

## Aluminum Electrolytic Capacitors Radial High Temperature Standard

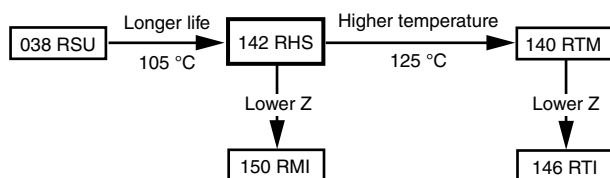
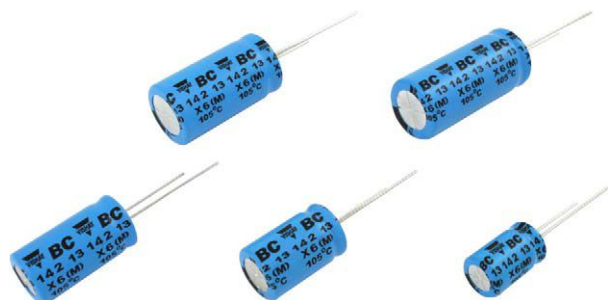


Fig. 1

### 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   | -         | -         | -         | -         |

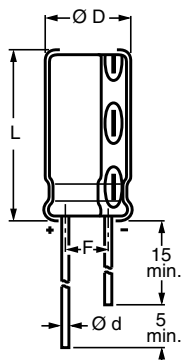
**DIMENSIONS** in millimeters **AND AVAILABLE FORMS**


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

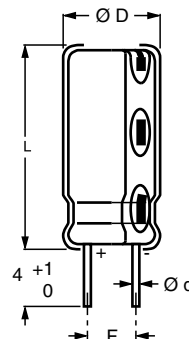
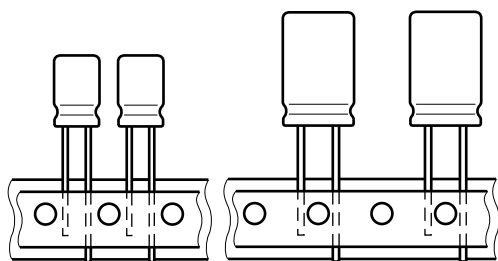
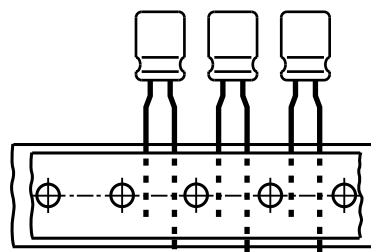


Fig. 3 - **Form CB**  
Cut leads



Dimensions of lead space F see Table 2

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



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

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

**Table 1**

| <b>DIMENSIONS</b> in millimeters, <b>MASS AND PACKAGING QUANTITIES</b> |              |                 |                        |            |               |                |                      |            |                  |
|------------------------------------------------------------------------|--------------|-----------------|------------------------|------------|---------------|----------------|----------------------|------------|------------------|
| NOMINAL<br>CASE SIZE<br>$\varnothing D \times L$                       | CASE<br>CODE | $\varnothing d$ | $\varnothing D_{max.}$ | $L_{max.}$ | 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       | $2.0 \pm 0.5$ | $\approx 0.4$  | 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                                                       |
| $C_R$           | 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 %.

**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

Table 2

| ELECTRICAL DATA AND ORDERING INFORMATION |                                      |                                                          |                                   |                                        |                         |                          |           |            |           |                |           |             |           |
|------------------------------------------|--------------------------------------|----------------------------------------------------------|-----------------------------------|----------------------------------------|-------------------------|--------------------------|-----------|------------|-----------|----------------|-----------|-------------|-----------|
| $U_R$<br>(V)                             | $C_R$<br>100 Hz<br>( $\mu\text{F}$ ) | NOMINAL<br>CASE SIZE<br>$\varnothing D \times L$<br>(mm) | $I_R$<br>100 Hz<br>105 °C<br>(mA) | $I_{L2}$<br>2 min<br>( $\mu\text{A}$ ) | $\tan \delta$<br>100 Hz | 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                    | 54331E3                  | 2.5       | -          | -         | 74331E3        | 2.5       | 34331E3     | 5.0       |
|                                          | 470                                  | 8 x 12                                                   | 290                               | 47                                     | 0.20                    | 54471E3                  | 3.5       | -          | -         | 74471E3        | 3.5       | 34471E3     | 5.0       |
|                                          | 1000                                 | 10 x 12                                                  | 460                               | 100                                    | 0.20                    | 54102E3                  | 5.0       | 64102E3    | 5.0       | -              | -         | 34102E3     | 5.0       |
|                                          | 2200                                 | 10 x 20                                                  | 760                               | 220                                    | 0.22                    | 54222E3                  | 5.0       | 64222E3    | 5.0       | -              | -         | 34222E3     | 5.0       |
|                                          | 4700                                 | 12.5 x 25                                                | 1260                              | 470                                    | 0.26                    | 54472E3                  | 5.0       | 64472E3    | 5.0       | -              | -         | 34472E3     | 5.0       |
|                                          | 6800                                 | 16 x 25                                                  | 1690                              | 680                                    | 0.28                    | 54682E3                  | 7.5       | 64682E3    | 7.5       | -              | -         | 34682E3     | 7.5       |
|                                          | 10 000                               | 16 x 31                                                  | 2120                              | 1000                                   | 0.30                    | 54103E3                  | 7.5       | 64103E3    | 7.5       | -              | -         | 34103E3     | 7.5       |
|                                          | 22 000                               | 18 x 40                                                  | 3100                              | 2200                                   | 0.32                    | 54223E3                  | 7.5       | 64223E3    | 7.5       | -              | -         | -           | -         |
| 16                                       | 100                                  | 5 x 11                                                   | 110                               | 16                                     | 0.16                    | 55101E3                  | 2.0       | -          | -         | 75101E3        | 2.5       | 35101E3     | 5.0       |
|                                          | 220                                  | 6.3 x 11                                                 | 190                               | 35                                     | 0.16                    | 55221E3                  | 2.5       | -          | -         | 75221E3        | 2.5       | 35221E3     | 5.0       |
|                                          | 330                                  | 8 x 12                                                   | 270                               | 53                                     | 0.16                    | 55331E3                  | 3.5       | -          | -         | 75331E3        | 3.5       | 35331E3     | 5.0       |
|                                          | 470                                  | 10 x 12                                                  | 370                               | 75                                     | 0.16                    | 55471E3                  | 5.0       | 65471E3    | 5.0       | -              | -         | 35471E3     | 5.0       |
|                                          | 1000                                 | 10 x 16                                                  | 560                               | 160                                    | 0.16                    | 55102E3                  | 5.0       | 65102E3    | 5.0       | -              | -         | 35102E3     | 5.0       |
|                                          | 2200                                 | 12.5 x 20                                                | 920                               | 352                                    | 0.18                    | 55222E3                  | 5.0       | 65222E3    | 5.0       | -              | -         | 35222E3     | 5.0       |
|                                          | 3300                                 | 12.5 x 25                                                | 1170                              | 528                                    | 0.20                    | 55332E3                  | 5.0       | 65332E3    | 5.0       | -              | -         | 35332E3     | 5.0       |
|                                          | 4700                                 | 16 x 25                                                  | 1480                              | 752                                    | 0.22                    | 55472E3                  | 7.5       | 65472E3    | 7.5       | -              | -         | 35472E3     | 7.5       |
|                                          | 6800                                 | 16 x 31                                                  | 1930                              | 1088                                   | 0.24                    | 55682E3                  | 7.5       | 65682E3    | 7.5       | -              | -         | 35682E3     | 7.5       |
|                                          | 10 000                               | 18 x 31                                                  | 2330                              | 1600                                   | 0.26                    | 55103E3                  | 7.5       | 65103E3    | 7.5       | -              | -         | -           | -         |
| 25                                       | 47                                   | 5 x 11                                                   | 97                                | 12                                     | 0.14                    | 56479E3                  | 2.0       | -          | -         | 76479E3        | 2.5       | 36479E3     | 5.0       |
|                                          | 100                                  | 6.3 x 11                                                 | 142                               | 25                                     | 0.14                    | 56101E3                  | 2.5       | -          | -         | 76101E3        | 2.5       | 36101E3     | 5.0       |
|                                          | 220                                  | 8 x 12                                                   | 236                               | 55                                     | 0.14                    | 56221E3                  | 3.5       | -          | -         | 76221E3        | 3.5       | 36221E3     | 5.0       |
|                                          | 470                                  | 10 x 12                                                  | 380                               | 118                                    | 0.14                    | 56471E3                  | 5.0       | 66471E3    | 5.0       | -              | -         | 36471E3     | 5.0       |
|                                          | 1000                                 | 10 x 20                                                  | 680                               | 250                                    | 0.14                    | 56102E3                  | 5.0       | 66102E3    | 5.0       | -              | -         | 36102E3     | 5.0       |
|                                          | 2200                                 | 12.5 x 25                                                | 1110                              | 550                                    | 0.16                    | 56222E3                  | 5.0       | 66222E3    | 5.0       | -              | -         | 36222E3     | 5.0       |
|                                          | 3300                                 | 16 x 25                                                  | 1440                              | 825                                    | 0.18                    | 56332E3                  | 7.5       | 66332E3    | 7.5       | -              | -         | 36332E3     | 7.5       |
|                                          | 4700                                 | 16 x 31                                                  | 1710                              | 1175                                   | 0.20                    | 56472E3                  | 7.5       | 66472E3    | 7.5       | -              | -         | 36472E3     | 7.5       |
|                                          | 6800                                 | 18 x 35                                                  | 2160                              | 1700                                   | 0.22                    | 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 | 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            | 50479E3                  | 2.0       | -          | -         | 70479E3        | 2.5       | 30479E3     | 5.0       |
|                                          | 100                              | 6.3 x 11                                | 150                                        | 35                               | 0.12            | 50101E3                  | 2.5       | -          | -         | 70101E3        | 2.5       | 30101E3     | 5.0       |
|                                          | 220                              | 8 x 12                                  | 270                                        | 77                               | 0.12            | 50221E3                  | 3.5       | -          | -         | 70221E3        | 3.5       | 30221E3     | 5.0       |
|                                          | 330                              | 10 x 12                                 | 350                                        | 116                              | 0.12            | 50331E3                  | 5.0       | 60331E3    | 5.0       | -              | -         | 30331E3     | 5.0       |
|                                          | 470                              | 10 x 16                                 | 460                                        | 165                              | 0.12            | 50471E3                  | 5.0       | 60471E3    | 5.0       | -              | -         | 30471E3     | 5.0       |
|                                          | 1000                             | 12.5 x 20                               | 810                                        | 350                              | 0.12            | 50102E3                  | 5.0       | 60102E3    | 5.0       | -              | -         | 30102E3     | 5.0       |
|                                          | 2200                             | 16 x 25                                 | 1260                                       | 770                              | 0.14            | 50222E3                  | 7.5       | 60222E3    | 7.5       | -              | -         | 30222E3     | 7.5       |
|                                          | 3300                             | 16 x 31                                 | 1420                                       | 1155                             | 0.16            | 50332E3                  | 7.5       | 60332E3    | 7.5       | -              | -         | 30332E3     | 7.5       |
|                                          | 4700                             | 18 x 35                                 | 1900                                       | 1645                             | 0.18            | 50472E3                  | 7.5       | 60472E3    | 7.5       | -              | -         | -           | -         |
| 50                                       | 22                               | 5 x 11                                  | 78                                         | 11                               | 0.10            | 51229E3                  | 2.0       | -          | -         | 71229E3        | 2.5       | 31229E3     | 5.0       |
|                                          | 47                               | 6.3 x 11                                | 120                                        | 24                               | 0.10            | 51479E3                  | 2.5       | -          | -         | 71479E3        | 2.5       | 31479E3     | 5.0       |
|                                          | 100                              | 8 x 12                                  | 188                                        | 50                               | 0.10            | 51101E3                  | 3.5       | -          | -         | 71101E3        | 3.5       | 31101E3     | 5.0       |
|                                          | 220                              | 10 x 12                                 | 240                                        | 110                              | 0.10            | 51221E3                  | 5.0       | 61221E3    | 5.0       | -              | -         | 31221E3     | 5.0       |
|                                          | 330                              | 10 x 16                                 | 410                                        | 165                              | 0.10            | 51331E3                  | 5.0       | 61331E3    | 5.0       | -              | -         | 31331E3     | 5.0       |
|                                          | 470                              | 12.5 x 20                               | 530                                        | 235                              | 0.10            | 51471E3                  | 5.0       | 61471E3    | 5.0       | -              | -         | 31471E3     | 5.0       |
|                                          | 1000                             | 12.5 x 25                               | 950                                        | 500                              | 0.10            | 51102E3                  | 5.0       | 61102E3    | 5.0       | -              | -         | 31102E3     | 5.0       |
|                                          | 2200                             | 16 x 35                                 | 1470                                       | 1100                             | 0.12            | 51222E3                  | 7.5       | 61222E3    | 7.5       | -              | -         | -           | -         |
|                                          | 3300                             | 18 x 35                                 | 1770                                       | 1650                             | 0.14            | 51332E3                  | 7.5       | 61332E3    | 7.5       | -              | -         | -           | -         |
| 63                                       | 4.7                              | 5 x 11                                  | 36                                         | 3                                | 0.09            | 58478E3                  | 2.0       | -          | -         | 78478E3        | 2.5       | 38478E3     | 5.0       |
|                                          | 10                               | 5 x 11                                  | 54                                         | 6                                | 0.09            | 58109E3                  | 2.0       | -          | -         | 78109E3        | 2.5       | 38109E3     | 5.0       |
|                                          | 22                               | 6.3 x 11                                | 86                                         | 14                               | 0.09            | 58229E3                  | 2.5       | -          | -         | 78229E3        | 2.5       | 38229E3     | 5.0       |
|                                          | 33                               | 6.3 x 11                                | 100                                        | 21                               | 0.09            | 58339E3                  | 2.5       | -          | -         | 78339E3        | 2.5       | 38339E3     | 5.0       |
|                                          | 47                               | 8 x 12                                  | 141                                        | 30                               | 0.09            | 58479E3                  | 3.5       | -          | -         | 78479E3        | 3.5       | 38479E3     | 5.0       |
|                                          | 100                              | 10 x 12                                 | 235                                        | 63                               | 0.09            | 58101E3                  | 5.0       | 68101E3    | 5.0       | -              | -         | 38101E3     | 5.0       |
|                                          | 220                              | 10 x 16                                 | 335                                        | 139                              | 0.09            | 58221E3                  | 5.0       | 68221E3    | 5.0       | -              | -         | 38221E3     | 5.0       |
|                                          | 330                              | 10 x 20                                 | 510                                        | 208                              | 0.09            | 58331E3                  | 5.0       | 68331E3    | 5.0       | -              | -         | 38331E3     | 5.0       |
|                                          | 470                              | 12.5 x 20                               | 640                                        | 296                              | 0.09            | 58471E3                  | 5.0       | 68471E3    | 5.0       | -              | -         | 38471E3     | 5.0       |
|                                          | 1000                             | 16 x 25                                 | 930                                        | 630                              | 0.09            | 58102E3                  | 7.5       | 68102E3    | 7.5       | -              | -         | 38102E3     | 7.5       |
|                                          | 2200                             | 18 x 40                                 | 2340                                       | 1380                             | 0.09            | 58222E3                  | 7.5       | 68222E3    | 7.5       | -              | -         | -           | -         |
| 100                                      | 2.2                              | 5 x 11                                  | 30                                         | 3                                | 0.08            | 59228E3                  | 2.0       | -          | -         | 79228E3        | 2.5       | 39228E3     | 5.0       |
|                                          | 4.7                              | 6.3 x 11                                | 40                                         | 5                                | 0.08            | 59478E3                  | 2.5       | -          | -         | 79478E3        | 2.5       | 39478E3     | 5.0       |
|                                          | 10                               | 8 x 12                                  | 66                                         | 10                               | 0.08            | 59109E3                  | 3.5       | -          | -         | 79109E3        | 3.5       | 39109E3     | 5.0       |
|                                          | 22                               | 8 x 12                                  | 99                                         | 22                               | 0.08            | 59229E3                  | 3.5       | -          | -         | 79229E3        | 3.5       | 39229E3     | 5.0       |
|                                          | 33                               | 10 x 12                                 | 148                                        | 33                               | 0.08            | 59339E3                  | 5.0       | 69339E3    | 5.0       | -              | -         | 39339E3     | 5.0       |
|                                          | 47                               | 10 x 16                                 | 180                                        | 47                               | 0.08            | 59479E3                  | 5.0       | 69479E3    | 5.0       | -              | -         | 39479E3     | 5.0       |
|                                          | 100                              | 10 x 20                                 | 265                                        | 100                              | 0.08            | 59101E3                  | 5.0       | 69101E3    | 5.0       | -              | -         | 39101E3     | 5.0       |
|                                          | 220                              | 12.5 x 25                               | 440                                        | 220                              | 0.08            | 59221E3                  | 5.0       | 69221E3    | 5.0       | -              | -         | 39221E3     | 5.0       |
|                                          | 330                              | 16 x 25                                 | 540                                        | 330                              | 0.08            | 59331E3                  | 7.5       | 69331E3    | 7.5       | -              | -         | 39331E3     | 7.5       |
|                                          | 470                              | 16 x 31                                 | 715                                        | 470                              | 0.08            | 59471E3                  | 7.5       | 69471E3    | 7.5       | -              | -         | 39471E3     | 7.5       |
|                                          | 1000                             | 18 x 40                                 | 985                                        | 1000                             | 0.08            | 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 | 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            | 52108E3                  | 2.0       | -          | -         | 72108E3        | 2.5       | 32108E3     | 5.0       |
|                                          | 2.2                              | 6.3 x 11                                | 30                                         | 28                               | 0.14            | 52228E3                  | 2.5       | -          | -         | 72228E3        | 2.5       | 32228E3     | 5.0       |
|                                          | 4.7                              | 8 x 12                                  | 54                                         | 43                               | 0.14            | 52478E3                  | 3.5       | -          | -         | 72478E3        | 3.5       | 32478E3     | 5.0       |
|                                          | 10                               | 10 x 12                                 | 94                                         | 65                               | 0.14            | 52109E3                  | 5.0       | 62109E3    | 5.0       | -              | -         | 32109E3     | 5.0       |
|                                          | 22                               | 10 x 16                                 | 142                                        | 113                              | 0.14            | 52229E3                  | 5.0       | 62229E3    | 5.0       | -              | -         | 32229E3     | 5.0       |
|                                          | 47                               | 12.5 x 20                               | 250                                        | 213                              | 0.14            | 52479E3                  | 5.0       | 62479E3    | 5.0       | -              | -         | 32479E3     | 5.0       |
|                                          | 100                              | 16 x 25                                 | 485                                        | 425                              | 0.14            | 52101E3                  | 7.5       | 62101E3    | 7.5       | -              | -         | 32101E3     | 7.5       |
|                                          | 220                              | 18 x 35                                 | 835                                        | 905                              | 0.14            | 52221E3                  | 7.5       | 62221E3    | 7.5       | -              | -         | -           | -         |
| 250                                      | 1.0                              | 5 x 11                                  | 16                                         | 23                               | 0.17            | 51083E3                  | 2.0       | -          | -         | 71083E3        | 2.5       | 31083E3     | 5.0       |
|                                          | 2.2                              | 6.3 x 11                                | 35                                         | 32                               | 0.17            | 52283E3                  | 2.5       | -          | -         | 72283E3        | 2.5       | 32283E3     | 5.0       |
|                                          | 4.7                              | 8 x 12                                  | 60                                         | 50                               | 0.17            | 54783E3                  | 3.5       | -          | -         | 74783E3        | 3.5       | 34783E3     | 5.0       |
|                                          | 10                               | 10 x 12                                 | 92                                         | 75                               | 0.17            | 51093E3                  | 5.0       | 61093E3    | 5.0       | -              | -         | 31093E3     | 5.0       |
|                                          | 22                               | 10 x 20                                 | 215                                        | 135                              | 0.17            | 52293E3                  | 5.0       | 62293E3    | 5.0       | -              | -         | 32293E3     | 5.0       |
|                                          | 33                               | 12.5 x 20                               | 315                                        | 190                              | 0.17            | 53393E3                  | 5.0       | 63393E3    | 5.0       | -              | -         | 33393E3     | 5.0       |
|                                          | 47                               | 12.5 x 25                               | 350                                        | 260                              | 0.17            | 54793E3                  | 5.0       | 64793E3    | 5.0       | -              | -         | 34793E3     | 5.0       |
|                                          | 100                              | 16 x 31                                 | 530                                        | 525                              | 0.17            | 51013E3                  | 7.5       | 61013E3    | 7.5       | -              | -         | 31013E3     | 7.5       |
| 350                                      | 1.0                              | 6.3 x 11                                | 23                                         | 26                               | 0.20            | 51085E3                  | 2.5       | -          | -         | 71085E3        | 2.5       | 31085E3     | 5.0       |
|                                          | 2.2                              | 8 x 12                                  | 41                                         | 38                               | 0.20            | 52285E3                  | 3.5       | -          | -         | 72285E3        | 3.5       | 32285E3     | 5.0       |
|                                          | 4.7                              | 10 x 12                                 | 65                                         | 58                               | 0.20            | 54785E3                  | 5.0       | 64785E3    | 5.0       | -              | -         | 34785E3     | 5.0       |
|                                          | 10                               | 10 x 16                                 | 105                                        | 95                               | 0.20            | 51095E3                  | 5.0       | 61095E3    | 5.0       | -              | -         | 31095E3     | 5.0       |
|                                          | 22                               | 12.5 x 20                               | 210                                        | 179                              | 0.20            | 52295E3                  | 5.0       | 62295E3    | 5.0       | -              | -         | 32295E3     | 5.0       |
|                                          | 47                               | 16 x 25                                 | 365                                        | 354                              | 0.20            | 54795E3                  | 7.5       | 64795E3    | 7.5       | -              | -         | 34795E3     | 7.5       |
|                                          | 100                              | 18 x 35                                 | 505                                        | 725                              | 0.20            | 51015E3                  | 7.5       | 61015E3    | 7.5       | -              | -         | -           | -         |
| 400                                      | 1.0                              | 6.3 x 11                                | 21                                         | 27                               | 0.25            | 51086E3                  | 2.5       | -          | -         | 71086E3        | 2.5       | 31086E3     | 5.0       |
|                                          | 2.2                              | 8 x 12                                  | 39                                         | 41                               | 0.25            | 52286E3                  | 3.5       | -          | -         | 72286E3        | 3.5       | 32286E3     | 5.0       |
|                                          | 4.7                              | 10 x 12                                 | 70                                         | 63                               | 0.25            | 54786E3                  | 5.0       | 64786E3    | 5.0       | -              | -         | 34786E3     | 5.0       |
|                                          | 10                               | 10 x 20                                 | 125                                        | 105                              | 0.25            | 51096E3                  | 5.0       | 61096E3    | 5.0       | -              | -         | 31096E3     | 5.0       |
|                                          | 22                               | 12.5 x 25                               | 235                                        | 201                              | 0.25            | 52296E3                  | 5.0       | 62296E3    | 5.0       | -              | -         | 32296E3     | 5.0       |
|                                          | 47                               | 16 x 31                                 | 390                                        | 401                              | 0.25            | 54796E3                  | 7.5       | 64796E3    | 7.5       | -              | -         | 34796E3     | 7.5       |
|                                          | 100                              | 18 x 40                                 | 530                                        | 825                              | 0.25            | 51016E3                  | 7.5       | 61016E3    | 7.5       | -              | -         | -           | -         |
| 450                                      | 1.0                              | 8 x 12                                  | 27                                         | 29                               | 0.25            | 57108E3                  | 3.5       | -          | -         | 77108E3        | 3.5       | 37108E3     | 5.0       |
|                                          | 2.2                              | 10 x 12                                 | 48                                         | 45                               | 0.25            | 57228E3                  | 5.0       | 67228E3    | 5.0       | -              | -         | 37228E3     | 5.0       |
|                                          | 4.7                              | 10 x 16                                 | 75                                         | 67                               | 0.25            | 57478E3                  | 5.0       | 67478E3    | 5.0       | -              | -         | 37478E3     | 5.0       |
|                                          | 10                               | 12.5 x 20                               | 145                                        | 115                              | 0.25            | 57109E3                  | 5.0       | 67109E3    | 5.0       | -              | -         | 37109E3     | 5.0       |
|                                          | 22                               | 16 x 20                                 | 245                                        | 223                              | 0.25            | 57229E3                  | 7.5       | 67229E3    | 7.5       | -              | -         | 37229E3     | 7.5       |
|                                          | 33                               | 16 x 25                                 | 325                                        | 322                              | 0.25            | 57339E3                  | 7.5       | 67339E3    | 7.5       | -              | -         | 37339E3     | 7.5       |
|                                          | 47                               | 16 x 35                                 | 420                                        | 448                              | 0.25            | 57479E3                  | 7.5       | 67479E3    | 7.5       | -              | -         | -           | -         |



| 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) | $ESR = \tan \delta / 2 \pi f C_R$                                                                                                                           |

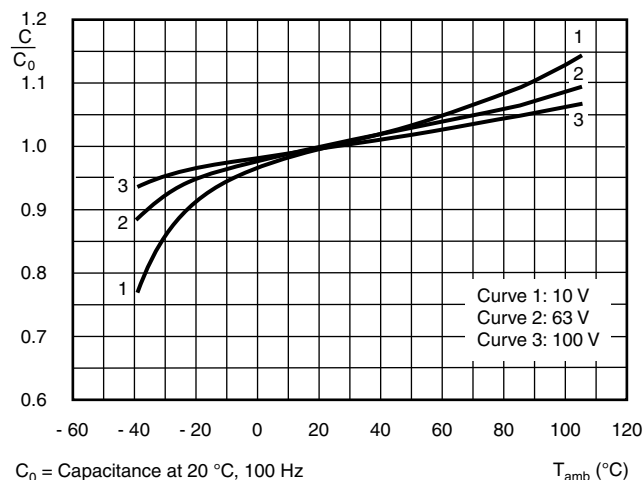
**CAPACITANCE (C)**

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

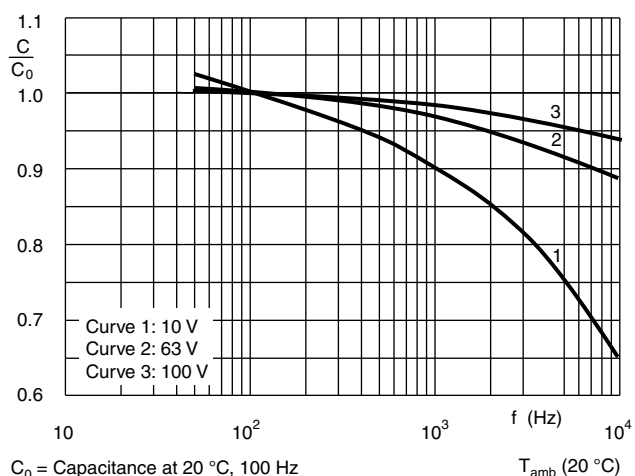


Fig. 7 - Typical multiplier of capacitance as a function of frequency

## RIPPLE CURRENT AND USEFUL LIFE

$I_A$  = 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

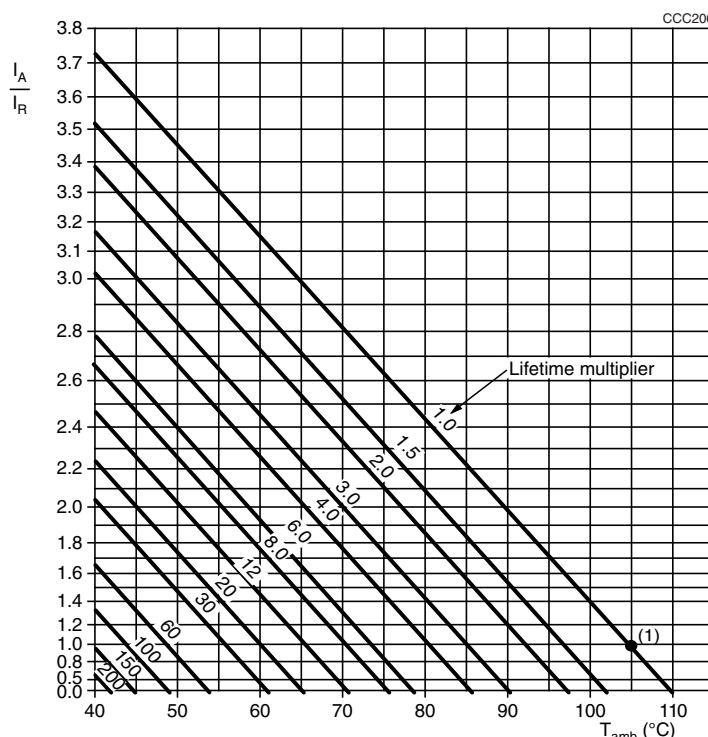


Fig. 8 - Multiplier of useful life as a function of ambient temperature and ripple current load

Table 3

| MULTIPLIER OF RIPPLE CURRENT ( $I_R$ ) AS A FUNCTION OF FREQUENCY |                   |                                   |                    |
|-------------------------------------------------------------------|-------------------|-----------------------------------|--------------------|
| FREQUENCY<br>(Hz)                                                 | $I_R$ MULTIPLIER  |                                   |                    |
|                                                                   | $C_R < 100 \mu F$ | $C_R = 100 \mu F$ TO $1000 \mu F$ | $C_R > 1000 \mu F$ |
| 50                                                                | 0.70              | 0.75                              | 0.80               |
| 100                                                               | 1.00              | 1.00                              | 1.00               |
| 500                                                               | 1.30              | 1.20                              | 1.10               |
| 1000                                                              | 1.40              | 1.30                              | 1.12               |
| $\geq 10\,000$                                                    | 1.50              | 1.35                              | 1.15               |

Table 4

| TEST PROCEDURES AND REQUIREMENTS               |                                             |                                                                                                                                          |                                                                                                                                                                                  |
|------------------------------------------------|---------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| TEST                                           |                                             | PROCEDURE<br>(quick reference)                                                                                                           | REQUIREMENTS                                                                                                                                                                     |
| NAME OF TEST                                   | REFERENCE                                   |                                                                                                                                          |                                                                                                                                                                                  |
| Endurance                                      | IEC 60384-4 /<br>EN130300<br>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<br>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<br>temperature) | IEC 60384-4 /<br>EN130300<br>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<br>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 /<br>EN130300<br>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>$I_{L5} \leq \text{spec. limit}$                                                                   |





## Disclaimer

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, "Vishay"), disclaim any and all liability for any errors, inaccuracies or incompleteness contained in any datasheet or in any other disclosure relating to any product.

Vishay makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, Vishay disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.

Statements regarding the suitability of products for certain types of applications are based on Vishay's knowledge of typical requirements that are often placed on Vishay products in generic applications. Such statements are not binding statements about the suitability of products for a particular application. It is the customer's responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Parameters provided in datasheets and/or specifications may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated for each customer application by the customer's technical experts. Product specifications do not expand or otherwise modify Vishay's terms and conditions of purchase, including but not limited to the warranty expressed therein.

Except as expressly indicated in writing, Vishay products are not designed for use in medical, life-saving, or life-sustaining applications or for any other application in which the failure of the Vishay product could result in personal injury or death. Customers using or selling Vishay products not expressly indicated for use in such applications do so at their own risk. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay. Product names and markings noted herein may be trademarks of their respective owners.

## Material Category Policy

**Vishay Intertechnology, Inc. hereby certifies that all its products that are identified as RoHS-Compliant fulfill the definitions and restrictions defined under Directive 2011/65/EU of The European Parliament and of the Council of June 8, 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (EEE) - recast, unless otherwise specified as non-compliant.**

**Please note that some Vishay documentation may still make reference to RoHS Directive 2002/95/EC. We confirm that all the products identified as being compliant to Directive 2002/95/EC conform to Directive 2011/65/EU.**

**Vishay Intertechnology, Inc. hereby certifies that all its products that are identified as Halogen-Free follow Halogen-Free requirements as per JEDEC JS709A standards. Please note that some Vishay documentation may still make reference to the IEC 61249-2-21 definition. We confirm that all the products identified as being compliant to IEC 61249-2-21 conform to JEDEC JS709A standards.**