

## Aluminum Capacitors SMD (Chip), High Temperature

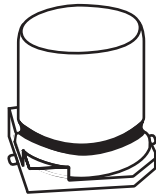
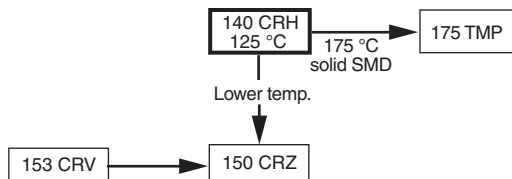


Fig.1 Component outline



### FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte, self healing
- SMD-version with base plate, lead (Pb)-free reflow solderable
- High temperature, 3000 h at 125 °C
- High capacitance values
- Very long useful life: 5000 h at 105 °C for case size  $\geq 12.5 \times 12.5 \times 13$
- Standard 4 pin-version for diameter  $\geq 12.5$  mm
- 4 pin-version for diameter 10 mm on request
- Charge and discharge proof, no peak current limitation
- Lead (Pb)-free and RoHS compliant
- ATTENTION: for maximum safe soldering conditions refer to Fig. 4


**RoHS**  
COMPLIANT

### APPLICATIONS

- SMD technology, for high mounting density
- Industrial and professional applications
- Automotive, general industrial
- Smoothing, filtering, buffering
- 4 pin-version for high vibration

### MARKING

- Rated capacitance (in  $\mu\text{F}$ )
- 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 (H)

### 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<br>to 12.5 x 12.5 x 16 |
| Rated capacitance range, $C_R$                                                                                                          | 10 to 1000 $\mu\text{F}$          |
| Tolerance on $C_R$                                                                                                                      | $\pm 20 \%$                       |
| Rated voltage range, $U_R$                                                                                                              | 6.3 to 63 V                       |
| Category temperature range                                                                                                              | - 55 to + 125 °C                  |
| Endurance test at 125 °C:<br>case size $\leq 10 \times 10 \times 14$<br>case size $\geq 12.5 \times 12.5 \times 13$                     | 1000 hours<br>2000 hours          |
| Useful life at 125 °C:<br>case size $\leq 10 \times 10 \times 14$<br>case size $\geq 12.5 \times 12.5 \times 13$                        | 1500 hours<br>3000 hours          |
| Useful life at 40 °C;<br>1.8 x $I_R$ applied:<br>case size $\leq 10 \times 10 \times 14$<br>case size $\geq 12.5 \times 12.5 \times 13$ | 150 000 hours<br>300 000 hours    |
| Shelf life at 0 V, 125 °C                                                                                                               | 1000 hours                        |
| Based on sectional specification                                                                                                        | IEC 60384-18/CECC32300            |
| Climatic category IEC 60068                                                                                                             | 55/125/56                         |

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

| $C_R$<br>( $\mu\text{F}$ ) | $U_R$ (V)    |                  |                  |                  |                  |                  |                  |
|----------------------------|--------------|------------------|------------------|------------------|------------------|------------------|------------------|
|                            | 6.3          | 10               | 16               | 25               | 35               | 50               | 63               |
| 10                         | -            | -                | -                | -                | -                | -                | 8 x 8 x 10       |
| 22                         | -            | -                | -                | -                | -                | -                | 8 x 8 x 10       |
| 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     | 10 x 10 x 14     |
| 100                        | -            | -                | -                | 8 x 8 x 10       | 10 x 10 x 10     | 10 x 10 x 14     | 12.5 x 12.5 x 13 |
| 150                        | -            | -                | 8 x 8 x 10       | -                | 10 x 10 x 14     | -                | 12.5 x 12.5 x 16 |
| 220                        | -            | 8 x 8 x 10       | -                | 10 x 10 x 10     | 12.5 x 12.5 x 13 | 12.5 x 12.5 x 13 | -                |
| 330                        | 8 x 8 x 10   | 10 x 10 x 10     | 10 x 10 x 14     | 12.5 x 12.5 x 13 | 12.5 x 12.5 x 13 | 12.5 x 12.5 x 16 | -                |
| 470                        | 10 x 10 x 10 | 10 x 10 x 14     | 12.5 x 12.5 x 13 | 12.5 x 12.5 x 16 | 12.5 x 12.5 x 16 | -                | -                |
| 680                        | 10 x 10 x 14 | 12.5 x 12.5 x 13 | 12.5 x 12.5 x 16 | -                | -                | -                | -                |
| 1000                       | -            | 12.5 x 12.5 x 16 | -                | -                | -                | -                | -                |

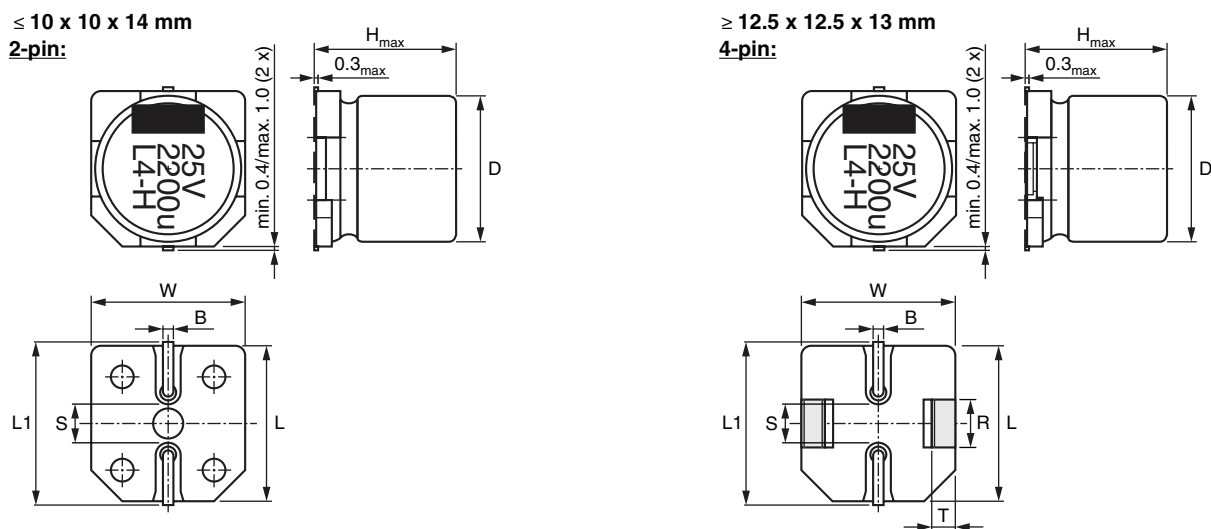


Fig.2 Dimensional outline

Table 1

| DIMENSIONS in millimeters AND MASS |           |                   |                   |                   |      |                   |     |                    |         |         |          |
|------------------------------------|-----------|-------------------|-------------------|-------------------|------|-------------------|-----|--------------------|---------|---------|----------|
| NOMINAL CASE SIZE<br>L x W x H     | CASE CODE | L <sub>max.</sub> | W <sub>max.</sub> | H <sub>max.</sub> | Ø D  | B <sub>max.</sub> | S   | L1 <sub>max.</sub> | R ± 0.1 | T ± 0.1 | MASS (g) |
| 8 x 8 x 10                         | 0810      | 8.5               | 8.5               | 10.5              | 8.0  | 1.0               | 2.2 | 9.9                | -       | -       | ≈ 1.0    |
| 10 x 10 x 10                       | 1010      | 10.5              | 10.5              | 10.5              | 10.0 | 1.0               | 3.5 | 11.8               | -       | -       | ≈ 1.3    |
| 10 x 10 x 14                       | 1014      | 10.5              | 10.5              | 14.3              | 10.0 | 1.0               | 3.5 | 11.8               | -       | -       | ≈ 1.5    |
| 12.5 x 12.5 x 13                   | 1213      | 12.8              | 12.8              | 14.0              | 12.5 | 1.3               | 3.6 | 14.9               | 3.7     | 2.4     | ≈ 2.6    |
| 12.5 x 12.5 x 16                   | 1216      | 12.8              | 12.8              | 16.5              | 12.5 | 1.3               | 3.6 | 14.9               | 3.7     | 2.4     | ≈ 2.8    |

Table 2

| TAPE AND REEL DIMENSIONS in millimeters, PACKAGING QUANTITIES |           |                         |                 |                                  |               |                                |
|---------------------------------------------------------------|-----------|-------------------------|-----------------|----------------------------------|---------------|--------------------------------|
| NOMINAL CASE SIZE<br>L x W x H                                | CASE CODE | PITCH<br>P <sub>1</sub> | TAPE WIDTH<br>W | TAPE THICKNESS<br>T <sub>2</sub> | REEL DIAMETER | PACKAGING QUANTITY<br>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                            |
| 12.5 x 12.5 x 13                                              | 1213      | 20                      | 24              | 15.5                             | 380           | 250                            |
| 12.5 x 12.5 x 16                                              | 1216      | 24                      | 32              | 17.5                             | 380           | 200                            |

#### Note

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.

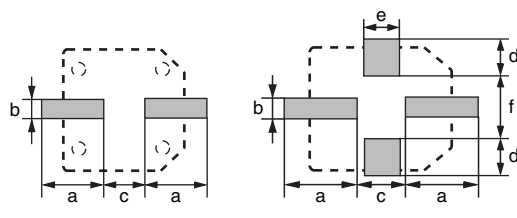
#### SOLDERING

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.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.



Case size Ø D ≤ 10 mm

Case size Ø D ≥ 12.5 mm

Fig.3 Recommended soldering pad dimensions

Table 3

| RECOMMENDED SOLDERING PAD DIMENSIONS in millimeters |     |     |     |     |     |     |
|-----------------------------------------------------|-----|-----|-----|-----|-----|-----|
| CASE CODE                                           | a   | b   | c   | d   | e   | f   |
| 0810                                                | 3.5 | 2.5 | 3.0 | -   | -   | -   |
| 1010                                                | 4.3 | 2.5 | 4.0 | -   | -   | -   |
| 1014                                                | 4.3 | 2.5 | 4.0 | -   | -   | -   |
| 1213                                                | 5.5 | 2.5 | 4.0 | 4.2 | 5.0 | 5.6 |
| 1216                                                | 5.5 | 2.5 | 4.0 | 4.2 | 5.0 | 5.6 |

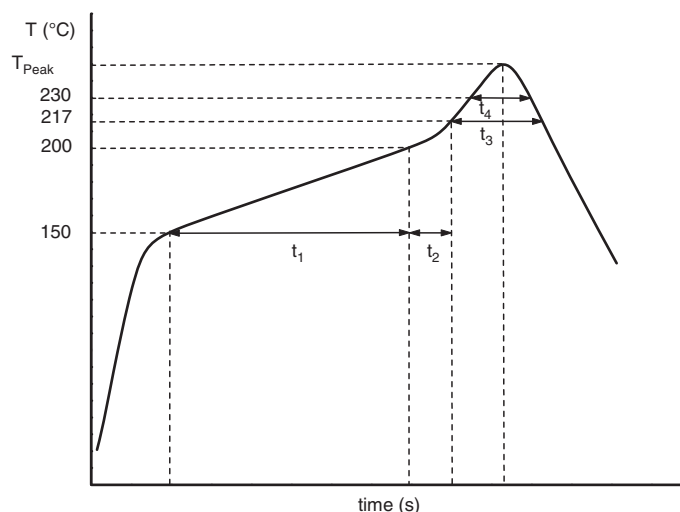


Fig.4 Maximum temperature load during reflow soldering

Table 4

| REFLOW SOLDERING CONDITIONS                       |                           |                           |
|---------------------------------------------------|---------------------------|---------------------------|
| PROFILE FEATURES                                  | CASE CODE<br>0810 to 1014 | CASE CODE<br>1213 to 1216 |
| Max. time from 25 °C to $T_{Peak}$                | 240 s                     | 200 s                     |
| Max. ramp-up rate to 150 °C                       | 3 K/s                     | 3 K/s                     |
| Max. time from 150 °C to 200 °C, ( $t_1$ )        | 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          |
| Max. time from 200 °C to 217 °C, ( $t_2$ )        | 60 s                      | 60 s                      |
| Max. time above $T_{Liquidus}$ (217 °C) ( $t_3$ ) | 90 s                      | 60 s                      |
| Max. time above 230 °C ( $t_4$ )                  | 40 s                      | 30 s                      |
| Peak temperature $T_{Peak}$                       | 250 °C                    | 240 °C                    |
| Max. time above $T_{Peak}$ minus 5 °C             | 5 s                       | 10 s                      |
| Max. ramp-down rate from $T_{Liquidus}$           | 6 K/s                     | 6 K/s                     |

**Note**

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

Aluminum Capacitors  
SMD (Chip), High Temperature

Vishay BCcomponents

| ELECTRICAL DATA |                                                   |
|-----------------|---------------------------------------------------|
| SYMBOL          | DESCRIPTION                                       |
| $C_R$           | rated capacitance at 100 Hz, tolerance $\pm 20\%$ |
| $I_R$           | rated RMS ripple current at 100 kHz, 125 °C       |
| $I_{L2}$        | max. leakage current after 2 minutes at $U_R$     |
| $\tan \delta$   | max. dissipation factor at 100 Hz                 |
| $Z$             | max. impedance at 100 kHz                         |

**Note**

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

**ORDERING EXAMPLE**

Electrolytic capacitor 140 CRH series

100  $\mu\text{F}$ /50 V;  $\pm 20\%$ 

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

Ordering Code: MAL214097102E3

Former 12NC: 2222 140 97102

Table 5

| ELECTRICAL DATA AND ORDERING INFORMATION |                            |                                           |                                    |                                        |                         |                                         |                               |
|------------------------------------------|----------------------------|-------------------------------------------|------------------------------------|----------------------------------------|-------------------------|-----------------------------------------|-------------------------------|
| $U_R$<br>(V)                             | $C_R$<br>( $\mu\text{F}$ ) | NOMINAL<br>CASE SIZE<br>L x W x H<br>(mm) | $I_R$<br>100 kHz<br>125 °C<br>(mA) | $I_{L2}$<br>2 min<br>( $\mu\text{A}$ ) | $\tan \delta$<br>100 Hz | $Z$<br>100 kHz<br>20 °C<br>( $\Omega$ ) | ORDERING CODE<br>MAL2140..... |
| 6.3                                      | 330                        | 8 x 8 x 10                                | 180                                | 21                                     | 0.30                    | 0.40                                    | 97303E3                       |
|                                          | 470                        | 10 x 10 x 10                              | 300                                | 30                                     | 0.30                    | 0.25                                    | 97301E3                       |
|                                          | 680                        | 10 x 10 x 14                              | 430                                | 43                                     | 0.30                    | 0.12                                    | 97302E3                       |
| 10                                       | 220                        | 8 x 8 x 10                                | 180                                | 22                                     | 0.26                    | 0.40                                    | 97403E3                       |
|                                          | 330                        | 10 x 10 x 10                              | 300                                | 33                                     | 0.26                    | 0.25                                    | 97401E3                       |
|                                          | 470                        | 10 x 10 x 14                              | 430                                | 47                                     | 0.26                    | 0.12                                    | 97402E3                       |
|                                          | 680                        | 12.5 x 12.5 x 13                          | 750                                | 68                                     | 0.22                    | 0.12                                    | 97411E3                       |
|                                          | 1000                       | 12.5 x 12.5 x 16                          | 900                                | 100                                    | 0.22                    | 0.09                                    | 97412E3                       |
| 16                                       | 150                        | 8 x 8 x 10                                | 180                                | 24                                     | 0.22                    | 0.40                                    | 97502E3                       |
|                                          | 330                        | 10 x 10 x 14                              | 430                                | 53                                     | 0.22                    | 0.20                                    | 97501E3                       |
|                                          | 470                        | 12.5 x 12.5 x 13                          | 750                                | 75                                     | 0.18                    | 0.12                                    | 97511E3                       |
|                                          | 680                        | 12.5 x 12.5 x 16                          | 900                                | 108                                    | 0.18                    | 0.09                                    | 97512E3                       |
| 25                                       | 100                        | 8 x 8 x 10                                | 180                                | 25                                     | 0.18                    | 0.40                                    | 97602E3                       |
|                                          | 220                        | 10 x 10 x 10                              | 300                                | 55                                     | 0.18                    | 0.25                                    | 97601E3                       |
|                                          | 330                        | 12.5 x 12.5 x 13                          | 750                                | 82                                     | 0.16                    | 0.12                                    | 97611E3                       |
|                                          | 470                        | 12.5 x 12.5 x 16                          | 900                                | 117                                    | 0.16                    | 0.09                                    | 97612E3                       |
| 35                                       | 68                         | 8 x 8 x 10                                | 180                                | 24                                     | 0.14                    | 0.40                                    | 97003E3                       |
|                                          | 100                        | 10 x 10 x 10                              | 255                                | 35                                     | 0.14                    | 0.25                                    | 97001E3                       |
|                                          | 150                        | 10 x 10 x 14                              | 317                                | 53                                     | 0.14                    | 0.20                                    | 97002E3                       |
|                                          | 220                        | 12.5 x 12.5 x 13                          | 750                                | 77                                     | 0.14                    | 0.12                                    | 97011E3                       |
|                                          | 330                        | 12.5 x 12.5 x 13                          | 750                                | 115                                    | 0.14                    | 0.12                                    | 97012E3                       |
|                                          | 470                        | 12.5 x 12.5 x 16                          | 900                                | 164                                    | 0.14                    | 0.09                                    | 97013E3                       |
| 50                                       | 47                         | 8 x 8 x 10                                | 145                                | 24                                     | 0.14                    | 0.70                                    | 97103E3                       |
|                                          | 68                         | 10 x 10 x 10                              | 205                                | 34                                     | 0.14                    | 0.50                                    | 97101E3                       |
|                                          | 100                        | 10 x 10 x 14                              | 255                                | 50                                     | 0.14                    | 0.40                                    | 97102E3                       |
|                                          | 220                        | 12.5 x 12.5 x 13                          | 750                                | 110                                    | 0.12                    | 0.23                                    | 97111E3                       |
|                                          | 330                        | 12.5 x 12.5 x 16                          | 900                                | 165                                    | 0.12                    | 0.18                                    | 97112E3                       |
| 63                                       | 10                         | 8 x 8 x 10                                | 145                                | 6.3                                    | 0.12                    | 0.70                                    | 97805E3                       |
|                                          | 22                         | 8 x 8 x 10                                | 145                                | 14                                     | 0.12                    | 0.70                                    | 97803E3                       |
|                                          | 33                         | 8 x 8 x 10                                | 145                                | 21                                     | 0.12                    | 0.70                                    | 97804E3                       |
|                                          | 47                         | 10 x 10 x 10                              | 205                                | 30                                     | 0.12                    | 0.50                                    | 97801E3                       |
|                                          | 68                         | 10 x 10 x 14                              | 255                                | 43                                     | 0.12                    | 0.40                                    | 97802E3                       |
|                                          | 100                        | 12.5 x 12.5 x 13                          | 500                                | 63                                     | 0.14                    | 0.25                                    | 97811E3                       |
|                                          | 220                        | 12.5 x 12.5 x 16                          | 600                                | 138                                    | 0.14                    | 0.20                                    | 97812E3                       |

| ADDITIONAL ELECTRICAL DATA                   |                                                             |                                      |
|----------------------------------------------|-------------------------------------------------------------|--------------------------------------|
| PARAMETER                                    | CONDITIONS                                                  | VALUE                                |
| <b>Voltage</b>                               |                                                             |                                      |
| 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                                | $U_{rev} \leq 1 \text{ V}$           |
| <b>Current</b>                               |                                                             |                                      |
| Leakage current                              | After 2 minutes at $U_R$                                    | $IL2 \leq 0.0 \times C_R \times U_R$ |
| <b>Inductance</b>                            |                                                             |                                      |
| Equivalent series inductance (ESL)           | $\varnothing D = 8 \text{ mm}$                              | typ. 6 nH                            |
|                                              | $\varnothing D = 10 \text{ mm}$                             | typ. 8 nH                            |
|                                              | $\varnothing D \geq 12.5 \text{ mm}$                        | typ. 11 nH                           |
| <b>Resistance</b>                            |                                                             |                                      |
| Equivalent series resistance (ESR) at 100 Hz | Calculated from $\tan \delta_{max}$ and $C_R$ (see Table 4) | $ESR = \tan \delta / 2 \pi f C_R$    |

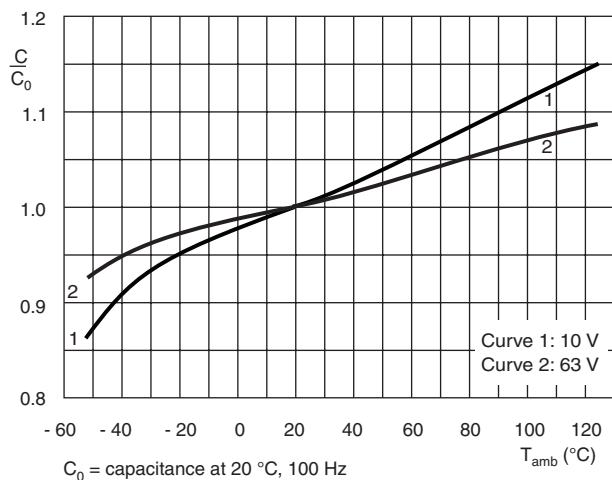
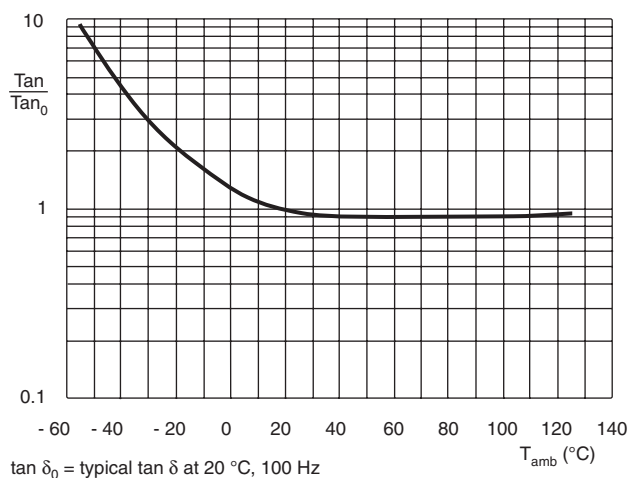
**CAPACITANCE (C)**

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

**DISSIPATION FACTOR ( $\tan \delta$ )**Fig.6 Multiplier of dissipation factor ( $\tan \delta$ ) as function of ambient temperature

### EQUIVALENT SERIES RESISTANCE (ESR)

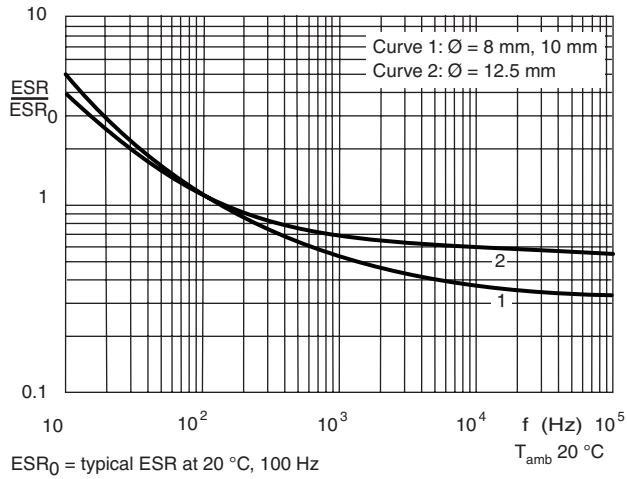


Fig.7 Typical multiplier of ESR as function of frequency

### IMPEDANCE (ESR)

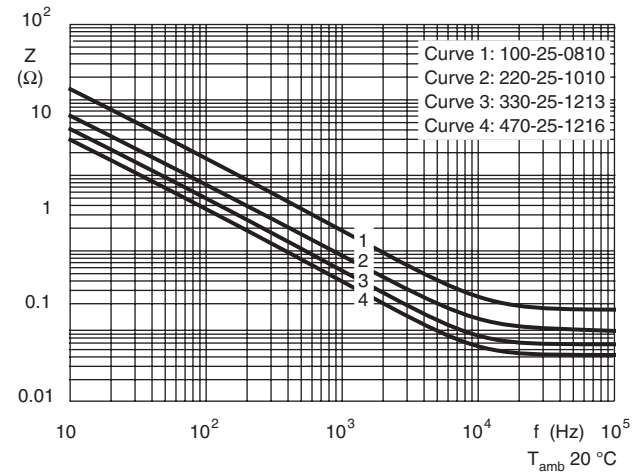


Fig.8 Typical impedance as function of frequency

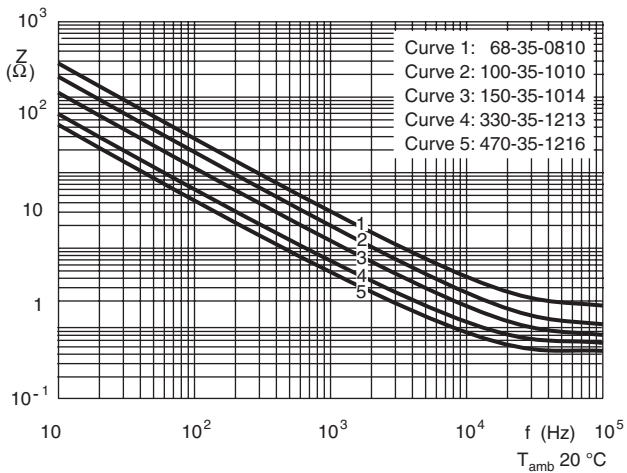


Fig.9 Typical impedance as function of frequency

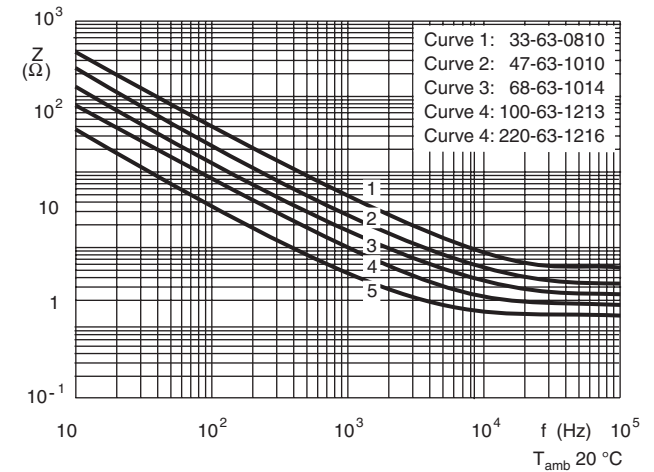


Fig.10 Typical impedance as function of frequency

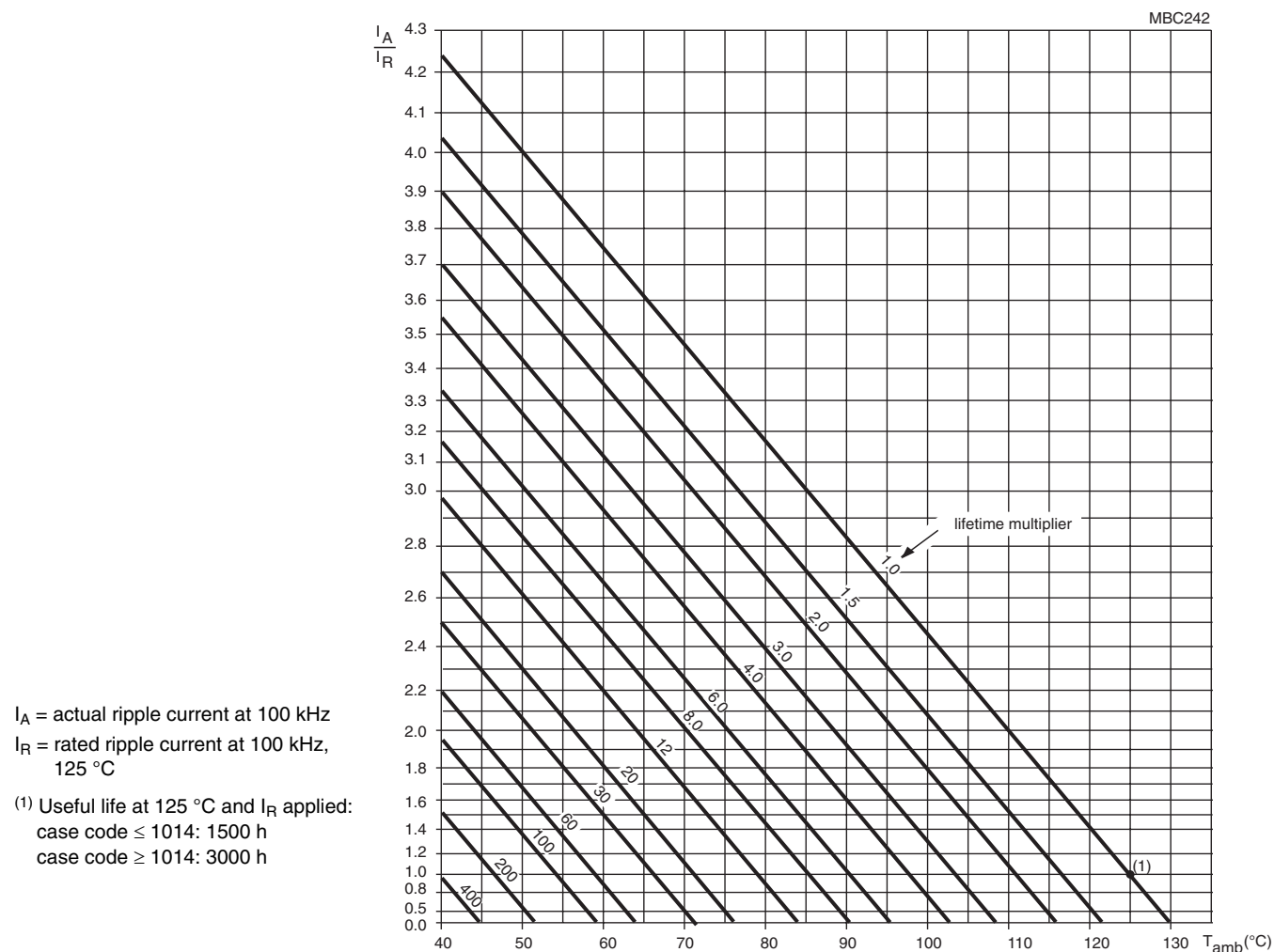
**RIPPLE CURRENT AND USEFUL LIFE**

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

Table 6

| MULTIPLIER OF RIPPLE CURRENT ( $I_R$ ) AS A FUNCTION OF FREQUENCY |                     |                     |              |
|-------------------------------------------------------------------|---------------------|---------------------|--------------|
| FREQUENCY<br>(Hz)                                                 | $I_R$ MULTIPLIER    |                     |              |
|                                                                   | $U_R = 6.3$ to 25 V | $U_R = 35$ and 50 V | $U_R = 63$ V |
| 50                                                                | 0.60                | 0.45                | 0.40         |
| 100                                                               | 0.70                | 0.60                | 0.55         |
| 300                                                               | 0.80                | 0.75                | 0.70         |
| 1000                                                              | 0.85                | 0.85                | 0.85         |
| 3000                                                              | 0.90                | 0.90                | 0.90         |
| 10 000                                                            | 0.95                | 0.95                | 0.95         |
| 30 000                                                            | 0.97                | 0.97                | 0.97         |
| 100 000                                                           | 1.00                | 1.00                | 1.00         |

Table 7

| <b>TEST PROCEDURES AND REQUIREMENTS</b>        |                                                 |                                                                                                                                                                             |                                                                                                                                                                                            |
|------------------------------------------------|-------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>TEST</b>                                    |                                                 | <b>PROCEDURE<br/>(quick reference)</b>                                                                                                                                      | <b>REQUIREMENTS</b>                                                                                                                                                                        |
| <b>NAME OF TEST</b>                            | <b>REFERENCE</b>                                |                                                                                                                                                                             |                                                                                                                                                                                            |
| Mounting                                       | IEC 60384-18,<br>subclause 4.3                  | shall be performed prior to tests mentioned below;<br>reflow soldering;<br>for maximum temperature load<br>refer to chapter "Mounting"                                      | $\Delta C/C: \pm 5 \%$<br>$\tan \delta \leq \text{spec. limit}$<br>$I_{L2} \leq \text{spec. limit}$                                                                                        |
| Endurance                                      | IEC 60384-18/<br>CECC 32 300,<br>subclause 4.15 | $T_{\text{amb}} = 125^\circ\text{C}$ ; $U_R$ applied;<br>case size $\leq 10 \times 10 \times 14$ : 1000 h<br>case size $\geq 12.5 \times 12.5 \times 13$ : 2000 h           | $U_R = 6.3 \text{ V}$ ; $\Delta C/C: \pm 25 \%$<br>$U_R \geq 10 \text{ V}$ ; $\Delta C/C: \pm 20 \%$<br>$\tan \delta \leq 2 \times \text{spec. limit}$<br>$I_{L2} \leq \text{spec. limit}$ |
| Useful life                                    | CECC 30301,<br>subclause 1.8.1                  | $T_{\text{amb}} = 125^\circ\text{C}$ ; $U_R$ and $I_R$ applied;<br>case size $\leq 10 \times 10 \times 14$ : 1500 h<br>case size $\geq 12.5 \times 12.5 \times 13$ : 3000 h | $\Delta C/C: \pm 50 \%$<br>$\tan \delta \leq 3 \times \text{spec. limit}$<br>$I_{L2} \leq \text{spec. limit}$<br>no short or open circuit'<br>total failure percentage: $\leq 1 \%$        |
| Shelf life<br>(storage at high<br>temperature) | IEC 60384-18/<br>CECC 32 300,<br>subclause 4.17 | $T_{\text{amb}} = 125^\circ\text{C}$ ; no voltage applied;<br>1000 h<br>after test: $U_R$ to be applied for 30 min,<br>24 to 48 h before measurement                        | for requirements<br>see 'Endurance test' above                                                                                                                                             |
| Reverse voltage                                | IEC 60384-18/<br>CECC 32 300,<br>subclause 4.16 | $T_{\text{amb}} = 125^\circ\text{C}$ :<br>125 h at $U = -0.5 \text{ V}$ ,<br>followed by 125 h at $U_R$                                                                     | $\Delta C/C: \pm 15 \%$<br>$\tan \delta \leq 1.5 \times \text{spec. limit}$<br>$I_{L2} \leq \text{spec. limit}$                                                                            |



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- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов;
- Поставка более 17-ти миллионов наименований электронных компонентов;
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- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
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- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



#### Как с нами связаться

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