

## Conductive Polymer Aluminum Capacitors SMD (Chip), Low Impedance

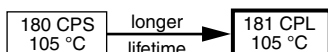


Fig. 1


**RoHS**  
COMPLIANT

### FEATURES

- Long useful life: up to 5000 h at 105 °C
- Very low ESR and highest ripple current
- SMD-version with base plate, lead (Pb)-free reflow solderable
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)

### APPLICATIONS

- SMD technology, for high temperature reflow soldering
- Industrial and professional applications
- Telecommunications and IT
- Portable and mobile equipment

### MARKING

- Rated capacitance (in  $\mu\text{F}$ )
- Rated voltage (in V)
- Date code, in accordance with IEC 60062
- Blue mark or “-” sign indicating the cathode (the anode is identified by bevelled edges)
- Code indicating group number (L)

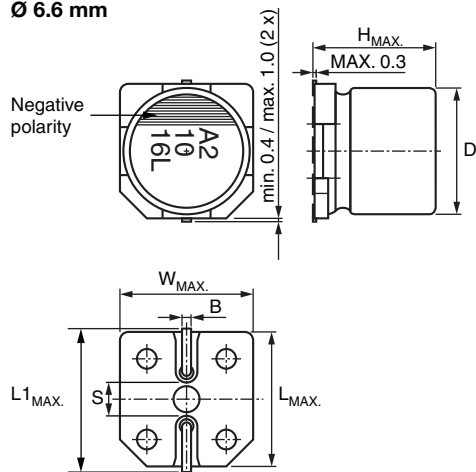
### PACKAGING

Supplied in blister tape on reel

| QUICK REFERENCE DATA                    |                                          |
|-----------------------------------------|------------------------------------------|
| DESCRIPTION                             | VALUE                                    |
| Nominal case sizes<br>(L x W x H in mm) | 6.6 x 6.6 x 5.9<br>to 10.4 x 10.4 x 12.6 |
| Rated capacitance range, $C_R$          | 18 $\mu\text{F}$ to 820 $\mu\text{F}$    |
| Tolerance on $C_R$                      | $\pm 20 \%$                              |
| Rated voltage range, $U_R$              | 4.0 V to 35 V                            |
| Category temperature range              | -55 °C to +105 °C                        |
| Endurance test at 105 °C                | 5000 h                                   |
| Useful life at 105 °C                   | 5000 h                                   |
| Shelf life at 0 V, 105 °C               | 1000 h                                   |
| Based on sectional<br>specification     | IEC 60384-18 / CECC 32300                |
| 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) |                                    |                                    |                                      |                    |                    |                    |                    |
|---------------------------------------------------------------------------------------|------------------------------------|------------------------------------|--------------------------------------|--------------------|--------------------|--------------------|--------------------|
| $C_R$<br>( $\mu F$ )                                                                  | $U_R$ (V)                          |                                    |                                      |                    |                    |                    |                    |
|                                                                                       | 4.0                                | 6.3                                | 10                                   | 16                 | 20                 | 25                 | 35                 |
| 18                                                                                    | →                                  | →                                  | →                                    | →                  | →                  | →                  | 6.6 x 6.6 x 5.9    |
| 39                                                                                    | →                                  | →                                  | →                                    | 6.6 x 6.6 x 5.9    | -                  | -                  | -                  |
| 47                                                                                    | →                                  | →                                  | →                                    | →                  | →                  | 6.6 x 6.6 x 5.9    | -                  |
| 56                                                                                    | →                                  | →                                  | 6.6 x 6.6 x 5.9                      | →                  | 6.6 x 6.6 x 5.9    | -                  | -                  |
| 68                                                                                    | →                                  | →                                  | 6.6 x 6.6 x 5.9                      | 6.6 x 6.6 x 5.9    | -                  | -                  | -                  |
| 82                                                                                    | →                                  | →                                  | →                                    | 8.4 x 8.4 x 6.7    | →                  | →                  | 8.4 x 8.4 x 12     |
| 100                                                                                   | →                                  | 6.6 x 6.6 x 5.9                    | →                                    | 10.4 x 10.4 x 7.7  | -                  | -                  | -                  |
| 120                                                                                   | →                                  | 6.6 x 6.6 x 5.9                    | 6.6 x 6.6 x 5.9                      | 8.4 x 8.4 x 6.7    | -                  | -                  | -                  |
| 150                                                                                   | 6.6 x 6.6 x 5.9                    | →                                  | 8.4 x 8.4 x 6.7<br>10.4 x 10.4 x 7.7 | 8.4 x 8.4 x 6.7    | →                  | 8.4 x 8.4 x 12     | 10.4 x 10.4 x 12.6 |
| 180                                                                                   | →                                  | →                                  | →                                    | 10.4 x 10.4 x 7.7  | -                  | -                  | -                  |
| 220                                                                                   | →                                  | 6.6 x 6.6 x 5.9<br>8.4 x 8.4 x 6.7 | -                                    | -                  | -                  | -                  | -                  |
| 270                                                                                   | 8.4 x 8.4 x 6.7                    | →                                  | 8.4 x 8.4 x 6.7                      | →                  | 8.4 x 8.4 x 12     | 10.4 x 10.4 x 12.6 | -                  |
| 330                                                                                   | 6.6 x 6.6 x 5.9<br>8.4 x 8.4 x 6.7 | →                                  | 10.4 x 10.4 x 7.7                    | -                  | -                  | -                  | -                  |
| 390                                                                                   | →                                  | 8.4 x 8.4 x 6.7                    | →                                    | →                  | 8.4 x 8.4 x 12     | -                  | -                  |
| 470                                                                                   | →                                  | 10.4 x 10.4 x 7.7                  | →                                    | →                  | 10.4 x 10.4 x 12.6 | -                  | -                  |
| 560                                                                                   | 8.4 x 8.4 x 6.7                    | -                                  | -                                    | -                  | -                  | -                  | -                  |
| 680                                                                                   | 10.4 x 10.4 x 7.7                  | -                                  | -                                    | -                  | -                  | -                  | -                  |
| 820                                                                                   | →                                  | →                                  | →                                    | 10.4 x 10.4 x 12.6 | -                  | -                  | -                  |

**2-pin:**  
**Ø 6.6 mm**



**2-pin:**  
**≥ Ø 8.4 mm**

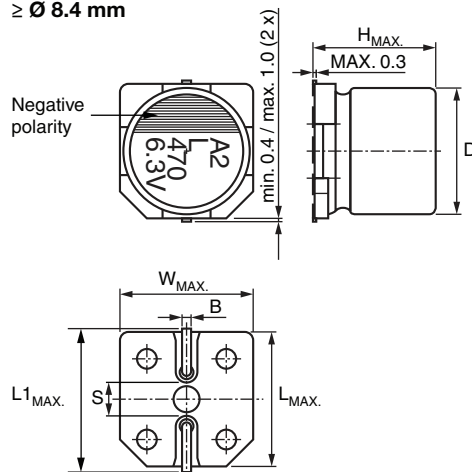


Fig. 2 - Dimensional outline

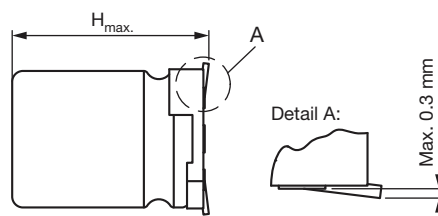


Fig. 3 - Coplanarity of pins

Table 1

| <b>DIMENSIONS</b> in millimeters <b>AND MASS</b> |              |                   |                   |                   |     |                   |     |                    |             |
|--------------------------------------------------|--------------|-------------------|-------------------|-------------------|-----|-------------------|-----|--------------------|-------------|
| NOMINAL<br>CASE SIZE<br>L x W x H                | CASE<br>CODE | L <sub>MAX.</sub> | W <sub>MAX.</sub> | H <sub>MAX.</sub> | Ø D | B <sub>MAX.</sub> | S   | L1 <sub>MAX.</sub> | MASS<br>(g) |
| 6.6 x 6.6 x 5.9                                  | 0606         | 6.8               | 6.8               | 6                 | 6.3 | 0.8               | 2.0 | 7.4                | ~ 0.25      |
| 8.4 x 8.4 x 6.7                                  | 0807         | 8.6               | 8.6               | 7                 | 8   | 1.1               | 3.1 | 9.2                | ~ 0.5       |
| 8.4 x 8.4 x 12                                   | 0812         | 8.6               | 8.6               | 12.5              | 8   | 1.1               | 3.1 | 9.2                | ~ 0.8       |
| 10.4 x 10.4 x 7.7                                | 1008         | 10.6              | 10.6              | 8                 | 10  | 1.3               | 4.7 | 11.2               | ~ 0.9       |
| 10.4 x 10.4 x 12.6                               | 1013         | 10.6              | 10.6              | 12.7              | 10  | 1.3               | 4.7 | 11.2               | ~ 1.3       |

Table 2

| <b>TAPE AND REEL DIMENSIONS</b> in millimeters, <b>PACKAGING QUANTITIES</b> |              |                         |                 |                                     |               |                                   |
|-----------------------------------------------------------------------------|--------------|-------------------------|-----------------|-------------------------------------|---------------|-----------------------------------|
| NOMINAL<br>CASE SIZE<br>L x W x H                                           | CASE<br>CODE | PITCH<br>P <sub>1</sub> | TAPE WIDTH<br>W | TAPE<br>THICKNESS<br>T <sub>2</sub> | REEL DIAMETER | PACKAGING<br>QUANTITY<br>PER REEL |
| 6.6 x 6.6 x 5.9                                                             | 0606         | 12                      | 16              | 6.2                                 | 380           | 1000                              |
| 8.4 x 8.4 x 6.7                                                             | 0807         | 12                      | 16              | 6.8                                 | 380           | 1000                              |
| 8.4 x 8.4 x 12                                                              | 0812         | 16                      | 16              | 13.0                                | 380           | 400                               |
| 10.4 x 10.4 x 7.7                                                           | 1008         | 16                      | 24              | 10.0                                | 380           | 500                               |
| 10.4 x 10.4 x 12.6                                                          | 1013         | 16                      | 24              | 14.0                                | 380           | 400                               |

## 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. 4 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. 5.

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.

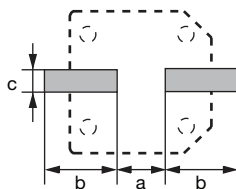


Fig. 4 - Recommended soldering pad dimensions

Table 3

| RECOMMENDED SOLDERING PAD DIMENSIONS in millimeters |     |     |     |
|-----------------------------------------------------|-----|-----|-----|
| CASE CODE                                           | a   | b   | c   |
| 0606                                                | 1.9 | 3.5 | 1.6 |
| 0807                                                | 3.0 | 3.5 | 2.5 |
| 0812                                                | 3.0 | 3.5 | 2.5 |
| 1008                                                | 4.0 | 4.0 | 2.5 |
| 1013                                                | 4.0 | 4.0 | 2.5 |

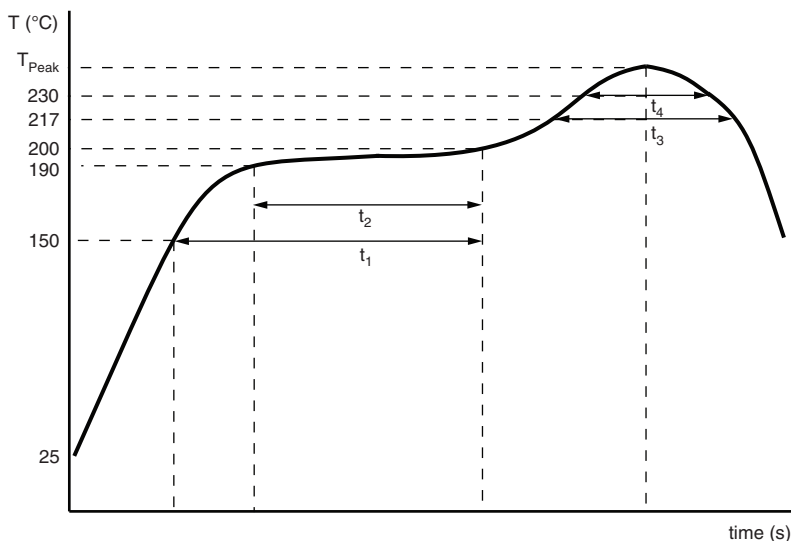
**ADVANCED SOLDERING PROFILE FOR LEAD (Pb)-FREE REFLOW PROCESS**


Fig. 5 - Maximum temperature load during reflow soldering

**Table 4**

| <b>REFLOW SOLDERING CONDITIONS</b> for MAL2181xxxxxE3 |                                   |
|-------------------------------------------------------|-----------------------------------|
| <b>PROFILE FEATURES</b>                               | <b>CASE CODE<br/>0606 TO 1013</b> |
| Max. time from 25 °C to $T_{Peak}$                    | 300 s                             |
| Max. ramp-up rate to 150 °C                           | 3 K/s                             |
| Max. time from 150 °C to 200 °C ( $t_1$ )             | 150 s                             |
| Max. time from 190 °C to 200 °C ( $t_2$ )             | 110 s                             |
| Ramp up rate from 200 °C to $T_{Peak}$                | 0.5 K/s to 3 K/s                  |
| Max. time above $T_{Liquidus}$ (217 °C) ( $t_3$ )     | 90 s                              |
| Max. time above 230 °C ( $t_4$ )                      | 70 s                              |
| Peak temperature $T_{Peak}$                           | 260 °C                            |
| Max. time above $T_{Peak}$ minus 5 °C                 | 40 s                              |
| Ramp-down rate from $T_{Liquidus}$                    | 3 K/s to 6 K/s                    |

**Note**

- Temperature measuring point on top of the case and on terminals.

**ELECTRICAL DATA**

| SYMBOL        | DESCRIPTION                                       |
|---------------|---------------------------------------------------|
| $C_R$         | Rated capacitance at 100 Hz, tolerance $\pm 20\%$ |
| $I_R$         | Rated RMS ripple current at 100 kHz, 105 °C       |
| $I_{L2}$      | Max. leakage current after 2 min 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 5 apply at  $T_{amb} = 20\text{ °C}$ ,  $P = 86\text{ kPa}$  to  $106\text{ kPa}$ ,  $RH = 45\%$  to  $75\%$

**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>105 °C<br>100 kHz<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>MAL2181... |
|--------------|----------------------------|-------------------------------------------|------------------------------------|----------------------------------------|-------------------------|-----------------------------------------|-----------------------------|
| 4.0          | 150                        | 6.6 x 6.6 x 5.9                           | 2570                               | 120                                    | 0.12                    | 0.022                                   | 97701E3                     |
|              | 270                        | 8.4 x 8.4 x 6.7                           | 3220                               | 216                                    | 0.12                    | 0.022                                   | 97702E3                     |
|              | 330                        | 6.6 x 6.6 x 5.9                           | 2800                               | 264                                    | 0.12                    | 0.020                                   | 97703E3                     |
|              | 330                        | 8.4 x 8.4 x 6.7                           | 3220                               | 264                                    | 0.12                    | 0.022                                   | 97704E3                     |
|              | 560                        | 8.4 x 8.4 x 6.7                           | 3600                               | 448                                    | 0.12                    | 0.018                                   | 97705E3                     |
|              | 680                        | 10.4 x 10.4 x 7.7                         | 4130                               | 544                                    | 0.12                    | 0.020                                   | 97706E3                     |
| 6.3          | 100                        | 6.6 x 6.6 x 5.9                           | 2800                               | 126                                    | 0.12                    | 0.022                                   | 97301E3                     |
|              | 120                        | 6.6 x 6.6 x 5.9                           | 2800                               | 151                                    | 0.12                    | 0.022                                   | 97302E3                     |
|              | 220                        | 6.6 x 6.6 x 5.9                           | 2800                               | 277                                    | 0.12                    | 0.020                                   | 97303E3                     |
|              | 220                        | 8.4 x 8.4 x 6.7                           | 3220                               | 277                                    | 0.12                    | 0.022                                   | 97306E3                     |
|              | 390                        | 8.4 x 8.4 x 6.7                           | 3220                               | 491                                    | 0.12                    | 0.022                                   | 97307E3                     |
|              | 470                        | 10.4 x 10.4 x 7.7                         | 4130                               | 592                                    | 0.12                    | 0.020                                   | 97308E3                     |
| 10           | 56                         | 6.6 x 6.6 x 5.9                           | 2300                               | 112                                    | 0.12                    | 0.027                                   | 97401E3                     |
|              | 68                         | 6.6 x 6.6 x 5.9                           | 2300                               | 136                                    | 0.12                    | 0.027                                   | 97402E3                     |
|              | 120                        | 6.6 x 6.6 x 5.9                           | 2300                               | 240                                    | 0.12                    | 0.027                                   | 97403E3                     |
|              | 150                        | 8.4 x 8.4 x 6.7                           | 2760                               | 300                                    | 0.12                    | 0.030                                   | 97404E3                     |
|              | 150                        | 10.4 x 10.4 x 7.7                         | 3020                               | 300                                    | 0.12                    | 0.030                                   | 97405E3                     |
|              | 270                        | 8.4 x 8.4 x 6.7                           | 3200                               | 540                                    | 0.12                    | 0.022                                   | 97406E3                     |
|              | 330                        | 10.4 x 10.4 x 7.7                         | 3770                               | 660                                    | 0.12                    | 0.024                                   | 97407E3                     |
| 16           | 39                         | 6.6 x 6.6 x 5.9                           | 2200                               | 125                                    | 0.12                    | 0.030                                   | 97501E3                     |
|              | 68                         | 6.6 x 6.6 x 5.9                           | 2200                               | 218                                    | 0.12                    | 0.030                                   | 97502E3                     |
|              | 82                         | 8.4 x 8.4 x 6.7                           | 2800                               | 262                                    | 0.12                    | 0.028                                   | 97503E3                     |
|              | 100                        | 10.4 x 10.4 x 7.7                         | 2670                               | 320                                    | 0.12                    | 0.035                                   | 97504E3                     |
|              | 120                        | 8.4 x 8.4 x 6.7                           | 2800                               | 384                                    | 0.12                    | 0.028                                   | 97505E3                     |
|              | 180                        | 10.4 x 10.4 x 7.7                         | 3430                               | 576                                    | 0.12                    | 0.029                                   | 97506E3                     |
|              | 820                        | 10.4 x 10.4 x 12.6                        | 5400                               | 2624                                   | 0.12                    | 0.012                                   | 97507E3                     |
| 20           | 56                         | 6.6 x 6.6 x 5.9                           | 1300                               | 224                                    | 0.12                    | 0.048                                   | 97201E3                     |
|              | 270                        | 8.4 x 8.4 x 12                            | 4000                               | 1080                                   | 0.12                    | 0.021                                   | 97202E3                     |
|              | 390                        | 8.4 x 8.4 x 12                            | 4950                               | 1560                                   | 0.12                    | 0.014                                   | 97203E3                     |
|              | 470                        | 10.4 x 10.4 x 12.6                        | 4300                               | 1880                                   | 0.12                    | 0.020                                   | 97204E3                     |
| 25           | 47                         | 6.6 x 6.6 x 5.9                           | 1300                               | 235                                    | 0.12                    | 0.049                                   | 97601E3                     |
|              | 150                        | 8.4 x 8.4 x 12                            | 2200                               | 750                                    | 0.12                    | 0.028                                   | 97602E3                     |
|              | 270                        | 10.4 x 10.4 x 12.6                        | 2700                               | 1350                                   | 0.12                    | 0.027                                   | 97603E3                     |
| 35           | 18                         | 6.6 x 6.6 x 5.9                           | 900                                | 126                                    | 0.12                    | 0.064                                   | 97001E3                     |
|              | 82                         | 8.4 x 8.4 x 12                            | 2200                               | 574                                    | 0.12                    | 0.029                                   | 97002E3                     |
|              | 150                        | 10.4 x 10.4 x 12.6                        | 2600                               | 1050                                   | 0.12                    | 0.028                                   | 97003E3                     |

**ORDERING EXAMPLE**

Conductive polymer 181 CPL series

100  $\mu\text{F}$  / 16 V;  $\pm 20\%$ 

Nominal case size: 10.4 mm x 10.4 mm x 7.7 mm; taped on reel

Ordering code: MAL218197504E3

Table 6

| 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; $T_A \leq 105^\circ\text{C}$ | $U_{rev} \leq 1\text{ V}$  |

## USEFUL LIFE AND ENDURANCE

Table 7

| ENDURANCE TEST AND USEFUL LIFE |              |                           |                         |                        |
|--------------------------------|--------------|---------------------------|-------------------------|------------------------|
| SERIES                         | CASE CODE    | USEFUL LIFE AT 105 °C (h) | ENDURANCE AT 105 °C (h) | ENDURANCE AT 85 °C (h) |
| 181 CPL                        | 0606 to 1013 | 5000                      | 5000                    | 50 000                 |

Endurance can be calculated by formula below:

$$L_r = L_0 \times 10^{\frac{T_0 - T_r}{20}}$$

$L_r$ : estimated lifetime (h)

$L_0$ : base lifetime specified at maximum operating temperature with applied the DC voltage (h)

$T_0$ : rated maximum operating temperature (°C)

$T_r$ : actual ambient temperature (°C)

Table 8

| TEST PROCEDURES AND REQUIREMENTS            |                                           |                                                                                                                                        |                                                                                                              |
|---------------------------------------------|-------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|
| TEST                                        |                                           | PROCEDURE<br>(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"          | $\Delta C/C: \pm 5\%$<br>$\tan \delta \leq \text{spec. limit}$<br>$I_{L2} \leq \text{spec. limit}$           |
| Endurance                                   | IEC 60384-18 / CECC 32300, subclause 4.15 | $T_{amb} = 105^\circ\text{C}$ ; $U_R$ applied; for test duration see Table 7                                                           | $\Delta C/C: \pm 20\%$<br>$\tan \delta \leq 2 \times \text{spec. limit}$<br>$I_{L2} \leq \text{spec. limit}$ |
| Useful life                                 | CECC 30301, subclause 1.8.1               | $T_{amb} = 105^\circ\text{C}$ ; $U_R$ and $I_R$ applied; for test duration see Table 7                                                 | $\Delta C/C: \pm 20\%$<br>$\tan \delta \leq 2 \times \text{spec. limit}$<br>$I_{L2} \leq \text{spec. limit}$ |
| Shelf life<br>(storage at high temperature) | IEC 60384-18 / CECC 32300, subclause 4.17 | $T_{amb} = 105^\circ\text{C}$ ; no voltage applied; 1000 h after test: $U_R$ to be applied for 30 min, 24 h to 48 h before measurement | For requirements see "Endurance test" above                                                                  |

Statements about product lifetime are based on calculations and internal testing. They should only be interpreted as estimations. Also due to external factors, the lifetime in the field application may deviate from the calculated lifetime. In general, nothing stated herein shall be construed as a guarantee of durability.



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