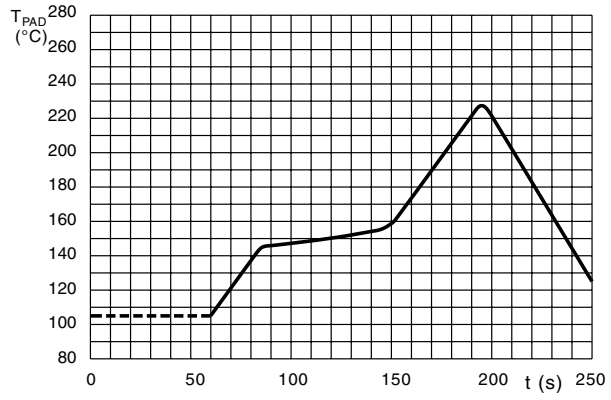



Fig.4 Maximum temperature load during infrared reflow soldering measured on the soldering pad

| ELECTRICAL DATA | |
|---|---|
| **SYMBOL** | **DESCRIPTION** |
| $C_R$ | rated capacitance at 100 Hz, tolerance ± 20 % |
| $I_R$ | rated RMS ripple current at 100 kHz, 105 °C |
| $I_{l2}$ | max. leakage current after 2 minutes at UR |
| Tan δ | max. dissipation factor at 100 Hz |
| Z | max. impedance at 100 kHz |

**Note**

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

## ORDERING EXAMPLE

Electrolytic capacitor 150 CLZ series

220 µF/50 V; ± 20 %

Nominal case size: 10 x 10 x 14 mm; taped on reel

Ordering code: MAL215095102E3
Former 12NC: 2222 150 95102

**Table 4**

| ELECTRICAL DATA AND ORDERING INFORMATION | | | | | | | |
|---|---|---|---|---|---|---|---|
| **$U_R$ (V)** | **$C_R$ (MF)** | **NOMINAL CASE SIZE L x W x H (mm)** | **$I_R$ 105 °C 100 kHz (mA)** | **$I_{L2}$ 2 min (mA)** | **Tan δ 100 Hz** | **Z 100 kHz (W)** | **ORDERING CODE MAL2150.....** |
| 6.3 | 470 | 8 x 8 x 10 | 435 | 30 | 0.24 | 0.25 | 95311E3 |
| | 1000 | 10 x 10 x 10 | 670 | 63 | 0.24 | 0.13 | 95301E3 |
| 10 | 330 | 8 x 8 x 10 | 435 | 33 | 0.20 | 0.25 | 95411E3 |
| | 470 | 8 x 8 x 10 | 435 | 47 | 0.20 | 0.25 | 95412E3 |
| | 680 | 10 x 10 x 10 | 670 | 68 | 0.20 | 0.13 | 95401E3 |
| | 1000 | 10 x 10 x 14 | 850 | 100 | 0.20 | 0.10 | 95402E3 |
| 16 | 220 | 8 x 8 x 10 | 435 | 35 | 0.16 | 0.25 | 95511E3 |
| | 330 | 8 x 8 x 10 | 435 | 53 | 0.16 | 0.25 | 95512E3 |
| | 470 | 10 x 10 x 10 | 670 | 75 | 0.16 | 0.13 | 95501E3 |
| | 680 | 10 x 10 x 14 | 850 | 109 | 0.16 | 0.10 | 95502E3 |
| 25 | 150 | 8 x 8 x 10 | 420 | 38 | 0.14 | 0.28 | 95611E3 |
| | 220 | 8 x 8 x 10 | 420 | 55 | 0.14 | 0.28 | 95612E3 |
| | 330 | 10 x 10 x 10 | 640 | 83 | 0.14 | 0.14 | 95601E3 |
| | 470 | 10 x 10 x 14 | 820 | 118 | 0.14 | 0.11 | 95602E3 |
| 35 | 100 | 8 x 8 x 10 | 405 | 35 | 0.12 | 0.30 | 95011E3 |
| | 220 | 10 x 10 x 10 | 630 | 77 | 0.12 | 0.15 | 95001E3 |
| | 330 | 10 x 10 x 14 | 790 | 116 | 0.12 | 0.12 | 95002E3 |
| 50 | 68 | 8 x 8 x 10 | 333 | 34 | 0.12 | 0.48 | 95111E3 |
| | 100 | 10 x 10 x 10 | 490 | 50 | 0.12 | 0.24 | 95101E3 |
| | 220 | 10 x 10 x 14 | 620 | 110 | 0.12 | 0.19 | 95102E3 |
| 63 | 33 | 8 x 8 x 10 | 270 | 21 | 0.10 | 0.65 | 95812E3 |
| | 47 | 8 x 8 x 10 | 270 | 30 | 0.10 | 0.65 | 95811E3 |
| | 47 | 10 x 10 x 10 | 390 | 30 | 0.10 | 0.38 | 95801E3 |
| | 68 | 10 x 10 x 10 | 390 | 43 | 0.10 | 0.38 | 95802E3 |
| | 100 | 10 x 10 x 14 | 507 | 63 | 0.10 | 0.29 | 95803E3 |

| ADDITIONAL ELECTRICAL DATA | | |
|---|---|---|
| **PARAMETER** | **CONDITIONS** | **VALUE** |
| **VOLTAGE** | | |
| Surge voltage for short periods | IEC 60384-18, subclause 4.14 | $U_s \leq 1.15 \times U_R$ |
| Reverse voltage for short periods | IEC 60384-18, subclause 4.16 | $U_{rev} \leq 1$ V |
| **CURRENT** | | |
| Leakage current | after 2 minutes at $U_R$ | $I_{L2} \leq 0.01 \times C_R \times U_R$ |
| **INDUCTANCE** | | |
| Equivalent series inductance (ESL) | | typ. 16 nH |
| **RESISTANCE** | | |
| Equivalent series resistance (ESR) at 100 Hz | calculated from tan $\delta_{max}$ and $C_R$ (see Table 4) | ESR = tan $\delta/2\ \pi f\ C_R$ |

## CAPACITANCE (C)

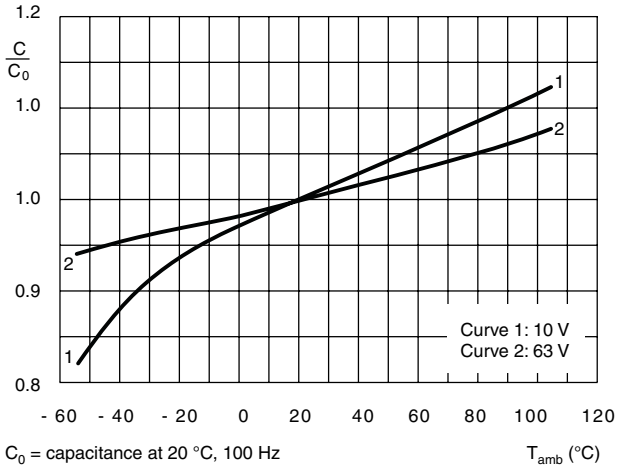



Fig.5 Typical multiplier of capacitance as a function of ambient temperatures

## DISSIPATION FACTOR (tan δ)

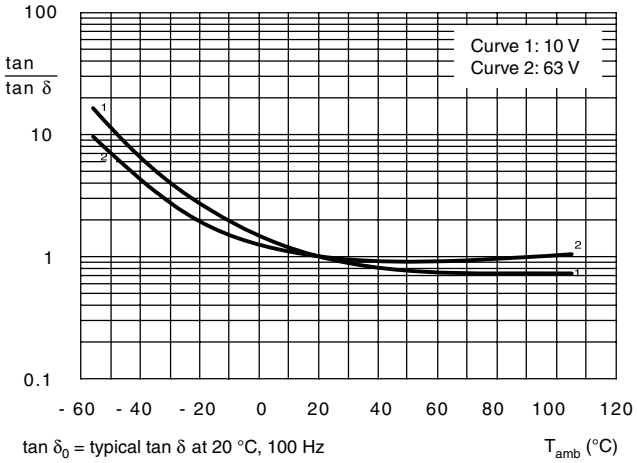



Fig.6 Typical multiplier of dissipation factor (tan δ) as a function of ambient temperatures

## EQUIVALENT SERIES RESISTANCE (ESR)

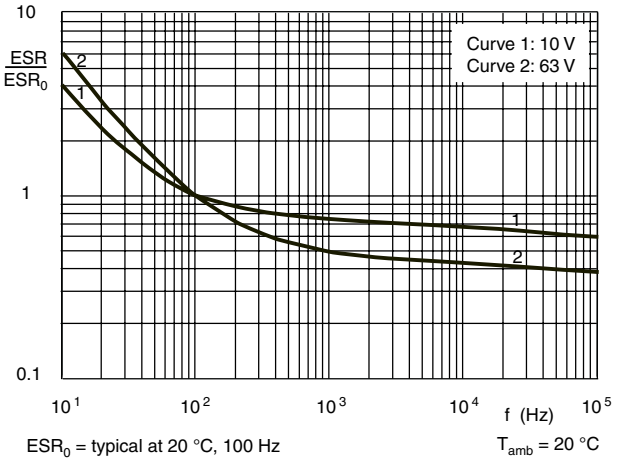



Fig.7 Typical multiplier of ESR as a function of frequency

## IMPEDANCE (Z)

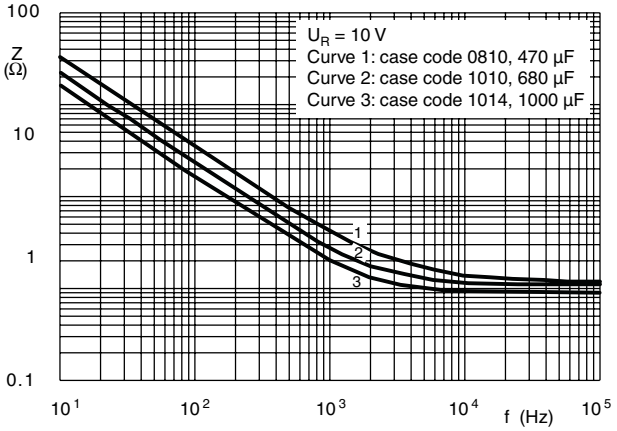



Fig.8 Typical impedance as a function of frequency

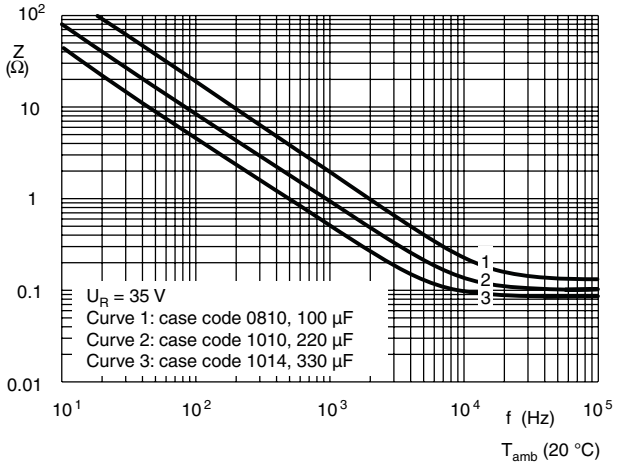



Fig.9 Typical impedance as a function of frequency

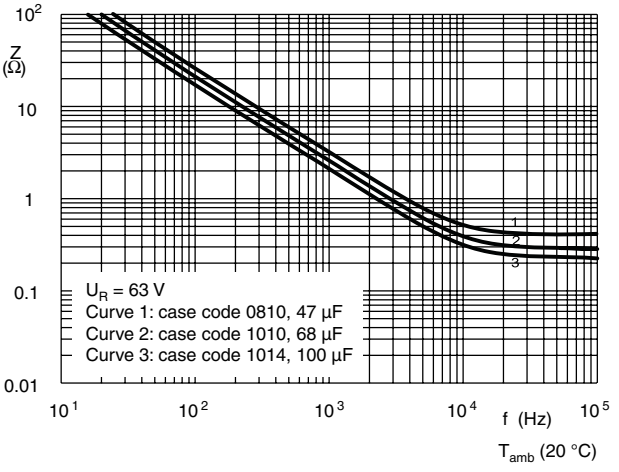
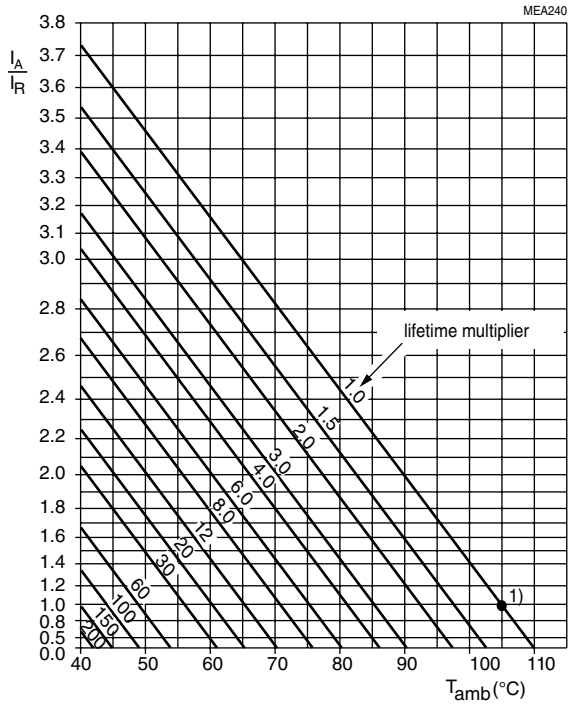



Fig.10 Typical impedance as a function of frequency

## RIPPLE CURRENT AND USEFUL LIFE




$I_A$ = actual ripple current at 100 kHz
$I_R$ = rated ripple current at 100 kHz, 105 °C
(1) = useful life at 105 °C and $I_R$ applied:
case code ≤ 1010 : 2500 h
case code = 1014 : 3000 h

Fig.11 Multiplier of useful life as a function of ambient temperature and ripple current load

| MULTIPLIER OF RIPPLE CURRENT ($I_R$) AS A FUNCTION OF FREQUENCY | | | |
|---|---|---|---|
| FREQUENCY (Hz) | $I_R$ MULTIPLIER | | |
| | $U_R$ = 6.3 to 25 V | $U_R$ = 35 V | $U_R$ = 50 to 63 V |
| 100 | 0.70 | 0.65 | 0.60 |
| 300 | 0.80 | 0.80 | 0.75 |
| 1000 | 0.85 | 0.85 | 0.85 |
| 3000 | 0.93 | 0.93 | 0.93 |
| 10 000 | 0.95 | 0.95 | 0.95 |
| 30 000 | 0.97 | 0.97 | 0.97 |
| 100 000 | 1.00 | 1.00 | 1.00 |

## TEST PROCEDURES AND REQUIREMENTS

| TEST | | PROCEDURE | REQUIREMENTS |
|---|---|---|---|
| NAME OF TEST | REFERENCE | (quick reference) | |
| Mounting | IEC 60384-18, subclause 4.3 | shall be performed prior to tests mentioned below;<br>reflow soldering;<br>for maximum temperature load<br>refer to chapter “Mounting” | $\Delta C/C$: ± 5 %<br>tan $\delta \leq$ spec. limit<br>$I_{L2} \leq$ spec. limit |
| Endurance | IEC 60384-18/ CECC32300, subclause 4.15 | $T_{amb}$ = 105 °C; $U_R$ applied;<br>2000 hours | $U_R$ = 6.3 V; $\Delta C/C$: ± 25 %<br>$U_R \geq$ 10 V; $\Delta C/C$: ± 20 %<br>tan $\delta \leq$ 2 x 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>case size ≤10 x 10 x 10: 2500 hours<br>case size = 10 x 10 x 14: 3000 hours, | $\Delta C/C$: ± 50 %<br>tan $\delta \leq$ 3 x 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 60384-18/ CECC32300, subclause 4.17 | $T_{amb}$ = 105 °C; no voltage applied;<br>1000 hours<br>after test: $U_R$ to be applied for 30 minutes,<br>24 to 48 hours before measurement | for requirements<br>see ‘Endurance test’ above |

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