

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

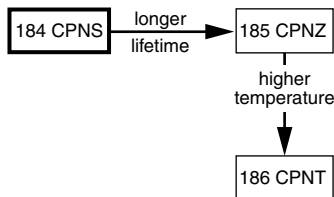


Fig. 1

| QUICK REFERENCE DATA                    |  |
|---|--|
| DESCRIPTION                             | VALUE                                    |
| Nominal case sizes<br>(L x W x H in mm) | 4.0 x 4.0 x 5.5<br>to 10.0 x 10.0 x 12.4 |
| Rated capacitance range, C <sub>R</sub> | 4.7 μF to 3300 μF                        |
| Tolerance on C <sub>R</sub>             | ± 20 %                                   |
| Rated voltage range, U <sub>R</sub>     | 2.5 V to 100 V                           |
| Category temperature range              | -55 °C to +105 °C                        |
| Endurance test at 105 °C                | 2000 h                                   |
| Useful life at 105 °C                   | 2000 h                                   |
| Shelf life at 0 V, 105 °C               | 1000 h                                   |
| Based on sectional specification        | IEC 60384-25 / CECC 32300                |
| Climatic category IEC 60068             | 55 / 105 / 56                            |

### FEATURES

- Useful life: up to 2000 h at 105 °C
- Very low ESR and high ripple current
- High voltages up to 100 V
- AEC-Q200 qualified products on request
- 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

- Automotive electronics
- Industrial and professional applications
- Telecommunications and IT
- Portable and mobile equipment

### 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 beveled edges)
- Code indicating group number (84)

### PACKAGING

Supplied in blister tape on reel



| <b>SELECTION CHART FOR C<sub>R</sub>, U<sub>R</sub> (2.5 V TO 20 V), AND RELEVANT NOMINAL CASE SIZES</b><br>(L x W x H in mm) |                                    |   |  |  |   |  |
|---|------------------------------------|---|--|--|---|--|
| C <sub>R</sub><br>(μF)  | U <sub>R</sub> (V)                 |   |  |  |   |  |
|   | 2.5                                | 4.0   | 6.3  | 10   | 16  | 20                                     |
| 10  | →                                  | →   | →  | 4.0 x 4.0 x 5.5  | 5.0 x 5.0 x 5.8<br>6.3 x 6.3 x 5.8<br>6.3 x 6.3 x 7.7 | 5.0 x 5.0 x 5.8<br>6.3 x 6.3 x 5.8     |
| 22  | →                                  | →   | →  | 4.0 x 4.0 x 5.5  | 5.0 x 5.0 x 5.8<br>6.3 x 6.3 x 5.8<br>6.3 x 6.3 x 7.7 | 6.3 x 6.3 x 5.8<br>6.3 x 6.3 x 7.7     |
| 33  | →                                  | →   | →  | →  | 5.0 x 5.0 x 5.8<br>6.3 x 6.3 x 5.8<br>6.3 x 6.3 x 7.7 | -                                      |
| 47  | →                                  | 5.0 x 5.0 x 5.8                                       | 5.0 x 5.0 x 5.5  | 5.0 x 5.0 x 5.5<br>6.3 x 6.3 x 5.8<br>6.3 x 6.3 x 7.7  | 5.0 x 5.0 x 5.8<br>6.3 x 6.3 x 5.8<br>6.3 x 6.3 x 7.7 | 6.3 x 6.3 x 5.8<br>6.3 x 6.3 x 7.7     |
| 68  | →                                  | →   | →  | →  | 6.3 x 6.3 x 5.8<br>6.3 x 6.3 x 7.7                    | -                                      |
| 100   | 6.3 x 6.3 x 5.8                    | 5.0 x 5.0 x 5.8<br>6.3 x 6.3 x 5.8                    | 5.0 x 5.0 x 5.5<br>5.0 x 5.0 x 5.8<br>6.3 x 6.3 x 5.8  | 5.0 x 5.0 x 5.5<br>6.3 x 6.3 x 5.8<br>6.3 x 6.3 x 7.7  | 6.3 x 6.3 x 5.8<br>6.3 x 6.3 x 7.7                    | 8.0 x 8.0 x 11.7<br>10.0 x 10.0 x 12.4 |
| 120   | →                                  | →   | →  | →  | →   | 6.3 x 6.3 x 5.8                        |
| 220   | 5.0 x 5.0 x 5.8<br>6.3 x 6.3 x 5.8 | 5.0 x 5.0 x 5.8<br>6.3 x 6.3 x 5.8<br>6.3 x 6.3 x 7.7 | 6.3 x 6.3 x 5.8<br>6.3 x 6.3 x 7.7                     | 6.3 x 6.3 x 5.8<br>6.3 x 6.3 x 7.7<br>8.0 x 8.0 x 11.7 | 8.0 x 8.0 x 11.7<br>10.0 x 10.0 x 12.4                | 8.0 x 8.0 x 11.7<br>10.0 x 10.0 x 12.4 |
| 330   | 6.3 x 6.3 x 5.8                    | 6.3 x 6.3 x 5.8<br>6.3 x 6.3 x 7.7                    | 6.3 x 6.3 x 5.8<br>6.3 x 6.3 x 7.7<br>8.0 x 8.0 x 11.7 | 6.3 x 6.3 x 7.7  | 8.0 x 8.0 x 11.7<br>10.0 x 10.0 x 12.4                | 10.0 x 10.0 x 12.4                     |
| 390   | →                                  | →   | →  | →  | →   | 8.0 x 8.0 x 11.7                       |
| 470   | 6.3 x 6.3 x 5.8<br>6.3 x 6.3 x 7.7 | 6.3 x 6.3 x 7.7                                       | 8.0 x 8.0 x 11.7                                       | 8.0 x 8.0 x 11.7<br>10.0 x 10.0 x 12.4                 | 10.0 x 10.0 x 12.4                                    | -                                      |
| 560   | →                                  | →   | →  | →  | 8.0 x 8.0 x 11.7                                      | -                                      |
| 680   | →                                  | →   | 10.0 x 10.0 x 12.4                                     | 8.0 x 8.0 x 11.7<br>10.0 x 10.0 x 12.4                 | →   | 10.0 x 10.0 x 12.4                     |
| 820   | →                                  | →   | 10.0 x 10.0 x 12.4                                     | -  | -   | -                                      |
| 1000  | →                                  | 8.0 x 8.0 x 11.7                                      | 8.0 x 8.0 x 11.7                                       | 10.0 x 10.0 x 12.4                                     | 10.0 x 10.0 x 12.4                                    | -                                      |
| 1200  | →                                  | 8.0 x 8.0 x 11.7<br>10.0 x 10.0 x 12.4                | -  | -  | -   | -                                      |
| 1500  | 8.0 x 8.0 x 11.7                   | 8.0 x 8.0 x 11.7<br>10.0 x 10.0 x 12.4                | →  | 10.0 x 10.0 x 12.4                                     | -   | -                                      |
| 2200  | →                                  | 10.0 x 10.0 x 12.4                                    | 10.0 x 10.0 x 12.4                                     | -  | -   | -                                      |
| 2700  | →                                  | 10.0 x 10.0 x 12.4                                    | -  | -  | -   | -                                      |
| 3300  | 10.0 x 10.0 x 12.4                 | -   | -  | -  | -   | -                                      |

| <b>SELECTION CHART FOR <math>C_R</math>, <math>U_R</math> (25 V TO 100 V), AND RELEVANT NOMINAL CASE SIZES</b><br>(L x W x H in mm) |  |                    |                    |  |                    |                    |
|---|--|--------------------|--------------------|--|--------------------|--------------------|
| $C_R$<br>( $\mu F$ )  | $U_R$ (V)                              |                    |                    |  |                    |                    |
|   | 25                                     | 35                 | 50                 | 63                                     | 80                 | 100                |
| 4.7   | →                                      | →                  | →                  | →                                      | →                  | 6.3 x 6.3 x 7.7    |
| 5.6   | →                                      | →                  | →                  | 6.3 x 6.3 x 5.8                        | -                  | -                  |
| 8.2   | →                                      | →                  | 6.3 x 6.3 x 5.8    | 6.3 x 6.3 x 5.8                        | -                  | -                  |
| 10  | 6.3 x 6.3 x 5.8                        | →                  | 8.0 x 8.0 x 11.7   | →                                      | →                  | 8.0 x 8.0 x 11.7   |
| 12  | →                                      | →                  | 6.3 x 6.3 x 5.8    | →                                      | 8.0 x 8.0 x 11.7   | -                  |
| 15  | →                                      | →                  | 6.3 x 6.3 x 5.8    | -                                      | -                  | -                  |
| 22  | 6.3 x 6.3 x 7.7                        | 6.3 x 6.3 x 5.8    | 8.0 x 8.0 x 11.7   | 8.0 x 8.0 x 11.7                       | 10.0 x 10.0 x 12.4 | 10.0 x 10.0 x 12.4 |
| 33  | 6.3 x 6.3 x 5.8<br>6.3 x 6.3 x 7.7     | →                  | 8.0 x 8.0 x 11.7   | 8.0 x 8.0 x 11.7<br>10.0 x 10.0 x 12.4 | -                  | -                  |
| 47  | 6.3 x 6.3 x 5.8<br>8.0 x 8.0 x 11.7    | 6.3 x 6.3 x 7.7    | 8.0 x 8.0 x 11.7   | 10.0 x 10.0 x 12.4                     | 10.0 x 10.0 x 12.4 | -                  |
| 56  | →                                      | →                  | 8.0 x 8.0 x 11.7   | -                                      | -                  | -                  |
| 68  | →                                      | →                  | →                  | 10.0 x 10.0 x 12.4                     | -                  | -                  |
| 100   | 8.0 x 8.0 x 11.7<br>10.0 x 10.0 x 12.4 | 10.0 x 10.0 x 12.4 | 10.0 x 10.0 x 12.4 | -                                      | -                  | -                  |
| 150   | →                                      | 8.0 x 8.0 x 11.7   | -                  | -                                      | -                  | -                  |
| 220   | 8.0 x 8.0 x 11.7<br>10.0 x 10.0 x 12.4 | 10.0 x 10.0 x 12.4 | -                  | -                                      | -                  | -                  |
| 270   | 10.0 x 10.0 x 12.4                     | -                  | -                  | -                                      | -                  | -                  |
| 330   | →                                      | 10.0 x 10.0 x 12.4 | -                  | -                                      | -                  | -                  |
| 390   | 10.0 x 10.0 x 12.4                     | -                  | -                  | -                                      | -                  | -                  |
| 470   | 10.0 x 10.0 x 12.4                     | -                  | -                  | -                                      | -                  | -                  |

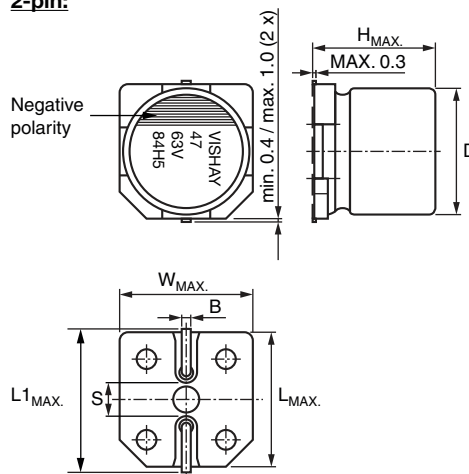
**2-pin:**


Fig. 2 - Dimensional outline

**Table 1**

| <b>DIMENSIONS</b> in millimeters <b>AND MASS</b> |           |                   |                   |                   |      |                   |     |                    |          |
|--|-----------|-------------------|-------------------|-------------------|------|-------------------|-----|--------------------|----------|
| 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> | MASS (g) |
| 4.0 x 4.0 x 5.5                                  | 0406      | 4.5               | 4.5               | 5.8               | 4.0  | 0.8               | 1.0 | 5.3                | 0.1      |
| 5.0 x 5.0 x 5.5                                  | 0505      | 5.5               | 5.5               | 5.8               | 5.0  | 0.8               | 1.4 | 6.1                | 0.2      |
| 5.0 x 5.0 x 5.8                                  | 0506      | 5.5               | 5.5               | 6.1               | 5.0  | 0.8               | 1.4 | 6.1                | 0.2      |
| 6.3 x 6.3 x 5.8                                  | 0606      | 6.7               | 6.7               | 6.1               | 6.3  | 0.8               | 2.2 | 7.4                | 0.3      |
| 6.3 x 6.3 x 7.7                                  | 0608      | 6.7               | 6.7               | 8.0               | 6.3  | 0.8               | 2.2 | 7.4                | 0.4      |
| 8.0 x 8.0 x 11.7                                 | 0812      | 8.5               | 8.5               | 12.0              | 8.0  | 1.1               | 3.1 | 9.2                | 0.8      |
| 10.0 x 10.0 x 12.4                               | 1012      | 10.5              | 10.5              | 12.7              | 10.0 | 1.1               | 4.5 | 11.2               | 1.3      |

**Table 2**

| <b>TAPE AND REEL DIMENSIONS</b> in millimeters, <b>PACKAGING QUANTITIES</b> |           |                         |                 |                                  |               |                             |
|---|-----------|-------------------------|-----------------|----------------------------------|---------------|-----------------------------|
| 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 PER REEL |
| 4.0 x 4.0 x 5.5   | 0406      | 8                       | 12              | 5.7                              | 380           | 2000                        |
| 5.0 x 5.0 x 5.5   | 0505      | 12                      | 12              | 5.7                              | 380           | 1000                        |
| 5.0 x 5.0 x 5.8   | 0506      | 12                      | 12              | 6.1                              | 380           | 1000                        |
| 6.3 x 6.3 x 5.8   | 0606      | 12                      | 16              | 6.2                              | 380           | 1000                        |
| 6.3 x 6.3 x 7.7   | 0608      | 12                      | 16              | 8.0                              | 380           | 900                         |
| 8.0 x 8.0 x 11.7  | 0812      | 16                      | 24              | 13.0                             | 380           | 400                         |
| 10.0 x 10.0 x 12.4  | 1012      | 16                      | 24              | 12.9                             | 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. 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.

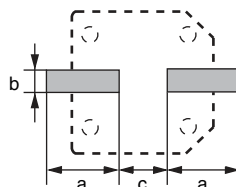


Fig. 3 - Recommended soldering pad dimensions

**Table 3**

| <b>RECOMMENDED SOLDERING PAD DIMENSIONS</b> in millimeters |                  |          |          |          |
|--|------------------|----------|----------|----------|
| <b>NOMINAL CASE SIZE</b><br>L x W x H                      | <b>CASE CODE</b> | <b>a</b> | <b>b</b> | <b>c</b> |
| 4.0 x 4.0 x 5.5  | 0406             | 2.6      | 1.6      | 1.0      |
| 5.0 x 5.0 x 5.5  | 0505             | 3.0      | 1.6      | 1.4      |
| 5.0 x 5.0 x 5.8  | 0506             | 3.0      | 1.6      | 1.4      |
| 6.3 x 6.3 x 5.8  | 0606             | 3.5      | 1.6      | 2.1      |
| 6.3 x 6.3 x 7.7  | 0608             | 3.5      | 1.6      | 2.1      |
| 8.0 x 8.0 x 11.7   | 0812             | 4.2      | 1.9      | 2.8      |
| 10.0 x 10.0 x 12.4   | 1012             | 4.4      | 1.9      | 4.3      |

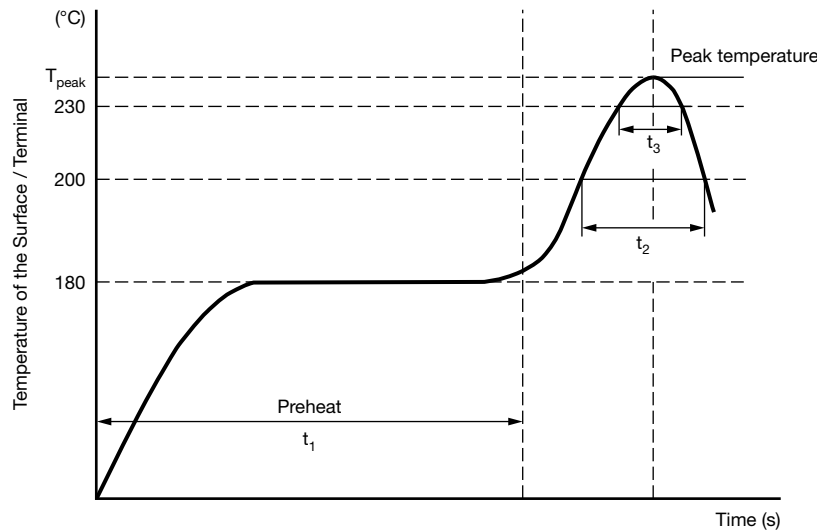
**SOLDERING PROFILE FOR LEAD (Pb)-FREE REFLOW PROCESS**


Fig. 4 - Maximum temperature load during reflow soldering

**Table 4**

| <b>REFLOW SOLDERING CONDITIONS</b> for MAL2182xxxxxE3 |                      |                     |                      |
|---|----------------------|---------------------|----------------------|
| <b>PROFILE FEATURES</b>                               | <b>2.5 V TO 10 V</b> | <b>16 V TO 25 V</b> | <b>35 V TO 100 V</b> |
| Maximum time between 150 °C to 180 °C ( $t_1$ )       | 120 s                | 120 s               | 120 s                |
| Maximum time above 200 °C ( $t_2$ )                   | 90 s                 | 80 s                | 70 s                 |
| Maximum time above 230 °C ( $t_3$ )                   | 60 s                 | 50 s                | 30 s                 |
| Peak temperature $T_{Peak}$                           | 250 °C               | 240 °C              | 240 °C               |
| Maximum reflow cycles                                 | 2                    | 2                   | 1                    |

**Note**

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



| ELECTRICAL DATA |   |
|-----------------|---|
| SYMBOL          | DESCRIPTION                                       |
| $C_R$           | Rated capacitance at 120 Hz, tolerance $\pm 20\%$ |
| $I_R$ 105 °C    | Max. allowed ripple current at 100 kHz            |
| $I_{L2}$        | Max. leakage current after 2 min at $U_R$         |
| $\tan \delta$   | Max. dissipation factor at 120 Hz                 |
| ESR             | Max. ESR at 100 kHz                               |

**ORDERING EXAMPLE**

Conductive polymer 184 CPNS series

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

Nominal case size: 6.3 mm x 6.3 mm x 7.7 mm;  
taped on reel

Ordering code: MAL218497517E3

**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>( $\mu F$ ) | NOMINAL 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>( $\mu A$ ) | $\tan \delta$<br>120 Hz | ESR<br>100 kHz<br>20 °C<br>(m $\Omega$ ) | ORDERING CODE<br>MAL2184... |
| 2.5                                      | 100                  | 6.3 x 6.3 x 5.8                        | 2500                               | 300                              | 0.08                    | 22                                       | 97251E3                     |
|  | 220                  | 5.0 x 5.0 x 5.8                        | 2310                               | 300                              | 0.08                    | 25                                       | 97252E3                     |
|  | 220                  | 6.3 x 6.3 x 5.8                        | 2800                               | 300                              | 0.08                    | 22                                       | 97253E3                     |
|  | 330                  | 6.3 x 6.3 x 5.8                        | 3100                               | 300                              | 0.08                    | 15                                       | 97254E3                     |
|  | 470                  | 6.3 x 6.3 x 5.8                        | 2800                               | 300                              | 0.08                    | 20                                       | 97255E3                     |
|  | 470                  | 6.3 x 6.3 x 7.7                        | 3600                               | 300                              | 0.08                    | 15                                       | 97256E3                     |
|  | 1500                 | 8.0 x 8.0 x 11.7                       | 5400                               | 750                              | 0.08                    | 9  | 97257E3                     |
| 3300                                     | 10.0 x 10.0 x 12.4   | 5600                                   | 1650                               | 0.10                             | 9                       | 97258E3                                  |                             |
| 4  | 47                   | 5.0 x 5.0 x 5.8                        | 2310                               | 300                              | 0.08                    | 25                                       | 97351E3                     |
|  | 100                  | 5.0 x 5.0 x 5.8                        | 2310                               | 300                              | 0.08                    | 25                                       | 97352E3                     |
|  | 100                  | 6.3 x 6.3 x 5.8                        | 2500                               | 300                              | 0.08                    | 22                                       | 97353E3                     |
|  | 220                  | 5.0 x 5.0 x 5.8                        | 2610                               | 300                              | 0.08                    | 22                                       | 97354E3                     |
|  | 220                  | 6.3 x 6.3 x 5.8                        | 2800                               | 300                              | 0.08                    | 22                                       | 97355E3                     |
|  | 220                  | 6.3 x 6.3 x 7.7                        | 3100                               | 300                              | 0.08                    | 20                                       | 97356E3                     |
|  | 330                  | 6.3 x 6.3 x 5.8                        | 3100                               | 300                              | 0.08                    | 15                                       | 97357E3                     |
|  | 330                  | 6.3 x 6.3 x 7.7                        | 3600                               | 300                              | 0.08                    | 15                                       | 97358E3                     |
|  | 470                  | 6.3 x 6.3 x 7.7                        | 3600                               | 300                              | 0.08                    | 15                                       | 97359E3                     |
|  | 1000                 | 8.0 x 8.0 x 11.7                       | 5200                               | 800                              | 0.10                    | 9  | 97361E3                     |
|  | 1200                 | 8.0 x 8.0 x 11.7                       | 5200                               | 960                              | 0.10                    | 9  | 97362E3                     |
|  | 1200                 | 10.0 x 10.0 x 12.4                     | 5600                               | 960                              | 0.10                    | 9  | 97363E3                     |
|  | 1500                 | 8.0 x 8.0 x 11.7                       | 5200                               | 1200                             | 0.10                    | 9  | 97364E3                     |
|  | 1500                 | 10.0 x 10.0 x 12.4                     | 5600                               | 1200                             | 0.10                    | 9  | 97365E3                     |
|  | 2200                 | 10.0 x 10.0 x 12.4                     | 5600                               | 1760                             | 0.10                    | 9  | 97366E3                     |
| 2700                                     | 10.0 x 10.0 x 12.4   | 5600                                   | 2160                               | 0.10                             | 9                       | 97367E3                                  |                             |
| 6.3                                      | 47                   | 5.0 x 5.0 x 5.5                        | 2000                               | 300                              | 0.08                    | 30                                       | 97301E3                     |
|  | 100                  | 5.0 x 5.0 x 5.5                        | 2000                               | 300                              | 0.08                    | 30                                       | 97302E3                     |
|  | 100                  | 5.0 x 5.0 x 5.8                        | 2310                               | 300                              | 0.08                    | 25                                       | 97303E3                     |
|  | 100                  | 6.3 x 6.3 x 5.8                        | 2800                               | 300                              | 0.08                    | 22                                       | 97304E3                     |
|  | 220                  | 6.3 x 6.3 x 5.8                        | 3100                               | 300                              | 0.08                    | 15                                       | 97305E3                     |
|  | 220                  | 6.3 x 6.3 x 7.7                        | 3600                               | 300                              | 0.08                    | 15                                       | 97306E3                     |
|  | 330                  | 6.3 x 6.3 x 5.8                        | 3100                               | 300                              | 0.08                    | 20                                       | 97307E3                     |
|  | 330                  | 6.3 x 6.3 x 7.7                        | 4200                               | 300                              | 0.08                    | 10                                       | 97308E3                     |
|  | 330                  | 8.0 x 8.0 x 11.7                       | 5200                               | 416                              | 0.08                    | 9  | 97309E3                     |
|  | 470                  | 8.0 x 8.0 x 11.7                       | 5200                               | 592                              | 0.08                    | 9  | 97311E3                     |
|  | 680                  | 10.0 x 10.0 x 12.4                     | 5500                               | 856                              | 0.08                    | 9  | 97312E3                     |
|  | 820                  | 10.0 x 10.0 x 12.4                     | 5500                               | 1033                             | 0.10                    | 9  | 97313E3                     |
|  | 1000                 | 8.0 x 8.0 x 11.7                       | 5200                               | 1260                             | 0.10                    | 9  | 97314E3                     |
|  | 2200                 | 10.0 x 10.0 x 12.4                     | 5500                               | 2772                             | 0.10                    | 9  | 97315E3                     |



| ELECTRICAL DATA AND ORDERING INFORMATION |                        |  |   |                                  |                 |                                 |                             |
|--|------------------------|--|---|----------------------------------|-----------------|---------------------------------|-----------------------------|
| U <sub>R</sub><br>(V)                    | C <sub>R</sub><br>(μF) | NOMINAL CASE SIZE<br>L x W x H<br>(mm) | I <sub>R</sub><br>105 °C<br>100 kHz<br>(mA) | I <sub>L2</sub><br>2 min<br>(μA) | tan δ<br>120 Hz | ESR<br>100 kHz<br>20 °C<br>(mΩ) | ORDERING CODE<br>MAL2184... |
| 10                                       | 10                     | 4.0 x 4.0 x 5.5                        | 1200  | 300                              | 0.08            | 80                              | 97401E3                     |
|  | 22                     | 4.0 x 4.0 x 5.5                        | 1200  | 300                              | 0.08            | 80                              | 97402E3                     |
|  | 47                     | 5.0 x 5.0 x 5.5                        | 2000  | 300                              | 0.08            | 30                              | 97403E3                     |
|  | 47                     | 6.3 x 6.3 x 5.8                        | 2200  | 300                              | 0.08            | 30                              | 97404E3                     |
|  | 47                     | 6.3 x 6.3 x 7.7                        | 2800  | 300                              | 0.08            | 20                              | 97405E3                     |
|  | 100                    | 5.0 x 5.0 x 5.5                        | 2000  | 300                              | 0.08            | 30                              | 97406E3                     |
|  | 100                    | 6.3 x 6.3 x 5.8                        | 2200  | 300                              | 0.08            | 30                              | 97407E3                     |
|  | 100                    | 6.3 x 6.3 x 7.7                        | 2800  | 300                              | 0.08            | 20                              | 97408E3                     |
|  | 220                    | 6.3 x 6.3 x 5.8                        | 2610  | 300                              | 0.08            | 25                              | 97409E3                     |
|  | 220                    | 6.3 x 6.3 x 7.7                        | 3100  | 300                              | 0.08            | 20                              | 97411E3                     |
|  | 220                    | 8.0 x 8.0 x 11.7                       | 5200  | 440                              | 0.08            | 9                               | 97412E3                     |
|  | 330                    | 6.3 x 6.3 x 7.7                        | 3100  | 300                              | 0.08            | 20                              | 97413E3                     |
|  | 470                    | 8.0 x 8.0 x 11.7                       | 5200  | 940                              | 0.08            | 9                               | 97414E3                     |
|  | 470                    | 10.0 x 10.0 x 12.4                     | 5500  | 940                              | 0.08            | 9                               | 97415E3                     |
|  | 680                    | 8.0 x 8.0 x 11.7                       | 5200  | 1360                             | 0.10            | 9                               | 97416E3                     |
| 680                                      | 10.0 x 10.0 x 12.4     | 5500                                   | 1360  | 0.10                             | 9               | 97417E3                         |                             |
| 1000                                     | 10.0 x 10.0 x 12.4     | 5500                                   | 2000  | 0.10                             | 9               | 97418E3                         |                             |
| 1500                                     | 10.0 x 10.0 x 12.4     | 5500                                   | 3000  | 0.10                             | 9               | 97419E3                         |                             |
| 16                                       | 10                     | 5.0 x 5.0 x 5.8                        | 2000  | 400                              | 0.08            | 40                              | 97501E3                     |
|  | 10                     | 6.3 x 6.3 x 5.8                        | 2200  | 400                              | 0.08            | 35                              | 97502E3                     |
|  | 10                     | 6.3 x 6.3 x 7.7                        | 2610  | 400                              | 0.08            | 30                              | 97503E3                     |
|  | 22                     | 5.0 x 5.0 x 5.8                        | 2000  | 400                              | 0.08            | 40                              | 97504E3                     |
|  | 22                     | 6.3 x 6.3 x 5.8                        | 2200  | 400                              | 0.08            | 35                              | 97505E3                     |
|  | 22                     | 6.3 x 6.3 x 7.7                        | 2610  | 400                              | 0.08            | 30                              | 97506E3                     |
|  | 33                     | 5.0 x 5.0 x 5.8                        | 2000  | 400                              | 0.08            | 40                              | 97507E3                     |
|  | 33                     | 6.3 x 6.3 x 5.8                        | 2200  | 400                              | 0.08            | 35                              | 97508E3                     |
|  | 33                     | 6.3 x 6.3 x 7.7                        | 2610  | 400                              | 0.08            | 30                              | 97509E3                     |
|  | 47                     | 5.0 x 5.0 x 5.8                        | 2000  | 400                              | 0.08            | 40                              | 97511E3                     |
|  | 47                     | 6.3 x 6.3 x 5.8                        | 2200  | 400                              | 0.08            | 35                              | 97512E3                     |
|  | 47                     | 6.3 x 6.3 x 7.7                        | 2610  | 400                              | 0.08            | 30                              | 97513E3                     |
|  | 68                     | 6.3 x 6.3 x 5.8                        | 2200  | 400                              | 0.08            | 35                              | 97514E3                     |
|  | 68                     | 6.3 x 6.3 x 7.7                        | 2690  | 400                              | 0.08            | 25                              | 97515E3                     |
|  | 100                    | 6.3 x 6.3 x 5.8                        | 2490  | 400                              | 0.08            | 30                              | 97516E3                     |
|  | 100                    | 6.3 x 6.3 x 7.7                        | 2690  | 400                              | 0.08            | 25                              | 97517E3                     |
|  | 220                    | 8.0 x 8.0 x 11.7                       | 4700  | 704                              | 0.08            | 15                              | 97518E3                     |
|  | 220                    | 10.0 x 10.0 x 12.4                     | 5100  | 704                              | 0.08            | 15                              | 97519E3                     |
|  | 330                    | 8.0 x 8.0 x 11.7                       | 4700  | 1056                             | 0.08            | 15                              | 97525E3                     |
|  | 330                    | 10.0 x 10.0 x 12.4                     | 5100  | 1056                             | 0.08            | 15                              | 97521E3                     |
| 470                                      | 10.0 x 10.0 x 12.4     | 5100                                   | 1504  | 0.10                             | 15              | 97522E3                         |                             |
| 560                                      | 8.0 x 8.0 x 11.7       | 4950                                   | 1792  | 0.12                             | 14              | 97523E3                         |                             |
| 1000                                     | 10.0 x 10.0 x 12.4     | 5400                                   | 3200  | 0.12                             | 14              | 97524E3                         |                             |
| 20                                       | 10                     | 5.0 x 5.0 x 5.8                        | 2000  | 600                              | 0.08            | 40                              | 97551E3                     |
|  | 10                     | 6.3 x 6.3 x 5.8                        | 2200  | 600                              | 0.08            | 40                              | 97552E3                     |
|  | 22                     | 6.3 x 6.3 x 5.8                        | 2200  | 600                              | 0.08            | 35                              | 97553E3                     |
|  | 22                     | 6.3 x 6.3 x 7.7                        | 2670  | 600                              | 0.08            | 30                              | 97554E3                     |
|  | 47                     | 6.3 x 6.3 x 5.8                        | 2200  | 600                              | 0.08            | 35                              | 97555E3                     |
|  | 47                     | 6.3 x 6.3 x 7.7                        | 2670  | 600                              | 0.08            | 30                              | 97556E3                     |
|  | 100                    | 8.0 x 8.0 x 11.7                       | 4210  | 400                              | 0.08            | 20                              | 97557E3                     |
|  | 100                    | 10.0 x 10.0 x 12.4                     | 4800  | 400                              | 0.08            | 20                              | 97558E3                     |
|  | 120                    | 6.3 x 6.3 x 5.8                        | 3200  | 600                              | 0.12            | 25                              | 97559E3                     |
|  | 220                    | 8.0 x 8.0 x 11.7                       | 4000  | 880                              | 0.10            | 22                              | 97561E3                     |
|  | 220                    | 10.0 x 10.0 x 12.4                     | 4800  | 880                              | 0.10            | 20                              | 97562E3                     |
|  | 330                    | 10.0 x 10.0 x 12.4                     | 4800  | 1320                             | 0.10            | 20                              | 97563E3                     |
|  | 390                    | 8.0 x 8.0 x 11.7                       | 4950  | 1560                             | 0.12            | 14                              | 97564E3                     |
|  | 680                    | 10.0 x 10.0 x 12.4                     | 5000  | 2720                             | 0.12            | 16                              | 97565E3                     |



| ELECTRICAL DATA AND ORDERING INFORMATION |                     |  |                                    |                                 |                         |  |                             |
|--|---------------------|--|------------------------------------|---------------------------------|-------------------------|--|-----------------------------|
| $U_R$<br>(V)                             | $C_R$<br>( $\mu$ F) | NOMINAL 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>( $\mu$ A) | $\tan \delta$<br>120 Hz | ESR<br>100 kHz<br>20 °C<br>(m $\Omega$ ) | ORDERING CODE<br>MAL2184... |
| 25                                       | 10                  | 6.3 x 6.3 x 5.8                        | 2200                               | 600                             | 0.08                    | 35                                       | 97601E3                     |
|  | 22                  | 6.3 x 6.3 x 7.7                        | 2670                               | 600                             | 0.08                    | 30                                       | 97602E3                     |
|  | 33                  | 6.3 x 6.3 x 5.8                        | 2200                               | 600                             | 0.08                    | 35                                       | 97603E3                     |
|  | 33                  | 6.3 x 6.3 x 7.7                        | 2670                               | 600                             | 0.08                    | 30                                       | 97604E3                     |
|  | 47                  | 6.3 x 6.3 x 5.8                        | 2200                               | 600                             | 0.08                    | 35                                       | 97605E3                     |
|  | 47                  | 8.0 x 8.0 x 11.7                       | 4210                               | 235                             | 0.08                    | 20                                       | 97606E3                     |
|  | 100                 | 8.0 x 8.0 x 11.7                       | 4210                               | 500                             | 0.10                    | 20                                       | 97607E3                     |
|  | 100                 | 10.0 x 10.0 x 12.4                     | 4800                               | 500                             | 0.10                    | 20                                       | 97608E3                     |
|  | 220                 | 8.0 x 8.0 x 11.7                       | 3800                               | 1100                            | 0.10                    | 25                                       | 97609E3                     |
|  | 220                 | 10.0 x 10.0 x 12.4                     | 4800                               | 1100                            | 0.10                    | 20                                       | 97611E3                     |
|  | 270                 | 10.0 x 10.0 x 12.4                     | 4800                               | 1350                            | 0.10                    | 20                                       | 97612E3                     |
|  | 390                 | 10.0 x 10.0 x 12.4                     | 4200                               | 1950                            | 0.12                    | 22                                       | 97613E3                     |
| 470                                      | 10.0 x 10.0 x 12.4  | 3800                                   | 2350                               | 0.12                            | 25                      | 97614E3                                  |                             |
| 35                                       | 22                  | 6.3 x 6.3 x 5.8                        | 1300                               | 600                             | 0.12                    | 50                                       | 97001E3                     |
|  | 47                  | 6.3 x 6.3 x 7.7                        | 1600                               | 600                             | 0.12                    | 50                                       | 97002E3                     |
|  | 100                 | 10.0 x 10.0 x 12.4                     | 3800                               | 700                             | 0.12                    | 25                                       | 97003E3                     |
|  | 150                 | 8.0 x 8.0 x 11.7                       | 3800                               | 840                             | 0.12                    | 25                                       | 97004E3                     |
|  | 220                 | 10.0 x 10.0 x 12.4                     | 4100                               | 1540                            | 0.12                    | 22                                       | 97005E3                     |
|  | 330                 | 10.0 x 10.0 x 12.4                     | 4400                               | 2310                            | 0.12                    | 20                                       | 97006E3                     |
| 50                                       | 8.2                 | 6.3 x 6.3 x 5.8                        | 800                                | 600                             | 0.12                    | 80                                       | 97101E3                     |
|  | 10                  | 8.0 x 8.0 x 11.7                       | 1800                               | 100                             | 0.12                    | 40                                       | 97102E3                     |
|  | 12                  | 6.3 x 6.3 x 5.8                        | 800                                | 600                             | 0.12                    | 80                                       | 97103E3                     |
|  | 15                  | 6.3 x 6.3 x 5.8                        | 800                                | 600                             | 0.12                    | 80                                       | 97104E3                     |
|  | 22                  | 8.0 x 8.0 x 11.7                       | 1800                               | 220                             | 0.12                    | 40                                       | 97105E3                     |
|  | 33                  | 8.0 x 8.0 x 11.7                       | 2000                               | 300                             | 0.12                    | 35                                       | 97106E3                     |
|  | 47                  | 8.0 x 8.0 x 11.7                       | 2300                               | 470                             | 0.12                    | 30                                       | 97107E3                     |
|  | 56                  | 8.0 x 8.0 x 11.7                       | 2500                               | 560                             | 0.12                    | 30                                       | 97108E3                     |
|  | 100                 | 10.0 x 10.0 x 12.4                     | 3000                               | 1000                            | 0.12                    | 25                                       | 97109E3                     |
| 63                                       | 5.6                 | 6.3 x 6.3 x 5.8                        | 700                                | 600                             | 0.12                    | 100                                      | 97801E3                     |
|  | 8.2                 | 6.3 x 6.3 x 5.8                        | 700                                | 600                             | 0.12                    | 100                                      | 97802E3                     |
|  | 22                  | 8.0 x 8.0 x 11.7                       | 1800                               | 277                             | 0.12                    | 35                                       | 97803E3                     |
|  | 33                  | 8.0 x 8.0 x 11.7                       | 2200                               | 416                             | 0.12                    | 35                                       | 97804E3                     |
|  | 33                  | 10.0 x 10.0 x 12.4                     | 2500                               | 416                             | 0.12                    | 30                                       | 97805E3                     |
|  | 47                  | 10.0 x 10.0 x 12.4                     | 2500                               | 592                             | 0.12                    | 30                                       | 97806E3                     |
|  | 68                  | 10.0 x 10.0 x 12.4                     | 2500                               | 856.8                           | 0.12                    | 30                                       | 97807E3                     |
| 80                                       | 12                  | 8.0 x 8.0 x 11.7                       | 1800                               | 192                             | 0.12                    | 40                                       | 97701E3                     |
|  | 22                  | 10.0 x 10.0 x 12.4                     | 2300                               | 352                             | 0.12                    | 38                                       | 97702E3                     |
|  | 47                  | 10.0 x 10.0 x 12.4                     | 1800                               | 752                             | 0.12                    | 40                                       | 97703E3                     |
| 100                                      | 4.7                 | 6.3 x 6.3 x 7.7                        | 1060                               | 600                             | 0.12                    | 100                                      | 97901E3                     |
|  | 10                  | 8.0 x 8.0 x 11.7                       | 1700                               | 200                             | 0.12                    | 45                                       | 97902E3                     |
|  | 22                  | 10.0 x 10.0 x 12.4                     | 2100                               | 440                             | 0.12                    | 40                                       | 97903E3                     |

Table 6

| ADDITIONAL ELECTRICAL DATA      |                              |                            |
|---------------------------------|------------------------------|----------------------------|
| PARAMETER                       | CONDITIONS                   | VALUE                      |
| <b>Voltage</b>                  |                              |                            |
| Surge voltage for short periods | IEC 60384-25, subclause 4.14 | $U_s \leq 1.15 \times U_R$ |



**USEFUL LIFE AND ENDURANCE**

Table 7

| <b>ENDURANCE TEST AND USEFUL LIFE</b> |              |  |                         |                        |                        |                        |                        |
|---------------------------------------|--------------|--|-------------------------|------------------------|------------------------|------------------------|------------------------|
| SERIES                                | CASE CODE    | USEFUL LIFE AT 105 °C (h) <sup>(1)</sup> | ENDURANCE AT 105 °C (h) | ENDURANCE AT 95 °C (h) | ENDURANCE AT 85 °C (h) | ENDURANCE AT 75 °C (h) | ENDURANCE AT 65 °C (h) |
| 184 CPNS                              | 0406 to 1012 | 2000                                     | 2000                    | 6000                   | 20 000                 | 63 000                 | 200 000                |

**Note**

(1) Identical with endurance for this series

Endurance can be calculated by formula below:

$$L = L_{T_{max.}} \times 10^{\frac{T_{max.} - T_a}{20}}$$

L: estimated lifetime (h)

 $L_{T_{max.}}$ : base lifetime specified at maximum operating temperature with applied DC voltage (h) $T_{max.}$ : rated maximum operating temperature (°C) $T_a$ : actual ambient temperature (°C)

Table 8

| <b>MULTIPLIER OF RIPPLE CURRENT (<math>I_R</math>) AS A FUNCTION OF FREQUENCY</b> |      |        |                |
|---|------|--------|----------------|
| FREQUENCY (Hz)  |      |        |                |
| 120   | 1000 | 10 000 | $\geq 100 000$ |
| $I_R$ MULTIPLIER  |      |        |                |
| 0.05  | 0.3  | 0.7    | 1              |

Table 9

| <b>TEST PROCEDURES AND REQUIREMENTS</b>     |   |   |   |
|---|---|---|---|
| TEST  |   | PROCEDURE<br>(quick reference)  | REQUIREMENTS  |
| NAME OF TEST                                | REFERENCE                                 |   |   |
| Mounting                                    | IEC 60384-25, 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 60384-25 / CECC 32300, subclause 4.15 | $T_{amb} = 105 \text{ °C}$ ; $U_R$ applied; for test duration see Table 7   | $\Delta C/C: \pm 20 \%$<br>$\tan \delta \leq 1.5 \times \text{spec. limit}$<br>$I_{L2} \leq \text{spec. limit}$<br>$ESR \leq 1.5 \times \text{spec. limit}$ |
| Useful life                                 | CECC 30301, subclause 1.8.1               | $T_{amb} = 105 \text{ °C}$ ; $U_R$ and $I_R$ applied; for test duration see Table 7   | $\Delta C/C: \pm 20 \%$<br>$\tan \delta \leq 1.5 \times \text{spec. limit}$<br>$I_{L2} \leq \text{spec. limit}$<br>$ESR \leq 1.5 \times \text{spec. limit}$ |
| Shelf life<br>(storage at high temperature) | IEC 60384-25 / CECC 32300, subclause 4.16 | $T_{amb} = 105 \text{ °C}$ ; 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.