

## Aluminum Electrolytic Capacitors Radial High Temperature Standard

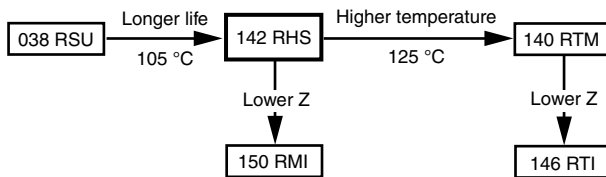
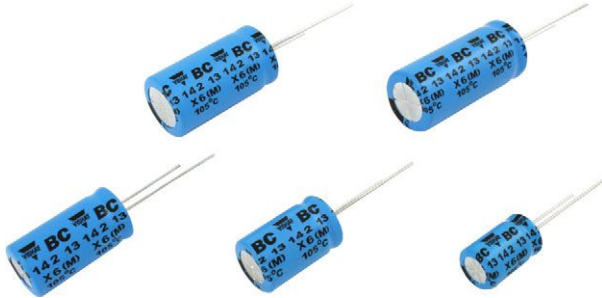


Fig. 1

| QUICK REFERENCE DATA                               |                        |
|--|------------------------|
| DESCRIPTION  | VALUE                  |
| Nominal case sizes (Ø D x L in mm)                 | 5 x 11 to 18 x 40      |
| Rated capacitance range, C <sub>R</sub>            | 1 µF to 22 000 µF      |
| Tolerance on C <sub>R</sub>                        | ± 20 %                 |
| Rated voltage range, U <sub>R</sub>                | 10 V to 450 V          |
| Category temperature range                         | -40 °C to +105 °C      |
| Endurance test at 105 °C                           | 2000 h                 |
| Useful life at 105 °C                              | 2500 h                 |
| Useful life at 40 °C, 1.6 x I <sub>R</sub> applied | 140 000 h              |
| Shelf life at 0 V, 105 °C                          | 1000 h                 |
| Based on sectional specification                   | IEC 60384-4 / EN130300 |
| Climatic category IEC 60068                        | 40 / 105 / 56          |

### FEATURES

- Useful life: 2500 h at 105 °C
- Miniaturized, high CV-product per unit volume
- Charge and discharge proof
- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Radial leads, cylindrical aluminum case, insulated with a blue sleeve
- Pressure relief for case Ø D ≥ 6.3 mm
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)


**RoHS  
COMPLIANT**

### APPLICATIONS

- Industrial, telecom and domestic appliances
- Decoupling, smoothing, filtering, buffering in SMPS
- Portable and mobile equipment (small size, low mass)

### MARKING

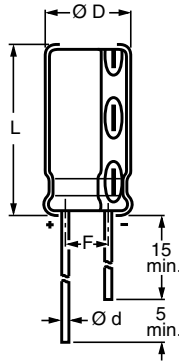
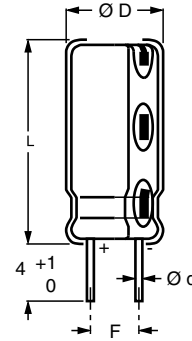
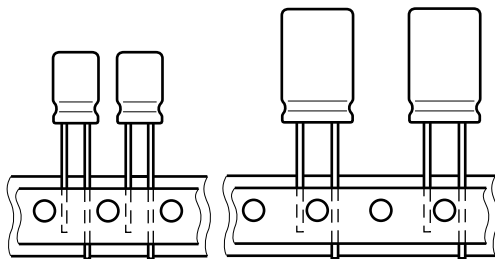
The capacitors are marked (where possible) with the following information:

- Rated capacitance (in µF)
- Tolerance on rated capacitance, code letter in accordance with IEC 60062 (M for ± 20 %)
- Rated voltage (in V)
- Date code, in accordance with IEC 60062
- Code indicating factory of origin
- Name or logo of manufacturer
- Negative terminal identification
- Series number (142)



| SELECTION CHART FOR C <sub>R</sub> , U <sub>R</sub> , AND RELEVANT NOMINAL CASE SIZES (∅ D x L in mm) |                    |           |           |           |           |           |           |
|---|--------------------|-----------|-----------|-----------|-----------|-----------|-----------|
| C <sub>R</sub><br>(μF)  | U <sub>R</sub> (V) |           |           |           |           |           |           |
|   | 10                 | 16        | 25        | 35        | 50        | 63        | 100       |
| 1.0   | →                  | →         | →         | →         | →         | 5 x 11    | -         |
| 2.2   | →                  | →         | →         | →         | →         | →         | 5 x 11    |
| 3.3   | →                  | →         | →         | →         | →         | 5 x 11    | -         |
| 4.7   | →                  | →         | →         | →         | →         | 5 x 11    | 5 x 11    |
|   |                    |           |           |           |           |           | 6.3 x 11  |
| 6.8   | →                  | →         | →         | →         | →         | 5 x 11    | -         |
| 10  | →                  | →         | →         | →         | →         | 5 x 11    | 6.3 x 11  |
|   |                    |           |           |           |           |           | 8 x 12    |
| 22  | →                  | →         | →         | →         | 5 x 11    | 5 x 11    | 6.3 x 11  |
|   |                    |           |           |           |           | 6.3 x 11  | 8 x 12    |
| 33  | →                  | →         | 5 x 11    | →         | 5 x 11    | 6.3 x 11  | 8 x 12    |
|   |                    |           | 10 x 12   |           |           |           |           |
| 47  | →                  | →         | 5 x 11    | 5 x 11    | 6.3 x 11  | 6.3 x 11  | 10 x 16   |
|   |                    |           | 8 x 12    |           |           |           |           |
| 100   | →                  | 5 x 11    | 6.3 x 11  | 6.3 x 11  | 8 x 12    | 10 x 12   | 10 x 20   |
| 220   | 5 x 11             | 6.3 x 11  | 8 x 12    | 8 x 12    | 10 x 12   | 10 x 16   | 12.5 x 25 |
| 330   | 6.3 x 11           | 8 x 12    | 8 x 12    | 10 x 12   | 10 x 16   | 10 x 20   | 12.5 x 25 |
|   |                    |           |           |           |           |           | 16 x 25   |
| 470   | 6.3 x 11           | 8 x 12    | 10 x 12   | 10 x 16   | 10 x 20   | 12.5 x 20 | 16 x 31   |
|   | 8 x 12             | 10 x 12   |           |           | 12.5 x 20 |           |           |
| 1000  | 10 x 12            | 10 x 16   | 10 x 20   | 12.5 x 20 | 12.5 x 25 | 16 x 25   | 18 x 40   |
| 2200  | 10 x 20            | 12.5 x 20 | 12.5 x 25 | 16 x 25   | 16 x 35   | 18 x 40   | -         |
| 3300  | →                  | 12.5 x 25 | 16 x 25   | 16 x 31   | 18 x 35   | -         | -         |
| 4700  | 12.5 x 25          | 16 x 25   | 16 x 31   | 18 x 35   | -         | -         | -         |
| 6800  | 16 x 25            | 16 x 31   | 18 x 35   | -         | -         | -         | -         |
| 10 000  | 16 x 31            | 18 x 31   | -         | -         | -         | -         | -         |
| 22 000  | 18 x 40            | -         | -         | -         | -         | -         | -         |

| SELECTION CHART FOR C <sub>R</sub> , U <sub>R</sub> , AND RELEVANT NOMINAL CASE SIZES (∅ D x L in mm) |                    |           |           |           |           |
|---|--------------------|-----------|-----------|-----------|-----------|
| C <sub>R</sub><br>(μF)  | U <sub>R</sub> (V) |           |           |           |           |
|   | 200                | 250       | 350       | 400       | 450       |
| 1.0   | 5 x 11             | 5 x 11    | 6.3 x 11  | 6.3 x 11  | 8 x 12    |
| 2.2   | 6.3 x 11           | 6.3 x 11  | 8 x 12    | 8 x 12    | 10 x 12   |
| 4.7   | 8 x 12             | 8 x 12    | 10 x 12   | 10 x 12   | 10 x 16   |
| 10  | 10 x 12            | 10 x 12   | 10 x 16   | 10 x 20   | 12.5 x 20 |
| 22  | 10 x 16            | 10 x 20   | 12.5 x 20 | 12.5 x 25 | 16 x 20   |
| 33  | →                  | 12.5 x 20 | →         | →         | 16 x 25   |
| 47  | 12.5 x 20          | 12.5 x 25 | 16 x 25   | 16 x 31   | 16 x 35   |
| 100   | 16 x 25            | 16 x 31   | 18 x 35   | 18 x 40   | -         |
| 220   | 18 x 35            | -         | -         | -         | -         |

**DIMENSIONS in millimeters AND AVAILABLE FORMS**

 Fig. 2 - Form CA  
Long leads

 Fig. 3 - Form CB  
Cut leads


Dimensions of lead space F see Table 2

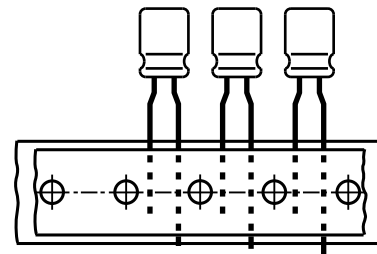
 Fig. 4 - Form TNA, Form TFA  
Taped in box (ammopack), straight leads

 Case  $\varnothing D = 5 \text{ mm to } 8 \text{ mm}$ ;  
Lead space F is 5 mm

 Fig. 5 - Form TFA  
Taped in box (ammopack), formed leads

**Table 1**

| DIMENSIONS in millimeters, MASS AND PACKAGING QUANTITIES |           |                 |                        |            |               |                |                      |         |               |
|--|-----------|-----------------|------------------------|------------|---------------|----------------|----------------------|---------|---------------|
| NOMINAL CASE SIZE<br>$\varnothing D \times L$            | CASE CODE | $\varnothing d$ | $\varnothing D_{max.}$ | $L_{max.}$ | F             | MASS (g)       | PACKAGING QUANTITIES |         |               |
|  |           |                 |                        |            |               |                | FORM CA              | FORM CB | FORM TFA, TNA |
| 5 x 11   | 11        | 0.5             | 5.5                    | 12.5       | $2.0 \pm 0.5$ | $\approx 0.4$  | 5000                 | -       | 2000          |
| 6.3 x 11   | 12        | 0.5             | 6.8                    | 12.5       | $2.5 \pm 0.5$ | $\approx 0.6$  | 5000                 | -       | 2000          |
| 8 x 12   | 13        | 0.6             | 8.5                    | 13.0       | $3.5 \pm 0.5$ | $\approx 1.1$  | 5000                 | -       | 1000          |
| 10 x 12  | 14        | 0.6             | 10.5                   | 13.5       | $5.0 \pm 0.5$ | $\approx 1.6$  | 3000                 | 1000    | 500           |
| 10 x 16  | 15        | 0.6             | 10.5                   | 17.5       | $5.0 \pm 0.5$ | $\approx 1.9$  | 2500                 | 1000    | 500           |
| 10 x 20  | 16        | 0.6             | 10.5                   | 22.0       | $5.0 \pm 0.5$ | $\approx 2.2$  | 2000                 | 800     | 500           |
| 12.5 x 20  | 17        | 0.6             | 13.0                   | 22.0       | $5.0 \pm 0.5$ | $\approx 4.0$  | 1500                 | 400     | 300           |
| 12.5 x 25  | 18        | 0.6             | 13.0                   | 27.0       | $5.0 \pm 0.5$ | $\approx 5.0$  | 1000                 | 400     | 300           |
| 16 x 20  | 19a       | 0.8             | 16.5                   | 22.0       | $7.5 \pm 0.5$ | $\approx 6.0$  | 1000                 | 200     | 200           |
| 16 x 25  | 19        | 0.8             | 16.5                   | 27.0       | $7.5 \pm 0.5$ | $\approx 8.0$  | 750                  | 200     | 200           |
| 16 x 31  | 20        | 0.8             | 16.5                   | 33.5       | $7.5 \pm 0.5$ | $\approx 9.0$  | 600                  | 200     | 200           |
| 16 x 35  | 21        | 0.8             | 16.5                   | 37.5       | $7.5 \pm 0.5$ | $\approx 11.0$ | 500                  | 200     | -             |
| 18 x 31  | 1831      | 0.8             | 18.5                   | 33.5       | $7.5 \pm 0.5$ | $\approx 12.5$ | 400                  | 150     | -             |
| 18 x 35  | 22        | 0.8             | 18.5                   | 37.5       | $7.5 \pm 0.5$ | $\approx 14.5$ | 400                  | 150     | -             |
| 18 x 40  | 23        | 0.8             | 18.5                   | 42.0       | $7.5 \pm 0.5$ | $\approx 16.0$ | 400                  | 150     | -             |

**Note**

- For detailed tape dimensions please refer to packaging information: [www.vishay.com/doc?28360](http://www.vishay.com/doc?28360)



| ELECTRICAL DATA |   |
|-----------------|---|
| SYMBOL          | DESCRIPTION   |
| C <sub>R</sub>  | Rated capacitance at 100 Hz, tolerance ± 20 %                       |
| I <sub>R</sub>  | Rated RMS ripple current at 100 Hz, 105 °C                          |
| I <sub>L2</sub> | Max. leakage current after 2 min at U <sub>R</sub> = 10 V to 100 V  |
| I <sub>L5</sub> | Max. leakage current after 5 min at U <sub>R</sub> = 200 V to 450 V |
| tan δ           | Max. dissipation factor at 100 Hz                                   |

**ORDERING EXAMPLE**

Electrolytic capacitor 142 series  
 470 µF / 25 V; ± 20 %  
 Nominal case size: Ø 10 mm x 12 mm; Form TFA  
 Ordering Code: MAL214236471E3

**Note**

- Unless otherwise specified, all electrical values in Table 2 apply at T<sub>amb</sub> = 20 °C, P = 86 kPa to 106 kPa, RH = 45 % to 75 %.

Table 2

| ELECTRICAL DATA AND ORDERING INFORMATION |                                  |   |  |                                  |                 |                   |                          |           |            |           |                |           |             |           |
|--|----------------------------------|---|--|----------------------------------|-----------------|-------------------|--------------------------|-----------|------------|-----------|----------------|-----------|-------------|-----------|
| U <sub>R</sub><br>(V)                    | C <sub>R</sub><br>100 Hz<br>(µF) | NOMINAL<br>CASE SIZE<br>Ø D x L<br>(mm) | I <sub>R</sub><br>100 Hz<br>105 °C<br>(mA) | I <sub>L2</sub><br>2 min<br>(µA) | tan δ<br>100 Hz | FREQ.<br>CODE (1) | ORDERING CODE MAL2142... |           |            |           |                |           |             |           |
|  |                                  |   |  |                                  |                 |                   | BULK PACKAGING           |           |            |           | TAPED AMMOPACK |           |             |           |
|  |                                  |   |  |                                  |                 |                   | LONG LEADS               |           | CUT LEADS  |           |                |           |             |           |
|  |                                  |   |  |                                  |                 |                   | FORM<br>CA               | F<br>(mm) | FORM<br>CB | F<br>(mm) | FORM<br>TNA    | F<br>(mm) | FORM<br>TFA | F<br>(mm) |
| 10                                       | 220                              | 5 x 11                                  | 115  | 22                               | 0.20            | MF2               | 54221E3                  | 2.0       | -          | -         | 74221E3        | 2.5       | 34221E3     | 5.0       |
|  | 330                              | 6.3 x 11                                | 200  | 33                               | 0.20            | MF2               | 54331E3                  | 2.5       | -          | -         | 74331E3        | 2.5       | 34331E3     | 5.0       |
|  | 470                              | 6.3 x 11                                | 204  | 47                               | 0.20            | MF2               | 94475E3                  | 2.5       | -          | -         | 94477E3        | 2.5       | 94473E3     | 5.0       |
|  | 470                              | 8 x 12                                  | 290  | 47                               | 0.20            | MF2               | 54471E3                  | 3.5       | -          | -         | 74471E3        | 3.5       | 34471E3     | 5.0       |
|  | 1000                             | 10 x 12                                 | 460  | 100                              | 0.20            | MF2               | 54102E3                  | 5.0       | 64102E3    | 5.0       | -              | -         | 34102E3     | 5.0       |
|  | 2200                             | 10 x 20                                 | 760  | 220                              | 0.22            | MF3               | 54222E3                  | 5.0       | 64222E3    | 5.0       | -              | -         | 34222E3     | 5.0       |
|  | 4700                             | 12.5 x 25                               | 1260                                       | 470                              | 0.26            | MF3               | 54472E3                  | 5.0       | 64472E3    | 5.0       | -              | -         | 34472E3     | 5.0       |
|  | 6800                             | 16 x 25                                 | 1690                                       | 680                              | 0.28            | MF3               | 54682E3                  | 7.5       | 64682E3    | 7.5       | -              | -         | 34682E3     | 7.5       |
|  | 10 000                           | 16 x 31                                 | 2120                                       | 1000                             | 0.30            | MF3               | 54103E3                  | 7.5       | 64103E3    | 7.5       | -              | -         | 34103E3     | 7.5       |
|  | 22 000                           | 18 x 40                                 | 3100                                       | 2200                             | 0.32            | MF3               | 54223E3                  | 7.5       | 64223E3    | 7.5       | -              | -         | -           | -         |
| 16                                       | 100                              | 5 x 11                                  | 110  | 16                               | 0.16            | MF2               | 55101E3                  | 2.0       | -          | -         | 75101E3        | 2.5       | 35101E3     | 5.0       |
|  | 220                              | 6.3 x 11                                | 190  | 35                               | 0.16            | MF2               | 55221E3                  | 2.5       | -          | -         | 75221E3        | 2.5       | 35221E3     | 5.0       |
|  | 330                              | 8 x 12                                  | 270  | 53                               | 0.16            | MF2               | 55331E3                  | 3.5       | -          | -         | 75331E3        | 3.5       | 35331E3     | 5.0       |
|  | 470                              | 8 x 12                                  | 310  | 75                               | 0.16            | MF2               | 95475E3                  | 3.5       | -          | -         | 95477E3        | 3.5       | 95473E3     | 5.0       |
|  | 470                              | 10 x 12                                 | 370  | 75                               | 0.16            | MF2               | 55471E3                  | 5.0       | 65471E3    | 5.0       | -              | -         | 35471E3     | 5.0       |
|  | 1000                             | 10 x 16                                 | 560  | 160                              | 0.16            | MF2               | 55102E3                  | 5.0       | 65102E3    | 5.0       | -              | -         | 35102E3     | 5.0       |
|  | 2200                             | 12.5 x 20                               | 920  | 352                              | 0.18            | MF3               | 55222E3                  | 5.0       | 65222E3    | 5.0       | -              | -         | 35222E3     | 5.0       |
|  | 3300                             | 12.5 x 25                               | 1170                                       | 528                              | 0.20            | MF3               | 55332E3                  | 5.0       | 65332E3    | 5.0       | -              | -         | 35332E3     | 5.0       |
|  | 4700                             | 16 x 25                                 | 1480                                       | 752                              | 0.22            | MF3               | 55472E3                  | 7.5       | 65472E3    | 7.5       | -              | -         | 35472E3     | 7.5       |
|  | 6800                             | 16 x 31                                 | 1930                                       | 1088                             | 0.24            | MF3               | 55682E3                  | 7.5       | 65682E3    | 7.5       | -              | -         | 35682E3     | 7.5       |
| 10 000                                   | 18 x 31                          | 2330                                    | 1600                                       | 0.26                             | MF3             | 55103E3           | 7.5                      | 65103E3   | 7.5        | -         | -              | -         | -           |           |
| 25                                       | 33                               | 5 x 11                                  | 68   | 8                                | 0.14            | MF1               | 56339E3                  | 2.0       | -          | -         | 76339E3        | 2.5       | 36339E3     | 5.0       |
|  | 47                               | 5 x 11                                  | 97   | 12                               | 0.14            | MF1               | 56479E3                  | 2.0       | -          | -         | 76479E3        | 2.5       | 36479E3     | 5.0       |
|  | 100                              | 6.3 x 11                                | 142  | 25                               | 0.14            | MF2               | 56101E3                  | 2.5       | -          | -         | 76101E3        | 2.5       | 36101E3     | 5.0       |
|  | 220                              | 8 x 12                                  | 236  | 55                               | 0.14            | MF2               | 56221E3                  | 3.5       | -          | -         | 76221E3        | 3.5       | 36221E3     | 5.0       |
|  | 330                              | 8 x 12                                  | 310  | 82                               | 0.14            | MF2               | 56331E3                  | 3.5       | -          | -         | 76331E3        | 3.5       | 36331E3     | 5.0       |
|  | 470                              | 10 x 12                                 | 380  | 118                              | 0.14            | MF2               | 56471E3                  | 5.0       | 66471E3    | 5.0       | -              | -         | 36471E3     | 5.0       |
|  | 1000                             | 10 x 20                                 | 680  | 250                              | 0.14            | MF2               | 56102E3                  | 5.0       | 66102E3    | 5.0       | -              | -         | 36102E3     | 5.0       |
|  | 2200                             | 12.5 x 25                               | 1110                                       | 550                              | 0.16            | MF3               | 56222E3                  | 5.0       | 66222E3    | 5.0       | -              | -         | 36222E3     | 5.0       |
|  | 3300                             | 16 x 25                                 | 1440                                       | 825                              | 0.18            | MF3               | 56332E3                  | 7.5       | 66332E3    | 7.5       | -              | -         | 36332E3     | 7.5       |
|  | 4700                             | 16 x 31                                 | 1710                                       | 1175                             | 0.20            | MF3               | 56472E3                  | 7.5       | 66472E3    | 7.5       | -              | -         | 36472E3     | 7.5       |
| 6800                                     | 18 x 35                          | 2160                                    | 1700                                       | 0.22                             | MF3             | 56682E3           | 7.5                      | 66682E3   | 7.5        | -         | -              | -         | -           |           |



| ELECTRICAL DATA AND ORDERING INFORMATION |                                  |   |  |                                  |                 |                              |                          |           |            |           |                |           |             |           |
|--|----------------------------------|---|--|----------------------------------|-----------------|------------------------------|--------------------------|-----------|------------|-----------|----------------|-----------|-------------|-----------|
| U <sub>R</sub><br>(V)                    | C <sub>R</sub><br>100 Hz<br>(µF) | NOMINAL<br>CASE SIZE<br>Ø D x L<br>(mm) | I <sub>R</sub><br>100 Hz<br>105 °C<br>(mA) | I <sub>L2</sub><br>2 min<br>(µA) | tan δ<br>100 Hz | FREQ.<br>CODE <sup>(1)</sup> | ORDERING CODE MAL2142... |           |            |           |                |           |             |           |
|  |                                  |   |  |                                  |                 |                              | BULK PACKAGING           |           |            |           | TAPED AMMOPACK |           |             |           |
|  |                                  |   |  |                                  |                 |                              | LONG LEADS               |           | CUT LEADS  |           | FORM TNA       |           | FORM TFA    |           |
|  |                                  |   |  |                                  |                 |                              | FORM<br>CA               | F<br>(mm) | FORM<br>CB | F<br>(mm) | FORM<br>TNA    | F<br>(mm) | FORM<br>TFA | F<br>(mm) |
| 35                                       | 47                               | 5 x 11                                  | 90   | 16                               | 0.12            | MF1                          | 50479E3                  | 2.0       | -          | -         | 70479E3        | 2.5       | 30479E3     | 5.0       |
|  | 100                              | 6.3 x 11                                | 150  | 35                               | 0.12            | MF2                          | 50101E3                  | 2.5       | -          | -         | 70101E3        | 2.5       | 30101E3     | 5.0       |
|  | 220                              | 8 x 12                                  | 270  | 77                               | 0.12            | MF2                          | 50221E3                  | 3.5       | -          | -         | 70221E3        | 3.5       | 30221E3     | 5.0       |
|  | 330                              | 10 x 12                                 | 350  | 116                              | 0.12            | MF2                          | 50331E3                  | 5.0       | 60331E3    | 5.0       | -              | -         | 30331E3     | 5.0       |
|  | 470                              | 10 x 16                                 | 460  | 165                              | 0.12            | MF2                          | 50471E3                  | 5.0       | 60471E3    | 5.0       | -              | -         | 30471E3     | 5.0       |
|  | 1000                             | 12.5 x 20                               | 810  | 350                              | 0.12            | MF2                          | 50102E3                  | 5.0       | 60102E3    | 5.0       | -              | -         | 30102E3     | 5.0       |
|  | 2200                             | 16 x 25                                 | 1260                                       | 770                              | 0.14            | MF3                          | 50222E3                  | 7.5       | 60222E3    | 7.5       | -              | -         | 30222E3     | 7.5       |
|  | 3300                             | 16 x 31                                 | 1420                                       | 1155                             | 0.16            | MF3                          | 50332E3                  | 7.5       | 60332E3    | 7.5       | -              | -         | 30332E3     | 7.5       |
|  | 4700                             | 18 x 35                                 | 1900                                       | 1645                             | 0.18            | MF3                          | 50472E3                  | 7.5       | 60472E3    | 7.5       | -              | -         | -           | -         |
| 50                                       | 22                               | 5 x 11                                  | 78   | 11                               | 0.10            | MF1                          | 51229E3                  | 2.0       | -          | -         | 71229E3        | 2.5       | 31229E3     | 5.0       |
|  | 33                               | 5 x 11                                  | 90   | 16                               | 0.10            | MF1                          | 51339E3                  | 2.0       | -          | -         | 71339E3        | 2.5       | 31339E3     | 5.0       |
|  | 47                               | 6.3 x 11                                | 120  | 24                               | 0.10            | MF1                          | 51479E3                  | 2.5       | -          | -         | 71479E3        | 2.5       | 31479E3     | 5.0       |
|  | 100                              | 8 x 12                                  | 188  | 50                               | 0.10            | MF2                          | 51101E3                  | 3.5       | -          | -         | 71101E3        | 3.5       | 31101E3     | 5.0       |
|  | 220                              | 10 x 12                                 | 240  | 110                              | 0.10            | MF2                          | 51221E3                  | 5.0       | 61221E3    | 5.0       | -              | -         | 31221E3     | 5.0       |
|  | 330                              | 10 x 16                                 | 410  | 165                              | 0.10            | MF2                          | 51331E3                  | 5.0       | 61331E3    | 5.0       | -              | -         | 31331E3     | 5.0       |
|  | 470                              | 10 x 20                                 | 530  | 235                              | 0.10            | MF2                          | 91475E3                  | 5.0       | 91476E3    | 5.0       | -              | -         | 91473E3     | 5.0       |
|  | 470                              | 12.5 x 20                               | 530  | 235                              | 0.10            | MF2                          | 51471E3                  | 5.0       | 61471E3    | 5.0       | -              | -         | 31471E3     | 5.0       |
|  | 1000                             | 12.5 x 25                               | 950  | 500                              | 0.10            | MF2                          | 51102E3                  | 5.0       | 61102E3    | 5.0       | -              | -         | 31102E3     | 5.0       |
|  | 2200                             | 16 x 35                                 | 1470                                       | 1100                             | 0.12            | MF3                          | 51222E3                  | 7.5       | 61222E3    | 7.5       | -              | -         | -           | -         |
|  | 3300                             | 18 x 35                                 | 1770                                       | 1650                             | 0.14            | MF3                          | 51332E3                  | 7.5       | 61332E3    | 7.5       | -              | -         | -           | -         |
| 63                                       | 1.0                              | 5 x 11                                  | 13   | 3                                | 0.09            | MF1                          | 58108E3                  | 2.0       | -          | -         | 78108E3        | 2.5       | 38108E3     | 5.0       |
|  | 3.3                              | 5 x 11                                  | 30   | 3                                | 0.09            | MF1                          | 58338E3                  | 2.0       | -          | -         | 78338E3        | 2.5       | 38338E3     | 5.0       |
|  | 4.7                              | 5 x 11                                  | 36   | 3                                | 0.09            | MF1                          | 58478E3                  | 2.0       | -          | -         | 78478E3        | 2.5       | 38478E3     | 5.0       |
|  | 6.8                              | 5 x 11                                  | 40   | 4                                | 0.09            | MF1                          | 58688E3                  | 2.0       | -          | -         | 78688E3        | 2.5       | 38688E3     | 5.0       |
|  | 10                               | 5 x 11                                  | 54   | 6                                | 0.09            | MF1                          | 58109E3                  | 2.0       | -          | -         | 78109E3        | 2.5       | 38109E3     | 5.0       |
|  | 22                               | 5 x 11                                  | 70   | 14                               | 0.09            | MF1                          | 98225E3                  | 2.0       | -          | -         | 98227E3        | 2.5       | 98223E3     | 5.0       |
|  | 22                               | 6.3 x 11                                | 86   | 14                               | 0.09            | MF1                          | 58229E3                  | 2.5       | -          | -         | 78229E3        | 2.5       | 38229E3     | 5.0       |
|  | 33                               | 6.3 x 11                                | 100  | 21                               | 0.09            | MF1                          | 58339E3                  | 2.5       | -          | -         | 78339E3        | 2.5       | 38339E3     | 5.0       |
|  | 47                               | 6.3 x 11                                | 130  | 30                               | 0.09            | MF1                          | 98475E3                  | 2.5       | -          | -         | 98477E3        | 2.5       | 98473E3     | 5.0       |
|  | 47                               | 8 x 12                                  | 141  | 30                               | 0.09            | MF1                          | 58479E3                  | 3.5       | -          | -         | 78479E3        | 3.5       | 38479E3     | 5.0       |
|  | 100                              | 10 x 12                                 | 235  | 63                               | 0.09            | MF2                          | 58101E3                  | 5.0       | 68101E3    | 5.0       | -              | -         | 38101E3     | 5.0       |
|  | 220                              | 10 x 16                                 | 335  | 139                              | 0.09            | MF2                          | 58221E3                  | 5.0       | 68221E3    | 5.0       | -              | -         | 38221E3     | 5.0       |
|  | 330                              | 10 x 20                                 | 510  | 208                              | 0.09            | MF2                          | 58331E3                  | 5.0       | 68331E3    | 5.0       | -              | -         | 38331E3     | 5.0       |
|  | 470                              | 12.5 x 20                               | 640  | 296                              | 0.09            | MF2                          | 58471E3                  | 5.0       | 68471E3    | 5.0       | -              | -         | 38471E3     | 5.0       |
|  | 1000                             | 16 x 25                                 | 930  | 630                              | 0.09            | MF2                          | 58102E3                  | 7.5       | 68102E3    | 7.5       | -              | -         | 38102E3     | 7.5       |
|  | 2200                             | 18 x 40                                 | 2340                                       | 1380                             | 0.09            | MF3                          | 58222E3                  | 7.5       | 68222E3    | 7.5       | -              | -         | -           | -         |



| ELECTRICAL DATA AND ORDERING INFORMATION |                                  |   |  |                                  |                 |                              |                          |           |            |           |                |           |             |           |
|--|----------------------------------|---|--|----------------------------------|-----------------|------------------------------|--------------------------|-----------|------------|-----------|----------------|-----------|-------------|-----------|
| U <sub>R</sub><br>(V)                    | C <sub>R</sub><br>100 Hz<br>(µF) | NOMINAL<br>CASE SIZE<br>Ø D x L<br>(mm) | I <sub>R</sub><br>100 Hz<br>105 °C<br>(mA) | I <sub>L2</sub><br>2 min<br>(µA) | tan δ<br>100 Hz | FREQ.<br>CODE <sup>(1)</sup> | ORDERING CODE MAL2142... |           |            |           |                |           |             |           |
|  |                                  |   |  |                                  |                 |                              | BULK PACKAGING           |           |            |           | TAPED AMMOPACK |           |             |           |
|  |                                  |   |  |                                  |                 |                              | LONG LEADS               |           | CUT LEADS  |           | FORM TNA       |           | FORM TFA    |           |
|  |                                  |   |  |                                  |                 |                              | FORM<br>CA               | F<br>(mm) | FORM<br>CB | F<br>(mm) | FORM<br>TNA    | F<br>(mm) | FORM<br>TFA | F<br>(mm) |
| 100                                      | 2.2                              | 5 x 11                                  | 30   | 3                                | 0.08            | MF1                          | 59228E3                  | 2.0       | -          | -         | 79228E3        | 2.5       | 39228E3     | 5.0       |
|  | 4.7                              | 5 x 11                                  | 36   | 5                                | 0.08            | MF1                          | 99475E3                  | 2.0       | -          | -         | 99477E3        | 2.5       | 99473E3     | 5.0       |
|  | 4.7                              | 6.3 x 11                                | 40   | 5                                | 0.08            | MF1                          | 59478E3                  | 2.5       | -          | -         | 79478E3        | 2.5       | 39478E3     | 5.0       |
|  | 10                               | 6.3 x 11                                | 54   | 10                               | 0.08            | MF1                          | 99105E3                  | 2.5       | -          | -         | 99107E3        | 2.5       | 99103E3     | 5.0       |
|  | 10                               | 8 x 12                                  | 66   | 10                               | 0.08            | MF1                          | 59109E3                  | 3.5       | -          | -         | 79109E3        | 3.5       | 39109E3     | 5.0       |
|  | 22                               | 6.3 x 11                                | 93   | 22                               | 0.08            | MF1                          | 99225E3                  | 2.5       | -          | -         | 99227E3        | 2.5       | 99223E3     | 5.0       |
|  | 22                               | 8 x 12                                  | 99   | 22                               | 0.08            | MF1                          | 59229E3                  | 3.5       | -          | -         | 79229E3        | 3.5       | 39229E3     | 5.0       |
|  | 33                               | 8 x 12                                  | 130  | 33                               | 0.08            | MF1                          | 99395E3                  | 3.5       | -          | -         | 99397E3        | 3.5       | 99393E3     | 5.0       |
|  | 33                               | 10 x 12                                 | 148  | 33                               | 0.08            | MF1                          | 59339E3                  | 5.0       | 69339E3    | 5.0       | -              | -         | 39339E3     | 5.0       |
|  | 47                               | 10 x 16                                 | 180  | 47                               | 0.08            | MF1                          | 59479E3                  | 5.0       | 69479E3    | 5.0       | -              | -         | 39479E3     | 5.0       |
|  | 100                              | 10 x 20                                 | 265  | 100                              | 0.08            | MF2                          | 59101E3                  | 5.0       | 69101E3    | 5.0       | -              | -         | 39101E3     | 5.0       |
|  | 220                              | 12.5 x 25                               | 440  | 220                              | 0.08            | MF2                          | 59221E3                  | 5.0       | 69221E3    | 5.0       | -              | -         | 39221E3     | 5.0       |
|  | 330                              | 12.5 x 25                               | 400  | 330                              | 0.08            | MF2                          | 99315E3                  | 5.0       | 99316E3    | 5.0       | -              | -         | 99313E3     | 5.0       |
|  | 330                              | 16 x 25                                 | 540  | 330                              | 0.08            | MF2                          | 59331E3                  | 7.5       | 69331E3    | 7.5       | -              | -         | 39331E3     | 7.5       |
| 470                                      | 16 x 31                          | 715                                     | 470  | 0.08                             | MF2             | 59471E3                      | 7.5                      | 69471E3   | 7.5        | -         | -              | 39471E3   | 7.5         |           |
| 1000                                     | 18 x 40                          | 985                                     | 1000                                       | 0.08                             | MF2             | 59102E3                      | 7.5                      | 69102E3   | 7.5        | -         | -              | -         | -           |           |
| 200                                      | 1.0                              | 5 x 11                                  | 18   | 21                               | 0.14            | MF1                          | 52108E3                  | 2.0       | -          | -         | 72108E3        | 2.5       | 32108E3     | 5.0       |
|  | 2.2                              | 6.3 x 11                                | 30   | 28                               | 0.14            | MF1                          | 52228E3                  | 2.5       | -          | -         | 72228E3        | 2.5       | 32228E3     | 5.0       |
|  | 4.7                              | 8 x 12                                  | 54   | 43                               | 0.14            | MF1                          | 52478E3                  | 3.5       | -          | -         | 72478E3        | 3.5       | 32478E3     | 5.0       |
|  | 10                               | 10 x 12                                 | 94   | 65                               | 0.14            | MF1                          | 52109E3                  | 5.0       | 62109E3    | 5.0       | -              | -         | 32109E3     | 5.0       |
|  | 22                               | 10 x 16                                 | 142  | 113                              | 0.14            | MF1                          | 52229E3                  | 5.0       | 62229E3    | 5.0       | -              | -         | 32229E3     | 5.0       |
|  | 47                               | 12.5 x 20                               | 250  | 213                              | 0.14            | MF1                          | 52479E3                  | 5.0       | 62479E3    | 5.0       | -              | -         | 32479E3     | 5.0       |
|  | 100                              | 16 x 25                                 | 485  | 425                              | 0.14            | MF2                          | 52101E3                  | 7.5       | 62101E3    | 7.5       | -              | -         | 32101E3     | 7.5       |
| 220                                      | 18 x 35                          | 835                                     | 905  | 0.14                             | MF2             | 52221E3                      | 7.5                      | 62221E3   | 7.5        | -         | -              | -         | -           |           |
| 250                                      | 1.0                              | 5 x 11                                  | 16   | 23                               | 0.17            | MF1                          | 51083E3                  | 2.0       | -          | -         | 71083E3        | 2.5       | 31083E3     | 5.0       |
|  | 2.2                              | 6.3 x 11                                | 35   | 32                               | 0.17            | MF1                          | 52283E3                  | 2.5       | -          | -         | 72283E3        | 2.5       | 32283E3     | 5.0       |
|  | 4.7                              | 8 x 12                                  | 60   | 50                               | 0.17            | MF1                          | 54783E3                  | 3.5       | -          | -         | 74783E3        | 3.5       | 34783E3     | 5.0       |
|  | 10                               | 10 x 12                                 | 92   | 75                               | 0.17            | MF1                          | 51093E3                  | 5.0       | 61093E3    | 5.0       | -              | -         | 31093E3     | 5.0       |
|  | 22                               | 10 x 20                                 | 215  | 135                              | 0.17            | MF1                          | 52293E3                  | 5.0       | 62293E3    | 5.0       | -              | -         | 32293E3     | 5.0       |
|  | 33                               | 12.5 x 20                               | 315  | 190                              | 0.17            | MF1                          | 53393E3                  | 5.0       | 63393E3    | 5.0       | -              | -         | 33393E3     | 5.0       |
|  | 47                               | 12.5 x 25                               | 350  | 260                              | 0.17            | MF1                          | 54793E3                  | 5.0       | 64793E3    | 5.0       | -              | -         | 34793E3     | 5.0       |
| 100                                      | 16 x 31                          | 530                                     | 525  | 0.17                             | MF2             | 51013E3                      | 7.5                      | 61013E3   | 7.5        | -         | -              | 31013E3   | 7.5         |           |
| 350                                      | 1.0                              | 6.3 x 11                                | 23   | 26                               | 0.20            | MF1                          | 51085E3                  | 2.5       | -          | -         | 71085E3        | 2.5       | 31085E3     | 5.0       |
|  | 2.2                              | 8 x 12                                  | 41   | 38                               | 0.20            | MF1                          | 52285E3                  | 3.5       | -          | -         | 72285E3        | 3.5       | 32285E3     | 5.0       |
|  | 4.7                              | 10 x 12                                 | 65   | 58                               | 0.20            | MF1                          | 54785E3                  | 5.0       | 64785E3    | 5.0       | -              | -         | 34785E3     | 5.0       |
|  | 10                               | 10 x 16                                 | 105  | 95                               | 0.20            | MF1                          | 51095E3                  | 5.0       | 61095E3    | 5.0       | -              | -         | 31095E3     | 5.0       |
|  | 22                               | 12.5 x 20                               | 210  | 179                              | 0.20            | MF1                          | 52295E3                  | 5.0       | 62295E3    | 5.0       | -              | -         | 32295E3     | 5.0       |
|  | 47                               | 16 x 25                                 | 365  | 354                              | 0.20            | MF1                          | 54795E3                  | 7.5       | 64795E3    | 7.5       | -              | -         | 34795E3     | 7.5       |
| 100                                      | 18 x 35                          | 505                                     | 725  | 0.20                             | MF2             | 51015E3                      | 7.5                      | 61015E3   | 7.5        | -         | -              | -         | -           |           |
| 400                                      | 1.0                              | 6.3 x 11                                | 21   | 27                               | 0.25            | MF1                          | 51086E3                  | 2.5       | -          | -         | 71086E3        | 2.5       | 31086E3     | 5.0       |
|  | 2.2                              | 8 x 12                                  | 39   | 41                               | 0.25            | MF1                          | 52286E3                  | 3.5       | -          | -         | 72286E3        | 3.5       | 32286E3     | 5.0       |
|  | 4.7                              | 10 x 12                                 | 70   | 63                               | 0.25            | MF1                          | 54786E3                  | 5.0       | 64786E3    | 5.0       | -              | -         | 34786E3     | 5.0       |
|  | 10                               | 10 x 20                                 | 125  | 105                              | 0.25            | MF1                          | 51096E3                  | 5.0       | 61096E3    | 5.0       | -              | -         | 31096E3     | 5.0       |
|  | 22                               | 12.5 x 25                               | 235  | 201                              | 0.25            | MF1                          | 52296E3                  | 5.0       | 62296E3    | 5.0       | -              | -         | 32296E3     | 5.0       |
|  | 47                               | 16 x 31                                 | 390  | 401                              | 0.25            | MF1                          | 54796E3                  | 7.5       | 64796E3    | 7.5       | -              | -         | 34796E3     | 7.5       |
| 100                                      | 18 x 40                          | 530                                     | 825  | 0.25                             | MF2             | 51016E3                      | 7.5                      | 61016E3   | 7.5        | -         | -              | -         | -           |           |
| 450                                      | 1.0                              | 8 x 12                                  | 27   | 29                               | 0.25            | MF1                          | 57108E3                  | 3.5       | -          | -         | 77108E3        | 3.5       | 37108E3     | 5.0       |
|  | 2.2                              | 10 x 12                                 | 48   | 45                               | 0.25            | MF1                          | 57228E3                  | 5.0       | 67228E3    | 5.0       | -              | -         | 37228E3     | 5.0       |
|  | 4.7                              | 10 x 16                                 | 75   | 67                               | 0.25            | MF1                          | 57478E3                  | 5.0       | 67478E3    | 5.0       | -              | -         | 37478E3     | 5.0       |
|  | 10                               | 12.5 x 20                               | 145  | 115                              | 0.25            | MF1                          | 57109E3                  | 5.0       | 67109E3    | 5.0       | -              | -         | 37109E3     | 5.0       |
|  | 22                               | 16 x 20                                 | 245  | 223                              | 0.25            | MF1                          | 57229E3                  | 7.5       | 67229E3    | 7.5       | -              | -         | 37229E3     | 7.5       |
|  | 33                               | 16 x 25                                 | 325  | 322                              | 0.25            | MF1                          | 57339E3                  | 7.5       | 67339E3    | 7.5       | -              | -         | 37339E3     | 7.5       |
| 47                                       | 16 x 35                          | 420                                     | 448  | 0.25                             | MF1             | 57479E3                      | 7.5                      | 67479E3   | 7.5        | -         | -              | -         | -           |           |

Note

<sup>(1)</sup> Determines the applicable row in the table “Multiplier of Ripple Current (I<sub>R</sub>) as a Function of Frequency”



| ADDITIONAL ELECTRICAL DATA         |   |   |
|------------------------------------|---|---|
| PARAMETER                          | CONDITIONS  | VALUE   |
| <b>Voltage</b>                     |   |   |
| Surge voltage                      |   | $U_s \leq 1.15 \times U_R$  |
| Reverse voltage                    |   | $U_{rev} \leq 1 \text{ V}$  |
| <b>Current</b>                     |   |   |
| Leakage current                    | After 2 min at $U_R = 10 \text{ V}$ to $100 \text{ V}$      | $I_{L2} \leq 0.01 C_R \times U_R$ or $3 \mu\text{A}$ , whichever is greater   |
|                                    | After 5 min at $U_R = 200 \text{ V}$ to $450 \text{ V}$     | $I_{L5} \leq 0.03 C_R \times U_R + 15 \mu\text{A}$ ( $C_R \times U_R \leq 1000$ )<br>$I_{L5} \leq 0.02 C_R \times U_R + 25 \mu\text{A}$ ( $C_R \times U_R > 1000$ ) |
| <b>Inductance</b>                  |   |   |
| Equivalent series inductance (ESL) | Case $\varnothing D \leq 8 \text{ mm}$                      | Typ. 13 nH  |
|                                    | Case $\varnothing D = 10 \text{ mm}$                        | Typ. 16 nH  |
|                                    | Case $\varnothing D \geq 12.5 \text{ mm}$                   | Typ. 18 nH  |
| <b>Resistance</b>                  |   |   |
| Equivalent series resistance (ESR) | Calculated from $\tan \delta_{max}$ and $C_R$ (see Table 2) | $ESR = \tan \delta / 2 \pi f C_R$   |

**CAPACITANCE (C)**

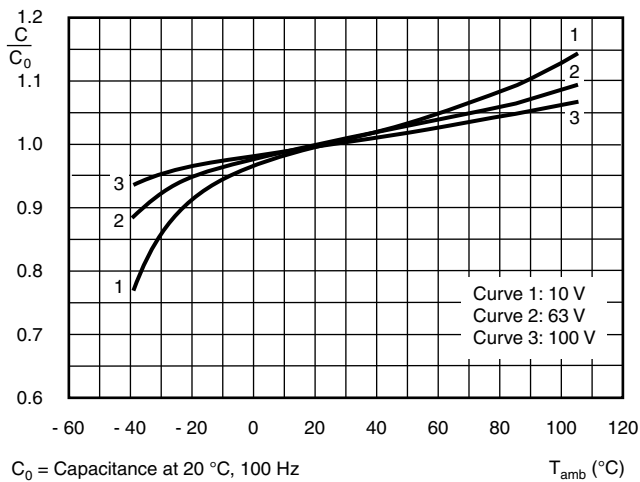


Fig. 6 - Typical multiplier of capacitance as a function of ambient temperature

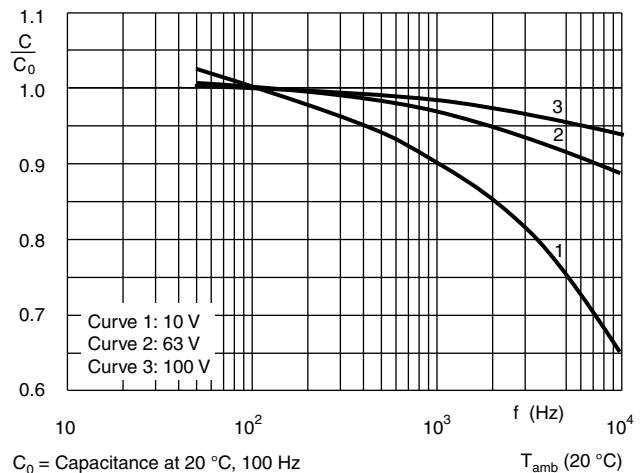


Fig. 7 - Typical multiplier of capacitance as a function of frequency

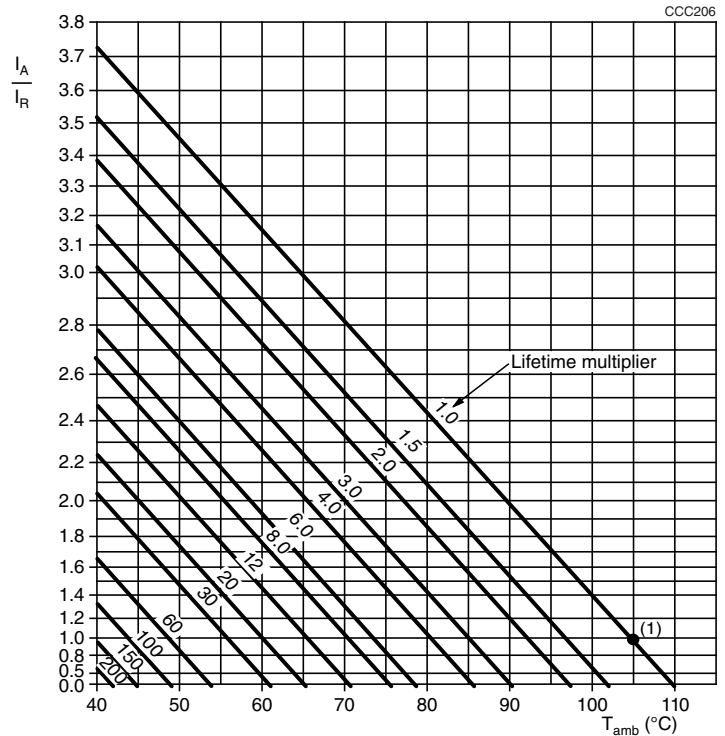
**RIPPLE CURRENT AND USEFUL LIFE**

Table 3

| ENDURANCE TEST DURATION AND USEFUL LIFE |                           |
|---|---------------------------|
| ENDURANCE AT 105 °C (h)                 | USEFUL LIFE AT 105 °C (h) |
| 2000                                    | 2500                      |

**Note**

- Multiplier of useful life code: CCC206



$I_A$  = Actual ripple current at 100 Hz, 105 °C  
 $I_R$  = Rated ripple current at 100 Hz, 105 °C

(1) Useful life at 105 °C and  $I_R$  applied

Fig. 8 - Multiplier of useful life as a function of ambient temperature and ripple current load

Table 4

| MULTIPLIER OF RIPPLE CURRENT ( $I_R$ ) AS A FUNCTION OF FREQUENCY |                |      |      |      |          |
|---|----------------|------|------|------|----------|
| FREQ. CODE  | FREQUENCY (Hz) |      |      |      |          |
|   | 50             | 100  | 500  | 1000 | ≥ 10 000 |
| $I_R$ MULTIPLIER  |                |      |      |      |          |
| MF1   | 0.70           | 1.00 | 1.30 | 1.40 | 1.50     |
| MF2   | 0.75           | 1.00 | 1.20 | 1.30 | 1.35     |
| MF3   | 0.80           | 1.00 | 1.10 | 1.12 | 1.15     |

Table 5

| TEST PROCEDURES AND REQUIREMENTS         |                                       |  |  |
|--|---------------------------------------|--|--|
| TEST                                     |                                       | PROCEDURE (quick reference)  | REQUIREMENTS   |
| NAME OF TEST                             | REFERENCE                             |  |  |
| Endurance                                | IEC 60384-4 / EN130300 subclause 4.13 | $T_{amb} = 105\text{ °C}$ ; $U_R$ applied; 2000 h  | $\Delta C/C: \pm 20\%$<br>$\tan \delta \leq 2 \times \text{spec. limit}$<br>$I_{L5} \leq \text{spec. limit}$   |
| Useful life                              | CECC 30301 subclause 1.8.1            | $T_{amb} = 105\text{ °C}$ ; $U_R$ and $I_R$ applied; 2500 h  | $\Delta C/C: \pm 30\%$<br>$\tan \delta \leq 3 \times \text{spec. limit}$<br>$I_{L5} \leq \text{spec. limit}$<br>no short or open circuit<br>total failure percentage: $\leq 1\%$ |
| Shelf life (storage at high temperature) | IEC 60384-4 / EN130300 subclause 4.17 | $T_{amb} = 105\text{ °C}$ ; no voltage applied; 1000 h<br>After test: $U_R$ to be applied for 30 min, 24 h to 48 h before measurement  | $\Delta C/C: \pm 20\%$<br>$\tan \delta \leq 2 \times \text{spec. limit}$<br>$I_{L5} \leq \text{spec. limit}$   |
| Surge                                    | IEC 60384-4 / EN130300 subclause 4.14 | From source of $1.15 \times U_R$ ;<br>$RC = 0.1\text{ s} \pm 0.05\text{ s}$ ;<br>1000 cycles of 30 s on, 330 s off, at $105\text{ °C}$ | $\Delta C/C: \pm 25\%$<br>$\tan \delta \leq 1.5 \times \text{spec. limit}$<br>$I_{L5} \leq \text{spec. limit}$   |

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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