

Aluminum Electrolytic Capacitors Power Ultra Long Life Snap-In



Fig. 1


**RoHS
COMPLIANT**

FEATURES

- Useful life: 5000 h at +105 °C
- Miniaturized, very small dimensions
- High ripple current capability
- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Large types, cylindrical aluminum case, insulated with a blue sleeve
- Keyed polarity version available
- High reliability
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

APPLICATIONS

- General purpose, industrial, telecom and audio / video systems
- Smoothing and filtering
- Standard and switched mode power supplies
- Energy storage in pulse systems

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 $\pm 20\%$)
- Rated voltage (in V)
- Date code (YYMM)
- Name of manufacturer
- Code for factory of origin
- “-” sign to identify the negative terminal, visible from the top and side of the capacitor
- Code number
- Climatic category in accordance with IEC 60068

| QUICK REFERENCE DATA | |
|---|---|
| DESCRIPTION | VALUE |
| Nominal case sizes (\varnothing D x L in mm) | 22 x 25 to 35 x 40 |
| Rated capacitance range (E6 / E12 series), C_R | 560 μF to 47 000 μF |
| Tolerance on C_R | $\pm 20\%$ |
| Rated voltage range, U_R | 25 V to 100 V |
| Category temperature range | -40 °C to +105 °C |
| Endurance test at 105 °C | 2000 h |
| Useful life at 105 °C | 5000 h |
| Useful life at 40 °C, 1.9 x I_R applied | 125 000 h |
| Shelf life at 0 V, 105 °C | 500 h |
| Based on sectional specification | IEC 60384-4 / EN 130300 |
| Climatic category IEC 60068 | 40 / 105 / 56 |

| SELECTION CHART FOR C_R , U_R , AND RELEVANT NOMINAL CASE SIZES (\varnothing D x L in mm) | | | | | | | | |
|--|-----------|---------|---------|----|--------------------|--------------------|--------------------|--------------------|
| C_R (μF) | U_R (V) | | | | | | | |
| | 16 | 25 | 35 | 40 | 50 | 63 | 80 | 100 |
| 560 | - | - | - | - | - | - | - | 22 x 25 |
| 680 | - | - | - | - | - | - | - | 22 x 30 |
| 820 | - | - | - | - | - | - | 22 x 25 | - |
| 1000 | - | - | - | - | - | - | 22 x 30 | 25 x 30 |
| 1500 | - | - | - | - | - | 22 x 25 | 25 x 30 | 25 x 40 30 x 30 |
| 1800 | - | - | - | - | - | - | - | 30 x 35 |
| 2200 | - | - | - | - | 22 x 25 | 22 x 30 | 25 x 40 30 x 30 | 30 x 40 |
| 2700 | - | - | - | - | - | 25 x 30 | 30 x 35 | - |
| 3300 | - | - | - | - | 22 x 30 | 25 x 40 | 30 x 40 | 35 x 40 |
| 3900 | - | - | - | - | 25 x 30 | 25 x 40 30 x 30 | - | - |
| 4700 | - | 22 x 25 | 22 x 30 | - | 25 x 30 25 x 40 | 30 x 30 30 x 35 | 35 x 40 | - |
| 5600 | - | - | - | - | 25 x 40 | 30 x 35 | - | - |

| SELECTION CHART FOR C_R , U_R , AND RELEVANT NOMINAL CASE SIZES ($\varnothing D \times L$ in mm) | | | | | | | | |
|---|--------------------|--------------------|---------|---------|---------|---------|----|-----|
| C_R (μF) | U_R (V) | | | | | | | |
| | 16 | 25 | 35 | 40 | 50 | 63 | 80 | 100 |
| 6800 | 22 x 25 | 22 x 30 | - | 25 x 40 | 30 x 30 | 30 x 40 | - | - |
| 8200 | - | 25 x 30 | - | - | 30 x 35 | 35 x 40 | - | - |
| 10 000 | 22 x 30 | 25 x 40 | 30 x 30 | 30 x 40 | 30 x 40 | - | - | - |
| 12 000 | - | 25 x 40 30 x 30 | - | - | - | - | - | - |
| 15 000 | 25 x 30 | 30 x 35 30 x 40 | 30 x 40 | 35 x 40 | 35 x 40 | - | - | - |
| 22 000 | 25 x 40 30 x 30 | 35 x 40 | 35 x 40 | - | - | - | - | - |
| 27 000 | 30 x 35 | - | - | - | - | - | - | - |
| 33 000 | 30 x 40 | - | - | - | - | - | - | - |
| 39 000 | - | - | - | - | - | - | - | - |
| 47 000 | 35 x 40 | - | - | - | - | - | - | - |

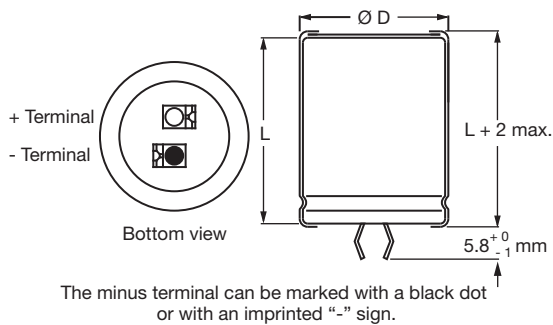
DIMENSIONS in millimeters AND AVAILABLE FORMS
TWO TERMINAL SNAP-IN


Fig. 2 - Two terminal snap-in

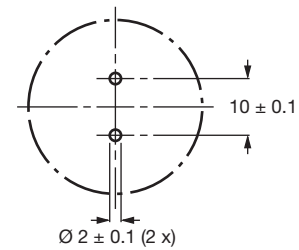


Fig. 3 - Mounting hole diagram

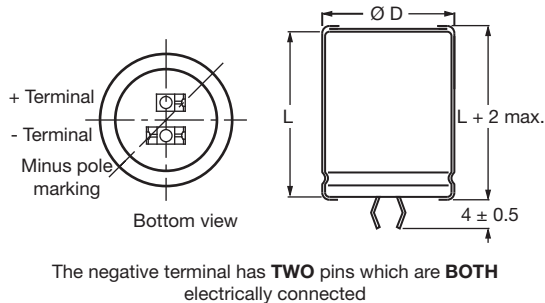
THREE TERMINAL SNAP-IN


Fig. 4 - Three terminal snap-in

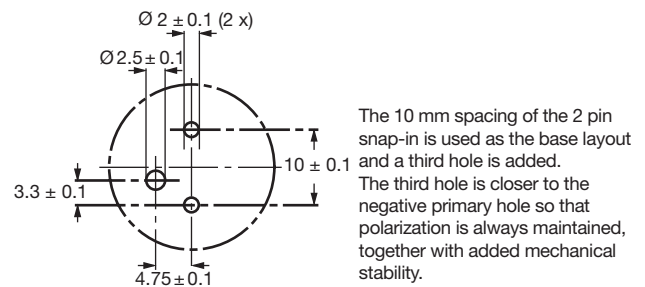


Fig. 5 - Mounting hole diagram



Table 1

| DIMENSIONS in millimeters, MASS, AND PACKAGING QUANTITIES | | | | | |
|---|---------------------|-------------------|-------------|---|---|
| NOMINAL CASE SIZE Ø D x L | Ø D _{max.} | L _{max.} | MASS (g) | PACKAGING QUANTITIES (units per box) | CARDBOARD BOX DIMENSIONS L x W x H (mm) |
| 22 x 25 | 23 | 27 | 12 | 100 | 260 x 250 x 39 |
| 22 x 30 | 23 | 32 | 16 | 100 | 260 x 250 x 44 |
| 25 x 30 | 26 | 32 | 22 | 100 | 290 x 280 x 44 |
| 25 x 40 | 26 | 42 | 27 | 100 | 290 x 280 x 54 |
| 30 x 30 | 31 | 32 | 30 | 100 | 340 x 330 x 44 |
| 30 x 35 | 31 | 37 | 35 | 100 | 340 x 330 x 49 |
| 30 x 40 | 31 | 42 | 40 | 100 | 340 x 330 x 54 |
| 35 x 40 | 36 | 42 | 55 | 50 | 390 x 198 x 54 |

| ELECTRICAL DATA | |
|-----------------|--|
| SYMBOL | DESCRIPTION |
| C _R | Rated capacitance at 100 Hz |
| I _R | Rated RMS ripple current at 100 Hz or 10 kHz, 105 °C |
| I _{L5} | Max. leakage current after 5 minutes at U _R |
| ESR | Max. equivalent series resistance at 100 Hz ⁽¹⁾ |
| Z | Max. impedance at 10 kHz |

Notes

- Unless otherwise specified, all electrical values in Table 2 apply at T_{amb} = 20 °C, P = 86 kPa to 106 kPa, RH = 45 % to 75 %
- ⁽¹⁾ ESR at 120 Hz is approximately 0.95 x ESR 100 Hz

ORDERING EXAMPLE

Electrolytic capacitor 090 series

3300 µF / 80 V; ± 20 %

Nominal case size: Ø 30 mm x 40 mm

2-terminal snap-in:

Ordering code: MAL209032332E3

Former 12NC: 2222 09032332

3-terminal snap-in:

Ordering code: MAL209072332E3

Former 12NC: 2222 09072332

Table 2

| ELECTRICAL DATA AND ORDERING INFORMATION | | | | | | | | | |
|--|----------------------------------|--------------------------------------|---|---|----------------------------------|---|--------------------------|-------------------------------|------------|
| U _R (V) | C _R 100 Hz (µF) | NOMINAL CASE SIZE Ø D x L (mm) | I _R 100 Hz 105 °C (A) | I _R 10 kHz 105 °C (A) | I _{L5} 5 min (µA) | MAX. ESR 100 Hz ⁽¹⁾ (mΩ) | MAX. Z 10 kHz (mΩ) | ORDERING CODE MAL2090..... | |
| | | | | | | | | 2-TERM. SI | 3-TERM. SI |
| 16 | 6800 | 22 x 25 | 2.5 | 3.0 | 222 | 82 | 66 | 15682E3 | 55682E3 |
| | 10 000 | 22 x 30 | 3.1 | 3.6 | 324 | 59 | 48 | 15103E3 | 55103E3 |
| | 15 000 | 25 x 30 | 3.2 | 3.9 | 484 | 53 | 44 | 25153E3 | 65153E3 |
| | 22 000 | 25 x 40 | 4.1 | 5.0 | 708 | 38 | 33 | 25223E3 | 65223E3 |
| | 22 000 | 30 x 30 | 3.3 | 4.1 | 708 | 54 | 43 | 35223E3 | 75223E3 |
| | 27 000 | 30 x 35 | 3.8 | 4.6 | 868 | 45 | 36 | 35273E3 | 75273E3 |
| | 33 000 | 30 x 40 | 4.2 | 5.0 | 1060 | 39 | 32 | 35333E3 | 75333E3 |
| | 47 000 | 35 x 40 | 4.3 | 5.2 | 1508 | 43 | 32 | 45473E3 | 85473E3 |
| 25 | 4700 | 22 x 25 | 2.3 | 2.8 | 236 | 89 | 66 | 16472E3 | 56472E3 |
| | 6800 | 22 x 30 | 2.9 | 3.4 | 341 | 65 | 49 | 16682E3 | 56682E3 |
| | 8200 | 25 x 30 | 3.1 | 3.7 | 411 | 60 | 46 | 26822E3 | 66822E3 |
| | 10 000 | 25 x 40 | 3.9 | 4.6 | 501 | 46 | 35 | 26103E3 | 66103E3 |
| | 12 000 | 25 x 40 | 3.9 | 4.7 | 601 | 43 | 34 | 26123E3 | 66123E3 |
| | 12 000 | 30 x 30 | 3.3 | 4.1 | 601 | 56 | 44 | 36123E3 | 76123E3 |
| | 15 000 | 30 x 35 | 3.8 | 4.6 | 751 | 46 | 36 | 16153E3 | 56153E3 |
| | 15 000 | 30 x 40 | 4.3 | 5.1 | 751 | 40 | 33 | 36153E3 | 76153E3 |
| 22 000 | 35 x 40 | 4.6 | 5.5 | 1101 | 40 | 31 | 46223E3 | 86223E3 | |
| 35 | 4700 | 22 x 30 | 2.5 | 3.1 | 330 | 78 | 53 | 10472E3 | 50472E3 |
| | 10 000 | 30 x 30 | 2.9 | 3.5 | 701 | 70 | 49 | 30103E3 | 70103E3 |
| | 15 000 | 30 x 40 | 3.7 | 4.4 | 1051 | 49 | 35 | 30153E3 | 70153E3 |
| | 22 000 | 35 x 40 | 3.8 | 4.5 | 1541 | 55 | 35 | 40223E3 | 80223E3 |



| ELECTRICAL DATA AND ORDERING INFORMATION | | | | | | | | | |
|--|----------------------------------|---|---|---|----------------------------------|---|--------------------------|-------------------------------|------------|
| U _R (V) | C _R 100 Hz (μF) | NOMINAL CASE SIZE Ø D x L (mm) | I _R 100 Hz 105 °C (A) | I _R 10 kHz 105 °C (A) | I _{L5} 5 min (μA) | MAX. ESR 100 Hz ⁽¹⁾ (mΩ) | MAX. Z 10 kHz (mΩ) | ORDERING CODE MAL2090..... | |
| | | | | | | | | 2-TERM. SI | 3-TERM. SI |
| 40 | 6800 | 25 x 40 | 3.5 | 4.2 | 545 | 51 | 38 | 27682E3 | 67682E3 |
| | 10 000 | 30 x 40 | 3.9 | 4.6 | 801 | 48 | 36 | 37103E3 | 77103E3 |
| | 15 000 | 35 x 40 | 4.1 | 4.9 | 1201 | 50 | 35 | 47153E3 | 87153E3 |
| 50 | 2200 | 22 x 25 | 1.9 | 2.3 | 221 | 145 | 106 | 11222E3 | 51222E3 |
| | 3300 | 22 x 30 | 2.3 | 2.9 | 331 | 101 | 76 | 11332E3 | 51332E3 |
| | 3900 | 25 x 30 | 2.5 | 3.1 | 391 | 93 | 71 | 21392E3 | 61392E3 |
| | 4700 | 25 x 30 | 2.6 | 3.2 | 471 | 85 | 70 | 31472E3 | 71472E3 |
| | 4700 | 25 x 40 | 3.2 | 3.9 | 471 | 71 | 55 | 21472E3 | 61472E3 |
| | 5600 | 25 x 40 | 3.2 | 4.0 | 561 | 66 | 51 | 21562E3 | 61562E3 |
| | 6800 | 30 x 30 | 2.8 | 3.3 | 681 | 83 | 65 | 31682E3 | 71682E3 |
| | 8200 | 30 x 35 | 3.2 | 3.8 | 821 | 68 | 54 | 31822E3 | 71822E3 |
| | 10 000 | 30 x 40 | 3.6 | 4.2 | 1001 | 58 | 46 | 31103E3 | 71103E3 |
| 15 000 | 35 x 40 | 3.6 | 4.4 | 1501 | 63 | 45 | 41153E3 | 81153E3 | |
| 63 | 1500 | 22 x 25 | 1.9 | 2.3 | 190 | 161 | 126 | 18152E3 | 58152E3 |
| | 2200 | 22 x 30 | 2.3 | 2.8 | 279 | 114 | 90 | 18222E3 | 58222E3 |
| | 2700 | 25 x 30 | 2.5 | 3.1 | 342 | 101 | 81 | 28272E3 | 68272E3 |
| | 3300 | 25 x 40 | 3.2 | 3.8 | 417 | 79 | 63 | 28332E3 | 68332E3 |
| | 3900 | 25 x 40 | 3.2 | 3.9 | 493 | 71 | 58 | 28392E3 | 68392E3 |
| | 3900 | 30 x 30 | 2.8 | 3.4 | 493 | 89 | 74 | 38392E3 | 78392E3 |
| | 4700 | 30 x 30 | 2.8 | 3.3 | 594 | 88 | 71 | 18472E3 | 58472E3 |
| | 4700 | 30 x 35 | 3.2 | 3.9 | 594 | 74 | 61 | 38472E3 | 78472E3 |
| | 5600 | 30 x 35 | 3.2 | 3.8 | 707 | 71 | 59 | 38562E3 | 78562E3 |
| | 6800 | 30 x 40 | 3.6 | 4.2 | 858 | 61 | 51 | 38682E3 | 78682E3 |
| 8200 | 35 x 40 | 3.9 | 4.6 | 1035 | 61 | 50 | 48822E3 | 88822E3 | |
| 80 | 820 | 22 x 25 | 1.4 | 1.6 | 133 | 244 | 184 | 12821E3 | 52821E3 |
| | 1000 | 22 x 30 | 1.6 | 1.9 | 161 | 196 | 146 | 12102E3 | 52102E3 |
| | 1500 | 25 x 30 | 1.9 | 2.3 | 241 | 145 | 113 | 22152E3 | 62152E3 |
| | 2200 | 25 x 40 | 2.5 | 3.0 | 353 | 101 | 79 | 22222E3 | 62222E3 |
| | 2200 | 30 x 30 | 2.3 | 2.7 | 353 | 119 | 96 | 32222E3 | 72222E3 |
| | 2700 | 30 x 35 | 2.5 | 3.1 | 433 | 98 | 79 | 32272E3 | 72272E3 |
| | 3300 | 30 x 40 | 2.9 | 3.4 | 529 | 81 | 66 | 32332E3 | 72332E3 |
| | 4700 | 35 x 40 | 3.1 | 3.7 | 753 | 75 | 63 | 42472E3 | 82472E3 |
| 100 | 560 | 22 x 25 | 1.3 | 1.4 | 113 | 269 | 184 | 19561E3 | 59561E3 |
| | 680 | 22 x 30 | 1.4 | 1.7 | 137 | 216 | 146 | 19681E3 | 59681E3 |
| | 1000 | 25 x 30 | 1.7 | 2.1 | 201 | 163 | 114 | 29102E3 | 69102E3 |
| | 1500 | 25 x 40 | 2.3 | 2.8 | 301 | 111 | 79 | 29152E3 | 69152E3 |
| | 1500 | 30 x 30 | 2.1 | 2.4 | 301 | 130 | 98 | 39152E3 | 79152E3 |
| | 1800 | 30 x 35 | 2.3 | 2.9 | 361 | 108 | 80 | 39182E3 | 79182E3 |
| | 2200 | 30 x 40 | 2.7 | 3.2 | 441 | 90 | 68 | 39222E3 | 79222E3 |
| | 3300 | 35 x 40 | 2.9 | 3.4 | 661 | 81 | 64 | 49332E3 | 89332E3 |



| ADDITIONAL ELECTRICAL DATA | | |
|------------------------------------|----------------------|--|
| PARAMETER | CONDITIONS | VALUE |
| Voltage | | |
| Surge voltage | | $U_s = 1.15 \times U_R$ |
| Reverse voltage | | $U_{rev} \leq 1 \text{ V}$ |
| Current | | |
| Leakage current | After 1 min at U_R | $I_{L1} \leq 0.006 C_R \times U_R + 4 \mu\text{A}$ |
| | After 5 min at U_R | $I_{L5} \leq 0.002 C_R \times U_R + 4 \mu\text{A}$ |
| Inductance | | |
| Equivalent series inductance (ESL) | All case sizes | Typ. 19 nH |
| | | Max. 25 nH |

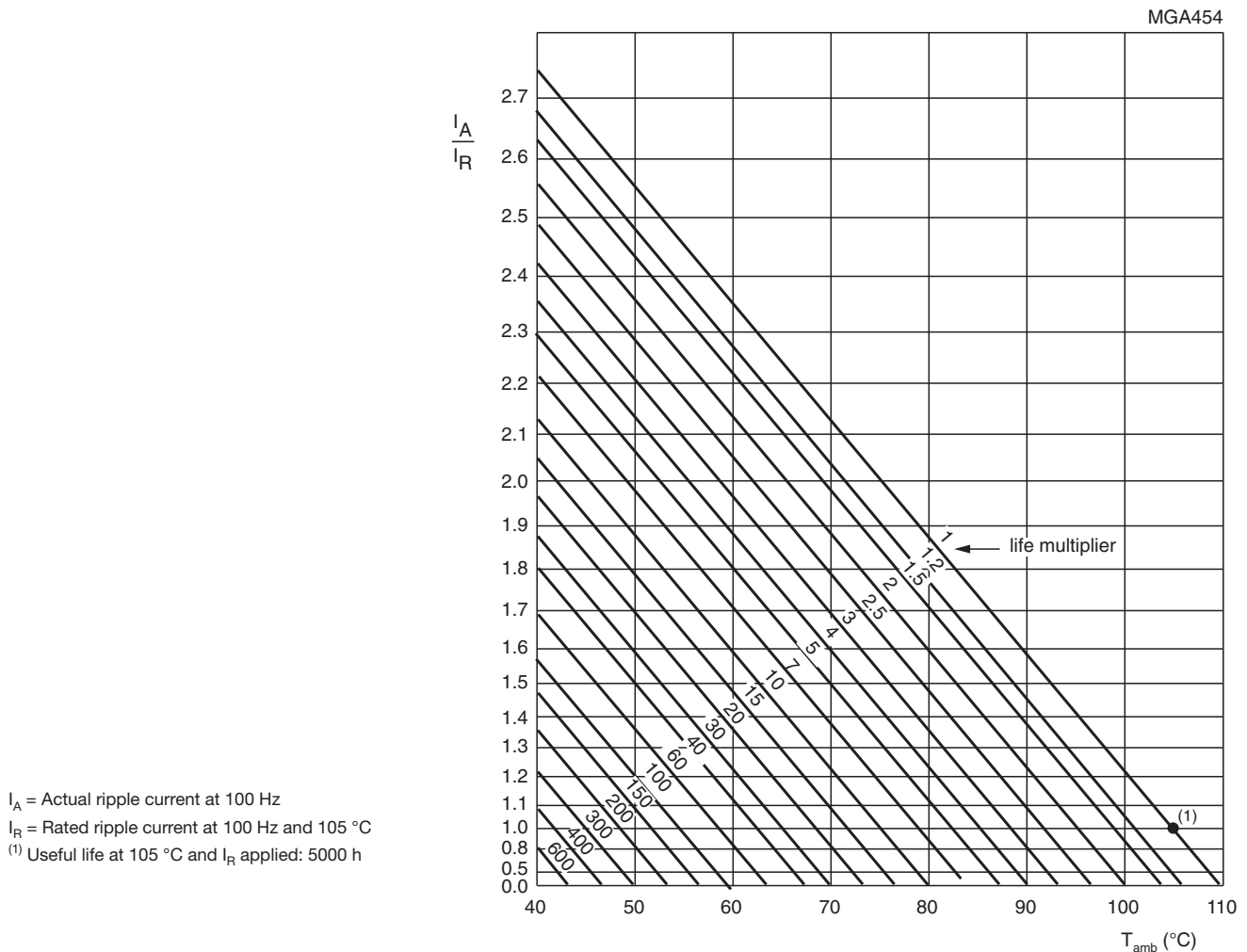
RIPPLE CURRENT AND USEFUL LIFE

Table 3

| ENDURANCE TEST DURATION AND USEFUL LIFE | |
|---|---------------------------|
| ENDURANCE AT 105 °C (h) | USEFUL LIFE AT 105 °C (h) |
| 2000 | 5000 |

Note

- Multiplier of useful life code: MGA454



I_A = Actual ripple current at 100 Hz
 I_R = Rated ripple current at 100 Hz and 105 °C
 (1) Useful life at 105 °C and I_R applied: 5000 h

Fig. 6 - 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 | | | | | | | |
|---|------|------|------|------|------|------|----------|
| FREQUENCY (Hz) | | | | | | | |
| 50 | 100 | 200 | 400 | 1000 | 2000 | 4000 | ≥ 10 000 |
| I_R MULTIPLIER | | | | | | | |
| 0.91 | 1.00 | 1.05 | 1.09 | 1.13 | 1.15 | 1.18 | 1.22 |

Table 5

| TEST PROCEDURES AND REQUIREMENTS | | | |
|--|--|--|--|
| TEST | | PROCEDURE (quick reference) | REQUIREMENTS |
| NAME OF TEST | REFERENCE | | |
| Endurance | IEC 60384-4 / EN 130300 subclause 4.13 | $T_{amb} = 105\text{ °C}$; U_R applied; 2000 h | $\Delta C/C: \pm 15\%$ $ESR \leq 1.3 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ |
| Useful life | CECC 30301 subclause 1.8.1 | $T_{amb} = 105\text{ °C}$; U_R and I_R applied; 5000 h | $\Delta C/C: \pm 20\%$ $ESR \leq 3 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit, no visible damage total failure percentage: $U_R: \leq 1\%$ |
| Shelf life (storage at high temperature) | IEC 60384-4 / EN 130300 subclause 4.17 | $T_{amb} = 105\text{ °C}$; no voltage applied; 500 h After test: U_R to be applied for 30 min, 24 h to 48 h before measurement | $\Delta C/C: \pm 15\%$ $ESR \leq 1.5 \times \text{spec. limit}$ $I_{L5} \leq 2 \times \text{spec. limit}$ |

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.



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.

Hyperlinks included in this datasheet may direct users to third-party websites. These links are provided as a convenience and for informational purposes only. Inclusion of these hyperlinks does not constitute an endorsement or an approval by Vishay of any of the products, services or opinions of the corporation, organization or individual associated with the third-party website. Vishay disclaims any and all liability and bears no responsibility for the accuracy, legality or content of the third-party website or for that of subsequent links.

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.