

Aluminum Electrolytic Capacitors Power Ultra Miniature Snap-In



Fig. 1

| QUICK REFERENCE DATA | |
|---|------------------------|
| DESCRIPTION | VALUE |
| Nominal case size (Ø D x L in mm) | 22 x 25 to 35 x 60 |
| Rated capacitance range (E6 series), C _R | 1000 µF to 22 000 µF |
| Tolerance on C _R | ± 20 % |
| Rated voltage range, U _R | 16 V to 100 V |
| Category temperature range | -40 °C to +85 °C |
| Endurance test at 85 °C | 2000 h |
| Useful life at 85 °C | 5000 h |
| Useful life at 40 °C and 1.4 x I _R applied | 90 000 h |
| Shelf life at 0 V, 85 °C | 500 h |
| Based on sectional specification | IEC 60384-4 / EN130300 |
| Climatic category IEC 60068 | 40 / 085 / 56 |

FEATURES

- Long useful life: 5000 h at 85 °C
- Low ESR
- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Large types, very small dimensions, cylindrical aluminum case, insulated with a blue sleeve
- Charge and discharge proof
- High ripple current capability
- Keyed polarity version available
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912


**RoHS
COMPLIANT**

APPLICATIONS

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

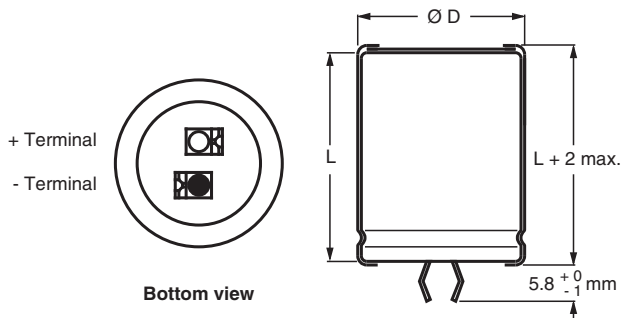
MARKING

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

- Rated capacitance (in µF)
- Tolerance code on rated capacitance, code letter in accordance with IEC 60062 (M for ± 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

| SELECTION CHART FOR C _R , U _R , AND RELEVANT NOMINAL CASE SIZES (Ø D x L in mm) | | | | | | | |
|---|--------------------|---------|---------|---------|---------|---------|---------|
| C _R (µF) | U _R (V) | | | | | | |
| | 16 | 25 | 40 | 50 | 63 | 80 | 100 |
| 1000 | - | - | - | - | - | - | 22 x 30 |
| 1200 | - | - | - | - | - | - | 22 x 35 |
| 1500 | - | - | - | - | 22 x 25 | 22 x 30 | 25 x 30 |
| 1800 | - | - | - | - | 25 x 25 | - | - |
| 2200 | - | - | - | 22 x 25 | 22 x 30 | 25 x 30 | 25 x 40 |
| | - | - | - | - | 25 x 25 | - | 30 x 30 |
| 2700 | - | - | 22 x 25 | - | 25 x 30 | - | 30 x 35 |
| 3300 | - | - | 22 x 30 | 22 x 30 | 25 x 35 | 25 x 40 | 30 x 40 |
| | - | - | 25 x 25 | - | - | - | 35 x 30 |
| 3900 | - | - | - | 25 x 30 | 25 x 40 | - | - |
| 4700 | - | - | 25 x 30 | 25 x 35 | 22 x 50 | 30 x 40 | 30 x 50 |
| | - | 22 x 25 | - | - | 30 x 30 | - | 35 x 40 |

| 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 | 40 | 50 | 63 | 80 | 100 |
| 5600 | - | 25 x 25 | - | 25 x 40 | 30 x 35 | - | - |
| 6800 | - | - | 25 x 40 | 30 x 30 | 30 x 40 | 30 x 50 | 35 x 50 |
| 8200 | - | - | 30 x 30 | 30 x 35 | 30 x 50 | - | 35 x 60 |
| 10 000 | 25 x 30 | 22 x 40 | 30 x 35 | 30 x 40 | 35 x 40 | 35 x 50 | - |
| 12 000 | - | 25 x 40 | 30 x 40 | 30 x 50 | 35 x 50 | - | - |
| 15 000 | 25 x 40 | 30 x 35 | 30 x 50 | - | 35 x 60 | - | - |
| | 30 x 30 | - | - | - | - | - | - |
| 18 000 | - | 30 x 40 | 35 x 40 | 35 x 50 | - | - | - |
| 22 000 | 30 x 35 | - | 35 x 50 | 35 x 60 | - | - | - |
| 27 000 | - | 35 x 40 | - | - | - | - | - |
| 39 000 | 35 x 40 | - | - | - | - | - | - |

DIMENSIONS in millimeters AND AVAILABLE FORMS
TWO TERMINAL SNAP-IN


The minus terminal can be marked with a black dot or with an imprinted “-” sign.

Fig. 2 - Two terminal snap-in

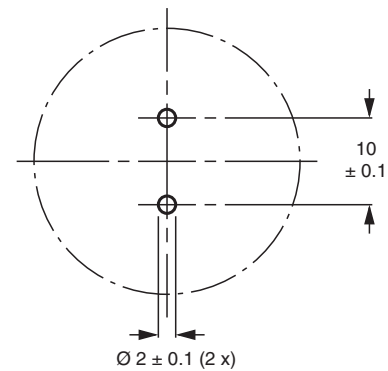
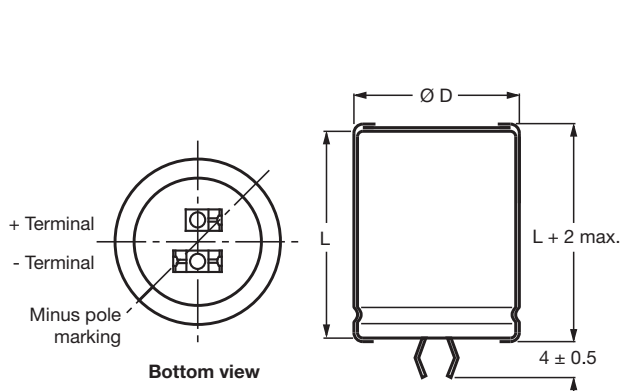
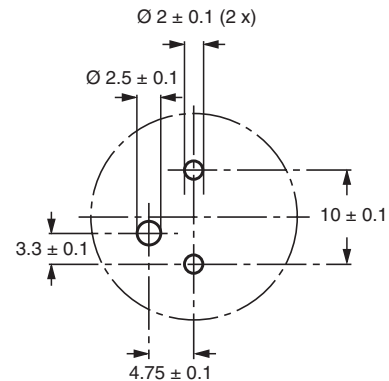


Fig. 3 - Mounting hole diagram

THREE TERMINAL SNAP-IN


The negative terminal has **TWO** pins which are **BOTH** electrically connected.

Fig. 4 - Three terminal snap-in



The 10 mm spacing of the 2 pin snap-in is used as the base layout and a third hole is added.

The third hole is closer to the negative primary hole so that polarization is always maintained, together with added mechanical stability.

Fig. 5 - Mounting hole diagram



Table 1

| DIMENSIONS in millimeters, MASS AND PACKAGING QUANTITIES | | | | | |
|--|-----------------------------|---------------------------|-------------|---|---------------------------------------|
| NOMINAL CASE SIZE Ø D x L | Ø D _{max.} (mm) | L _{max.} (mm) | MASS (g) | PACKAGING QUANTITIES (units per box) | CARDBOARD BOX DIMENSIONS L x W x H |
| 22 x 25 | 23 | 27 | ≈ 12 | 100 | 260 x 250 x 39 |
| 22 x 30 | 23 | 32 | ≈ 16 | 100 | 260 x 250 x 44 |
| 22 x 35 | 23 | 37 | ≈ 20 | 100 | 260 x 250 x 49 |
| 22 x 40 | 23 | 42 | ≈ 23 | 100 | 260 x 250 x 54 |
| 22 x 50 | 23 | 52 | ≈ 29 | 100 | 260 x 250 x 64 |
| 25 x 25 | 26 | 27 | ≈ 20 | 100 | 290 x 280 x 39 |
| 25 x 30 | 26 | 32 | ≈ 22 | 100 | 290 x 280 x 44 |
| 25 x 35 | 26 | 37 | ≈ 24 | 100 | 290 x 280 x 49 |
| 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 | ≈ 42 | 100 | 340 x 330 x 54 |
| 30 x 50 | 31 | 52 | ≈ 52 | 100 | 340 x 330 x 64 |
| 35 x 30 | 36 | 32 | ≈ 40 | 50 | 390 x 198 x 44 |
| 35 x 40 | 36 | 42 | ≈ 55 | 50 | 390 x 198 x 54 |
| 35 x 50 | 36 | 52 | ≈ 72 | 50 | 390 x 198 x 64 |
| 35 x 60 | 36 | 62 | ≈ 84 | 50 | 390 x 198 x 74 |

| ELECTRICAL DATA | |
|-----------------|--|
| SYMBOL | DESCRIPTION |
| C _R | Rated capacitance at 100 Hz |
| I _R | Rated RMS ripple current at 100 Hz and 85 °C |
| I _{L1} | Max. leakage current after 1 min at U _R |
| ESR | Max. equivalent series resistance at 100 Hz |
| Z | Max. impedance at 10 kHz |

Note

- 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 %

ORDERING EXAMPLE

Electrolytic capacitor 156 series

1000 µF / 25 V; ± 20 %

Nominal case size: Ø 25 x 40 mm

2-terminal snap-in:

Ordering code: MAL2 156 26123 E3

Former 12NC: 2222 156 26123

3-terminal snap-in:

Ordering code: MAL2 156 66123 E3

Former 12NC: 2222 156 66123

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 85 °C (A) | I _{L5} 5 min (µA) | MAX. ESR 100 Hz (mΩ) | MAX. Z 10 kHz (mΩ) | ORDERING CODE MAL2156..... | |
| | | | | | | | 2-TERM. | 3-TERM. |
| 16 | 10 000 | 25 x 30 | 3.93 | 324 | 49 | 33 | 25103E3 | 65103E3 |
| | 15 000 | 25 x 40 | 4.98 | 484 | 36 | 26 | 35153E3 | 75153E3 |
| | 18 000 | 30 x 30 | 4.12 | 580 | 53 | 33 | 35183E3 | 75183E3 |
| | 22 000 | 30 x 35 | 4.71 | 708 | 44 | 29 | 25223E3 | 65223E3 |
| | 39 000 | 35 x 40 | 5.17 | 1252 | 45 | 26 | 25393E3 | 65393E3 |
| 25 | 4700 | 22 x 25 | 2.37 | 239 | 100 | 90 | 16472E3 | 56472E3 |
| | 5600 | 25 x 25 | 3.03 | 284 | 74 | 46 | 26562E3 | 66562E3 |
| | 10 000 | 22 x 40 | 4.40 | 504 | 41 | 27 | 16103E3 | 56103E3 |
| | 12 000 | 25 x 40 | 4.73 | 604 | 40 | 27 | 26123E3 | 66123E3 |
| | 15 000 | 30 x 35 | 4.55 | 754 | 47 | 31 | 26153E3 | 66153E3 |
| | 18 000 | 30 x 40 | 5.06 | 904 | 41 | 27 | 16183E3 | 56183E3 |
| | 27 000 | 35 x 40 | 5.04 | 1354 | 47 | 27 | 26273E3 | 66273E3 |



| 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 85 °C (A) | I _{L5} 5 min (μA) | MAX. ESR 100 Hz (mΩ) | MAX. Z 10 kHz (mΩ) | ORDERING CODE MAL2156..... | |
| | | | | | | | 2-TERM. | 3-TERM. |
| 40 | 2700 | 22 x 25 | 2.47 | 220 | 97 | 57 | 17272E3 | 57272E3 |
| | 3300 | 22 x 30 | 2.98 | 268 | 74 | 43 | 27332E3 | 67332E3 |
| | 3300 | 25 x 25 | 2.69 | 268 | 93 | 58 | 17332E3 | 57332E3 |
| | 4700 | 25 x 30 | 3.32 | 380 | 68 | 44 | 27472E3 | 67472E3 |
| | 6800 | 25 x 40 | 4.26 | 548 | 49 | 33 | 37682E3 | 77682E3 |
| | 8200 | 30 x 30 | 3.49 | 660 | 74 | 44 | 37822E3 | 77822E3 |
| | 10 000 | 30 x 35 | 4.02 | 804 | 60 | 38 | 17103E3 | 57103E3 |
| | 12 000 | 30 x 40 | 4.49 | 964 | 52 | 33 | 17123E3 | 57123E3 |
| | 15 000 | 30 x 50 | 5.39 | 1204 | 41 | 28 | 37153E3 | 77153E3 |
| | 18 000 | 35 x 40 | 4.39 | 1444 | 62 | 33 | 17183E3 | 57183E3 |
| 22 000 | 35 x 50 | 5.34 | 1764 | 47 | 28 | 27223E3 | 67223E3 | |
| 50 | 2200 | 22 x 25 | 2.34 | 224 | 107 | 62 | 11222E3 | 51222E3 |
| | 3300 | 22 x 30 | 2.92 | 334 | 76 | 46 | 11332E3 | 51332E3 |
| | 3900 | 25 x 30 | 3.17 | 394 | 74 | 47 | 21392E3 | 61392E3 |
| | 4700 | 25 x 35 | 3.64 | 474 | 62 | 40 | 21472E3 | 61472E3 |
| | 5600 | 25 x 40 | 4.09 | 564 | 53 | 35 | 21562E3 | 61562E3 |
| | 6800 | 30 x 30 | 3.35 | 684 | 79 | 48 | 21682E3 | 61682E3 |
| | 8200 | 30 x 35 | 3.88 | 824 | 65 | 40 | 21822E3 | 61822E3 |
| | 10 000 | 30 x 40 | 4.32 | 1004 | 56 | 35 | 11103E3 | 51103E3 |
| | 12 000 | 30 x 50 | 5.23 | 1204 | 43 | 29 | 11123E3 | 51123E3 |
| | 18 000 | 35 x 50 | 5.18 | 1804 | 50 | 29 | 11183E3 | 51183E3 |
| 22 000 | 35 x 60 | 5.97 | 2204 | 51 | 46 | 11223E3 | 51223E3 | |
| 63 | 1500 | 22 x 25 | 2.13 | 193 | 128 | 68 | 18152E3 | 58152E3 |
| | 1800 | 25 x 25 | 2.37 | 231 | 120 | 69 | 18182E3 | 58182E3 |
| | 2200 | 22 x 30 | 2.66 | 281 | 92 | 50 | 18222E3 | 58222E3 |
| | 2200 | 25 x 25 | 2.42 | 281 | 115 | 70 | 28222E3 | 68222E3 |
| | 2700 | 25 x 30 | 2.95 | 344 | 86 | 51 | 28272E3 | 68272E3 |
| | 3300 | 25 x 35 | 3.39 | 420 | 71 | 43 | 28332E3 | 68332E3 |
| | 3900 | 25 x 40 | 3.81 | 495 | 61 | 37 | 28392E3 | 68392E3 |
| | 4700 | 22 x 50 | 4.26 | 596 | 50 | 30 | 18472E3 | 58472E3 |
| | 4700 | 30 x 30 | 3.25 | 596 | 85 | 53 | 38472E3 | 78472E3 |
| | 5600 | 30 x 35 | 3.75 | 710 | 69 | 45 | 28562E3 | 68562E3 |
| | 6800 | 30 x 40 | 4.19 | 861 | 59 | 39 | 18682E3 | 58682E3 |
| | 6800 | 35 x 30 | 3.28 | 861 | 97 | 53 | 28682E3 | 68682E3 |
| | 8200 | 30 x 50 | 5.05 | 1037 | 46 | 32 | 38822E3 | 78822E3 |
| | 10 000 | 35 x 40 | 4.23 | 1264 | 67 | 39 | 18103E3 | 58103E3 |
| | 12 000 | 35 x 50 | 5.15 | 1516 | 51 | 32 | 18123E3 | 58123E3 |
| | 15 000 | 35 x 60 | 5.89 | 1894 | 52 | 47 | 18153E3 | 58153E3 |



| 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 85 °C (A) | I _{L5} 5 min (μA) | MAX. ESR 100 Hz (mΩ) | MAX. Z 10 kHz (mΩ) | ORDERING CODE MAL2156..... | |
| | | | | | | | 2-TERM. | 3-TERM. |
| 80 | 1500 | 22 x 30 | 1.83 | 244 | 318 | 308 | 12152E3 | 52152E3 |
| | 2200 | 25 x 30 | 2.23 | 356 | 230 | 224 | 22222E3 | 62222E3 |
| | 3300 | 25 x 40 | 2.92 | 532 | 155 | 152 | 22332E3 | 62332E3 |
| | 4700 | 30 x 40 | 3.44 | 756 | 121 | 119 | 12472E3 | 52472E3 |
| | 6800 | 30 x 50 | 4.18 | 1092 | 88 | 87 | 12682E3 | 52682E3 |
| | 10 000 | 35 x 50 | 4.51 | 1604 | 74 | 73 | 12103E3 | 52103E3 |
| 100 | 1000 | 22 x 30 | 1.72 | 204 | 338 | 312 | 19102E3 | 59102E3 |
| | 1200 | 22 x 35 | 1.98 | 244 | 282 | 261 | 29122E3 | 59122E3 |
| | 1500 | 25 x 30 | 2.12 | 304 | 239 | 223 | 29152E3 | 69152E3 |
| | 2200 | 25 x 40 | 2.77 | 444 | 164 | 154 | 29222E3 | 69222E3 |
| | 2200 | 30 x 30 | 2.55 | 444 | 181 | 171 | 39222E3 | 79222E3 |
| | 2700 | 30 x 35 | 2.94 | 544 | 148 | 140 | 29272E3 | 69272E3 |
| | 3300 | 30 x 40 | 3.32 | 664 | 123 | 116 | 19332E3 | 59332E3 |
| | 3300 | 35 x 30 | 2.84 | 664 | 147 | 140 | 29332E3 | 69332E3 |
| | 4700 | 30 x 50 | 4.04 | 944 | 90 | 86 | 19472E3 | 59472E3 |
| | 4700 | 35 x 40 | 3.67 | 944 | 102 | 98 | 29472E3 | 69472E3 |
| | 6800 | 35 x 50 | 4.39 | 1364 | 76 | 73 | 19682E3 | 59682E3 |
| | 8200 | 35 x 60 | 5.21 | 1644 | 63 | 61 | 19822E3 | 59822E3 |

| ADDITIONAL ELECTRICAL DATA | | |
|------------------------------------|-------------------------------|--|
| PARAMETER | CONDITIONS | VALUE |
| Voltage | | |
| Surge voltage | | U _s = 1.15 x U _R |
| Reverse voltage | | U _{rev} ≤ 1 V |
| Current | | |
| Leakage current | After 1 min at U _R | I _{L1} ≤ 0.006 C _R x U _R + 4 μA |
| | After 5 min at U _R | I _{L5} ≤ 0.002 C _R x U _R + 4 μA |
| 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 85 °C (h) | USEFUL LIFE AT 85 °C (h) |
| 2000 | 5000 |

Note

- Multiplier of useful life code: MGA453

MGA453

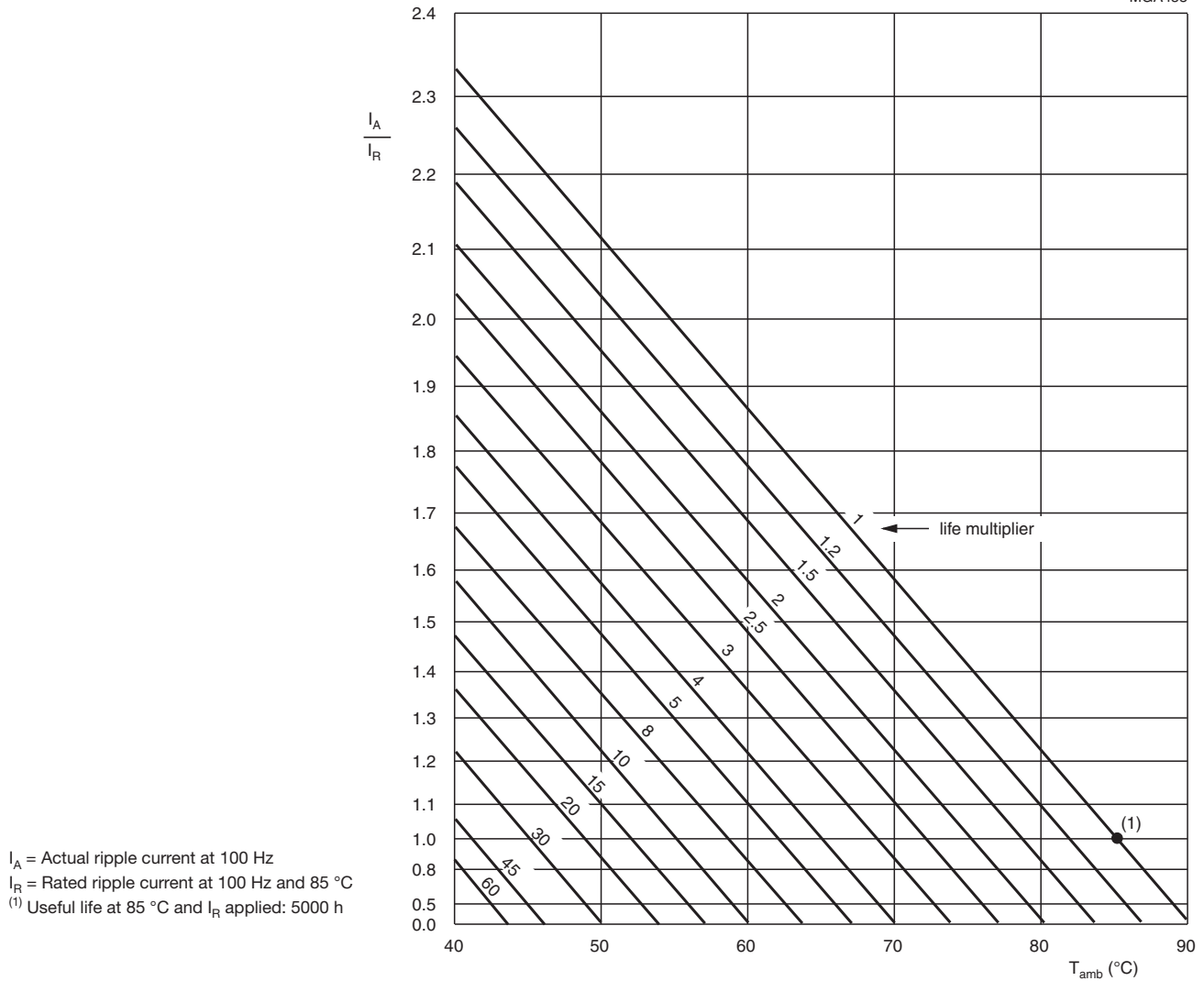


Fig. 6 - Multiplier of useful life as a function of ambient temperature and ripple current load

Table 4

| MULTIPLIER OF RIPPLE CURRENT (I_R) AS A FUNCTION OF FREQUENCY | | | | | | | | |
|---|------------------|------|------|------|------|------|------|----------|
| U_R (V) | FREQUENCY (Hz) | | | | | | | |
| | 50 | 100 | 200 | 400 | 1000 | 2000 | 4000 | ≥ 10 000 |
| | I_R MULTIPLIER | | | | | | | |
| 16 | 0.93 | 1.00 | 1.04 | 1.07 | 1.11 | 1.13 | 1.15 | 1.18 |
| 25 | 0.93 | 1.00 | 1.04 | 1.07 | 1.11 | 1.13 | 1.15 | 1.18 |
| 40 | 0.91 | 1.00 | 1.05 | 1.09 | 1.13 | 1.15 | 1.18 | 1.22 |
| 50 | 0.91 | 1.00 | 1.05 | 1.09 | 1.13 | 1.15 | 1.18 | 1.22 |
| 63 | 0.91 | 1.00 | 1.05 | 1.09 | 1.13 | 1.15 | 1.18 | 1.22 |
| 80 | 0.91 | 1.00 | 1.05 | 1.09 | 1.13 | 1.15 | 1.18 | 1.22 |
| 100 | 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 / EN130300 subclause 4.13 | $T_{amb} = 85\text{ }^{\circ}\text{C}$; U_R applied: 2000 h | $\Delta C/C: \pm 15\%$ ESR $\leq 1.3 \times$ spec. limit $Z \leq 2 \times$ spec. limit $I_{L5} \leq$ spec. limit |
| Useful life | CECC 30301 subclause 1.8.1 | $T_{amb} = 85\text{ }^{\circ}\text{C}$; U_R and I_R applied: 5000 h | $\Delta C/C: \pm 15\%$ ESR $\leq 3 \times$ spec. limit $Z \leq 3 \times$ spec. limit $I_{L5} \leq$ spec. limit no short or open circuit, no visible damage total failure percentage: $\leq 1\%$ |
| Shelf life (storage at high temperature) | IEC 60384-4 / EN130300 subclause 4.17 | $T_{amb} = 85\text{ }^{\circ}\text{C}$; no voltage applied; 500 h After test: U_R to be applied for 30 min, 24 h to 48 h before measurement | $\Delta C/C: \pm 10\%$ ESR $\leq 1.2 \times$ spec. limit $I_{L5} \leq 2 \times$ 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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