

## Aluminum Electrolytic Capacitors Radial High Temperature Standard

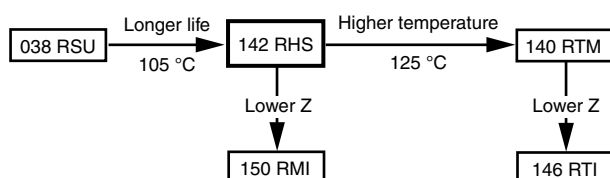
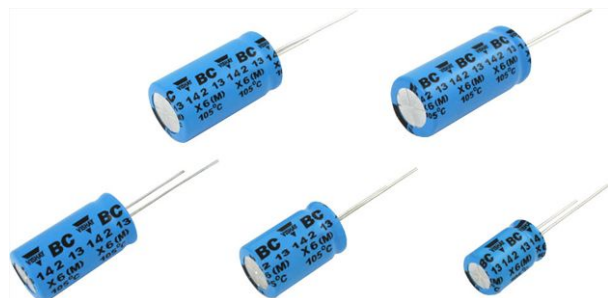


Fig. 1

### 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  $C_R$ ,  $U_R$ , AND RELEVANT NOMINAL CASE SIZES ( $\varnothing D \times L$  in mm)**

| $C_R$<br>( $\mu F$ ) | $U_R$ (V) |           |           |           |           |           |           |
|----------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
|                      | 10        | 16        | 25        | 35        | 50        | 63        | 100       |
| 1.0                  | →         | →         | →         | →         | →         | →         | →         |
| 2.2                  | →         | →         | →         | →         | →         | →         | 5 x 11    |
| 4.7                  | →         | →         | →         | →         | →         | 5 x 11    | 6.3 x 11  |
| 10                   | →         | →         | →         | →         | →         | 5 x 11    | 8 x 12    |
| 22                   | →         | →         | →         | →         | 5 x 11    | 6.3 x 11  | 8 x 12    |
| 33                   | →         | →         | →         | →         | →         | 6.3 x 11  | 10 x 12   |
| 47                   | →         | →         | 5 x 11    | 5 x 11    | 6.3 x 11  | 8 x 12    | 10 x 16   |
| 100                  | →         | 5 x 11    | 6.3 x 11  | 6.3 x 11  | 8 x 12    | 10 x 12   | 10 x 20   |
| 220                  | →         | 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    | →         | 10 x 12   | 10 x 16   | 10 x 20   | 16 x 25   |
| 470                  | 8 x 12    | 10 x 12   | 10 x 12   | 10 x 16   | 12.5 x 20 | 12.5 x 20 | 16 x 31   |
| 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  $C_R$ ,  $U_R$ , AND RELEVANT NOMINAL CASE SIZES ( $\varnothing D \times L$  in mm)**

| $C_R$<br>( $\mu F$ ) | $U_R$ (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   | -         | -         | -         | -         |

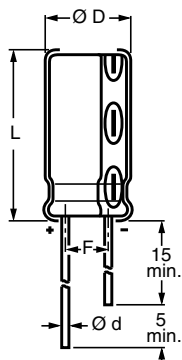
**DIMENSIONS** in millimeters **AND AVAILABLE FORMS**


Fig. 2 - **Form CA**  
Long leads

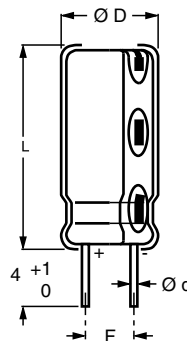
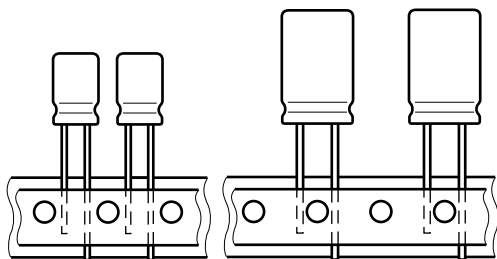
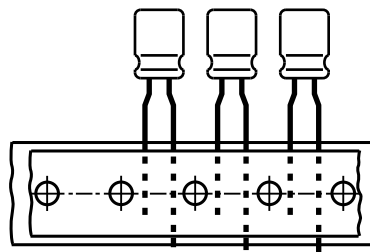


Fig. 3 - **Form CB**  
Cut leads



Dimensions of lead space F see Table 2

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



Case Ø D = 5 mm to 8 mm;  
Lead space F is 5 mm

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

**Table 1**

| <b>DIMENSIONS</b> in millimeters, <b>MASS AND PACKAGING QUANTITIES</b> |              |     |                     |                   |           |             |                      |            |                  |
|------------------------------------------------------------------------|--------------|-----|---------------------|-------------------|-----------|-------------|----------------------|------------|------------------|
| NOMINAL<br>CASE SIZE<br>Ø D x L                                        | CASE<br>CODE | Ø d | Ø D <sub>max.</sub> | L <sub>max.</sub> | F         | MASS<br>(g) | PACKAGING QUANTITIES |            |                  |
|                                                                        |              |     |                     |                   |           |             | FORM<br>CA           | FORM<br>CB | FORM<br>TFA, TNA |
| 5 x 11                                                                 | 11           | 0.5 | 5.5                 | 12.5              | 2.0 ± 0.5 | ≈ 0.4       | 5000                 | -          | 2000             |
| 6.3 x 11                                                               | 12           | 0.5 | 6.8                 | 12.5              | 2.5 ± 0.5 | ≈ 0.6       | 5000                 | -          | 2000             |
| 8 x 12                                                                 | 13           | 0.6 | 8.5                 | 13.0              | 3.5 ± 0.5 | ≈ 1.1       | 5000                 | -          | 1000             |
| 10 x 12                                                                | 14           | 0.6 | 10.5                | 13.5              | 5.0 ± 0.5 | ≈ 1.6       | 3000                 | 1000       | 500              |
| 10 x 16                                                                | 15           | 0.6 | 10.5                | 17.5              | 5.0 ± 0.5 | ≈ 1.9       | 2500                 | 1000       | 500              |
| 10 x 20                                                                | 16           | 0.6 | 10.5                | 22.0              | 5.0 ± 0.5 | ≈ 2.2       | 2000                 | 800        | 500              |
| 12.5 x 20                                                              | 17           | 0.6 | 13.0                | 22.0              | 5.0 ± 0.5 | ≈ 4.0       | 1500                 | 400        | 300              |
| 12.5 x 25                                                              | 18           | 0.6 | 13.0                | 27.0              | 5.0 ± 0.5 | ≈ 5.0       | 1000                 | 400        | 300              |
| 16 x 20                                                                | 19a          | 0.8 | 16.5                | 22.0              | 7.5 ± 0.5 | ≈ 6.0       | 1000                 | 200        | 200              |
| 16 x 25                                                                | 19           | 0.8 | 16.5                | 27.0              | 7.5 ± 0.5 | ≈ 8.0       | 750                  | 200        | 200              |
| 16 x 31                                                                | 20           | 0.8 | 16.5                | 33.5              | 7.5 ± 0.5 | ≈ 9.0       | 600                  | 200        | 200              |
| 16 x 35                                                                | 21           | 0.8 | 16.5                | 37.5              | 7.5 ± 0.5 | ≈ 11.0      | 500                  | 200        | -                |
| 18 x 31                                                                | 1831         | 0.8 | 18.5                | 33.5              | 7.5 ± 0.5 | ≈ 12.5      | 400                  | 150        | -                |
| 18 x 35                                                                | 22           | 0.8 | 18.5                | 37.5              | 7.5 ± 0.5 | ≈ 14.5      | 400                  | 150        | -                |
| 18 x 40                                                                | 23           | 0.8 | 18.5                | 42.0              | 7.5 ± 0.5 | ≈ 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                                                       |
| $C_R$           | Rated capacitance at 100 Hz, tolerance $\pm 20\%$                 |
| $I_R$           | Rated RMS ripple current at 100 Hz, 105 °C                        |
| $I_{L2}$        | Max. leakage current after 2 min at $U_R = 10\text{ V}$ to 100 V  |
| $I_{L5}$        | Max. leakage current after 5 min at $U_R = 200\text{ V}$ to 450 V |
| $\tan \delta$   | Max. dissipation factor at 100 Hz                                 |

**Note**

- Unless otherwise specified, all electrical values in Table 2 apply at  $T_{amb} = 20\text{ °C}$ ,  $P = 86\text{ kPa}$  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 <sup>(1)</sup> | 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                                       | 330                              | 6.3 x 11                                | 200                                        | 33                               | 0.20            | MF2                          | 54331E3                  | 2.5       | -          | -         | 74331E3        | 2.5       | 34331E3     | 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                              | 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                                       | 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       |
|                                          | 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       | -              | -         | -           | -         |

**ORDERING EXAMPLE**

Electrolytic capacitor 142 series

470  $\mu\text{F}$  / 25 V;  $\pm 20\%$ 

Nominal case size:  $\varnothing 10\text{ mm} \times 12\text{ mm}$ ; Form TFA

Ordering Code: MAL214236471E3



| 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<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       |
|                                          | 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                              | 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                                       | 4.7                              | 5 x 11                                  | 36                                         | 3                                | 0.09            | MF1                          | 58478E3                  | 2.0       | -          | -         | 78478E3        | 2.5       | 38478E3     | 5.0       |
|                                          | 10                               | 5 x 11                                  | 54                                         | 6                                | 0.09            | MF1                          | 58109E3                  | 2.0       | -          | -         | 78109E3        | 2.5       | 38109E3     | 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                               | 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       | -              | -         | -           | -         |
| 100                                      | 2.2                              | 5 x 11                                  | 30                                         | 3                                | 0.08            | MF1                          | 59228E3                  | 2.0       | -          | -         | 79228E3        | 2.5       | 39228E3     | 5.0       |
|                                          | 4.7                              | 6.3 x 11                                | 40                                         | 5                                | 0.08            | MF1                          | 59478E3                  | 2.5       | -          | -         | 79478E3        | 2.5       | 39478E3     | 5.0       |
|                                          | 10                               | 8 x 12                                  | 66                                         | 10                               | 0.08            | MF1                          | 59109E3                  | 3.5       | -          | -         | 79109E3        | 3.5       | 39109E3     | 5.0       |
|                                          | 22                               | 8 x 12                                  | 99                                         | 22                               | 0.08            | MF1                          | 59229E3                  | 3.5       | -          | -         | 79229E3        | 3.5       | 39229E3     | 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                              | 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       | -              | -         | -           | -         |



| 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<br>CA               | F<br>(mm) | FORM<br>CB | F<br>(mm) | FORM<br>TNA    | F<br>(mm) | FORM<br>TFA | F<br>(mm) |
| 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 $U_R = 10 \text{ V to } 100 \text{ V}$       | $I_{L2} \leq 0.01 C_R \times U_R \text{ or } 3 \mu\text{A, whichever is greater}$                                                                           |
|                                    | 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)

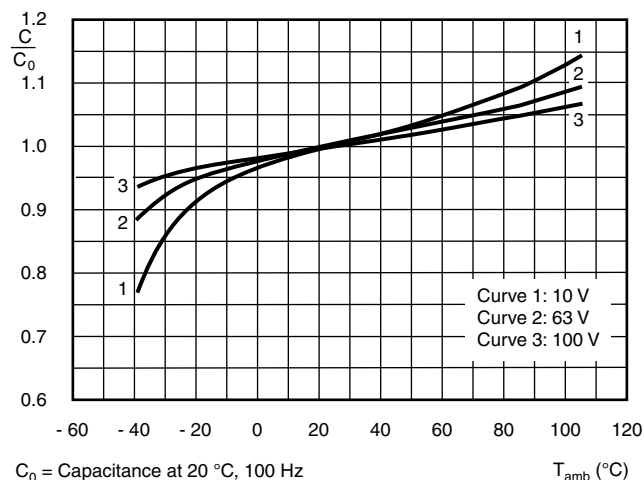


Fig. 6 - Typical multiplier of capacitance as a function of ambient temperature

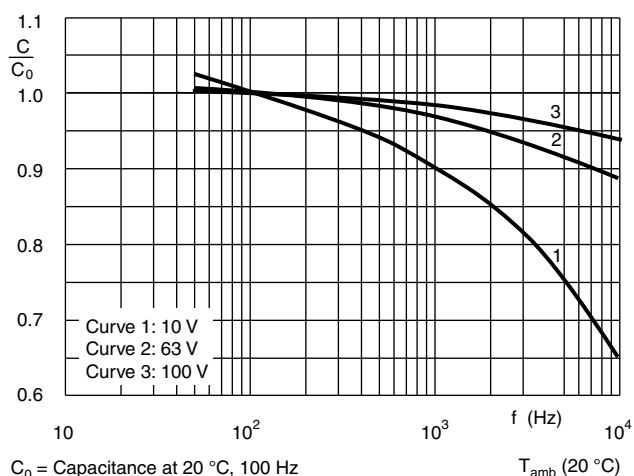


Fig. 7 - Typical multiplier of capacitance as a function of frequency

## RIPPLE CURRENT AND USEFUL LIFE

Table 3

| ENDURANCE TEST DURATION AND USEFUL LIFE |                                           |
|-----------------------------------------|-------------------------------------------|
| ENDURANCE AT 105 $^{\circ}\text{C}$ (h) | USEFUL LIFE AT 105 $^{\circ}\text{C}$ (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

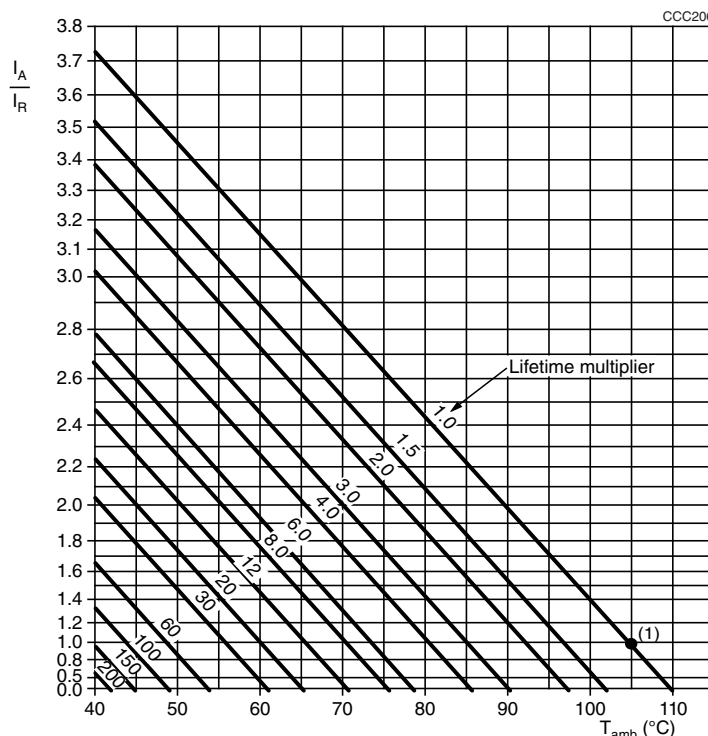
<sup>(1)</sup> Useful life at 105 °C and  $I_R$  applied


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.<br>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<br>(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<br>(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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