

Aluminum Electrolytic Capacitors Power Long Life 4-Terminal Snap-In

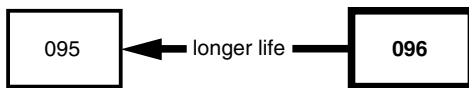


Fig. 1

| QUICK REFERENCE DATA | |
|---|-----------------------------|
| DESCRIPTION | VALUE |
| Nominal case size (D x L in mm) | 35 x 50 to 45 x 100 |
| Rated capacitance range C_R | 390 μ F to 2700 μ F |
| Tolerance on C_R | $\pm 20\%$ |
| Rated voltage range, U_R | 350 V to 500 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, 1.4 x I_R applied | 200 000 h |
| Shelf life at 0 V, 85 °C | 1000 h |
| Max. RMS value of ripple voltage | 12 V |
| Based on sectional specification | IEC 60384-4 / EN130300 |
| Climatic category IEC 60068 | 40 / 085 / 56 |

FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Large types, minimized dimensions, cylindrical aluminum case, insulated with a blue sleeve
- Pressure relief on the side of the aluminum case
- Very long useful life: 5000 h at 85 °C
- Temperature range up to 85 °C
- Keyed polarity
- Low ESR, high ripple current capability
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912


**RoHS
COMPLIANT**

APPLICATIONS

- Telecommunication and industrial systems
- Smoothing and filtering applications
- Switched mode power supplies
- Renewable energy power converters
- Energy storage in pulse systems
- For excellent mounting stability

MARKING

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

- Rated capacitance (in μ F)
- Tolerance code 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

| SELECTION CHART FOR C_R , U_R , AND RELEVANT NOMINAL CASE SIZES (\varnothing D x L in mm) | | | | | | |
|--|-------------------------------|---------------------|--------------------------------|---------------------|--------------------------------|---------------------|
| C_R (μ F) | U_R (V) | | | | | |
| | 350 | 385 | 400 | 420 | 450 | 500 |
| 390 | - | - | - | - | - | 35 x 60 |
| 470 | - | - | - | - | - | 35 x 70 |
| 560 | - | - | - | - | 35 x 60 | 35 x 70 40 x 60 |
| 680 | - | 35 x 50 40 x 50 | 35 x 60 40 x 50 | 35 x 60 40 x 50 | 35 x 70 40 x 50 | 35 x 80 40 x 70 |
| 820 | 35 x 50 40 x 40 | 35 x 60 40 x 50 | 35 x 60 40 x 50 | 35 x 70 40 x 60 | 35 x 80 40 x 60 | 35 x 100 40 x 80 |
| 1000 | 35 x 60 40 x 50 | 35 x 70 40 x 60 | 35 x 70 40 x 60 45 x 50 | 35 x 80 40 x 60 | 35 x 100 40 x 70 45 x 60 | 40 x 100 45 x 70 |
| 1200 | 35 x 70 40 x 60 | 35 x 80 40 x 70 | 35 x 80 40 x 70 45 x 60 | 40 x 70 | 40 x 80 45 x 70 | 45 x 100 |
| 1500 | 35 x 80 40 x 70 45 x 60 | 40 x 80 45 x 60 | 35 x 100 40 x 80 45 x 70 | 40 x 100 45 x 70 | 40 x 100 45 x 80 | 45 x 100 |
| 1800 | 40 x 80 45 x 60 | 40 x 100 45 x 70 | 40 x 100 45 x 80 | 40 x 100 45 x 80 | 45 x 100 | - |
| 2200 | 40 x 100 45 x 70 | 40 x 100 | 45 x 100 | 45 x 100 | - | - |
| 2700 | 45 x 100 | 45 x 100 | 45 x 100 | - | - | - |

DIMENSIONS in millimeters **AND AVAILABLE FORMS**

PRINTED WIRING

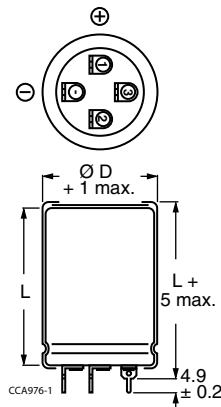


Fig. 2 - Printed wiring pin version
(Case Ø D = 35 mm)

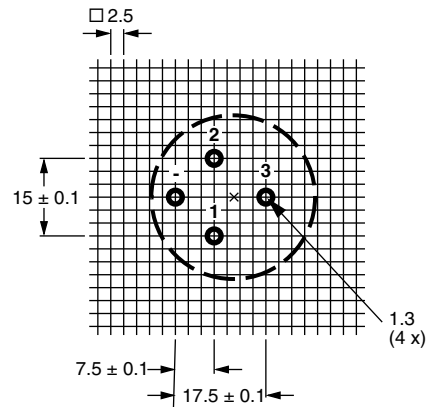


Fig. 3 - Mounting hole diagram viewed from component side
(Case Ø D = 35 mm)

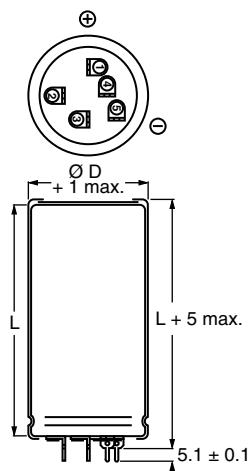


Fig. 4 - Printed wiring pin version
(Case Ø D = 40 mm)

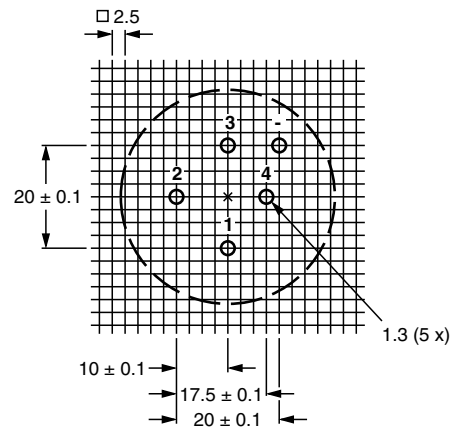
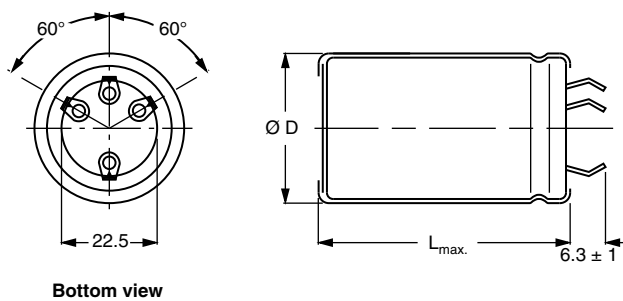


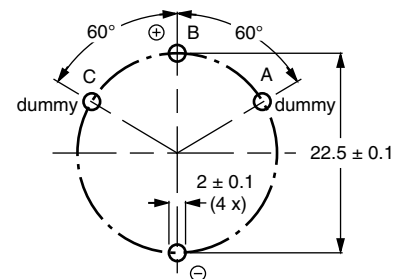
Fig. 5 - Mounting hole diagram viewed from component side
(Case Ø D = 40 mm)

FOUR TERMINAL SNAP-IN



Bottom view

Fig. 6 - 4-Terminal snap-in



Dummy terminals (A and C) must be free from the electrical circuit

Fig. 7 - Mounting hole diagram

Pin number 1 is the positive terminal. Pin “-” is the negative terminal.

Pin numbers 2, 3 and 4 (if present) should be free from the electrical circuit or connected to the minus terminal.



Table 1

| DIMENSIONS in millimeters, MASS AND PACKAGING QUANTITIES | | | | | | |
|--|---------------------|----------------------------|-------------|-------------|---|--|
| NOMINAL CASE SIZE Ø D x L | Ø D _{MAX.} | 4T-SI L _{max.} | PW L + 5 | MASS (g) | PACKAGING QUANTITIES (units per box) | CARDBOARD BOX DIMENSIONS L x W x H |
| 35 x 50 | 36 | 52 | 55 | 72 | 50 | 390 x 198 x 60 |
| 35 x 60 | 36 | 62 | 65 | 91 | 50 | 390 x 198 x 70 |
| 35 x 70 | 36 | 72 | 75 | 103 | 50 | 377 x 375 x 97 |
| 35 x 80 | 36 | 82 | 85 | 115 | 50 | 377 x 375 x 107 |
| 35 x 100 | 36 | 102 | 105 | 151 | 50 | 377 x 375 x 127 |
| 40 x 40 | 41 | 42 | 45 | 70 | 50 | 440 x 223 x 60 |
| 40 x 50 | 41 | 52 | 55 | 94 | 50 | 440 x 223 x 70 |
| 40 x 60 | 41 | 62 | 65 | 118 | 25 | 230 x 230 x 80 |
| 40 x 70 | 41 | 72 | 75 | 134 | 25 | 230 x 230 x 90 |
| 40 x 80 | 41 | 82 | 85 | 150 | 25 | 230 x 230 x 100 |
| 40 x 100 | 41 | 102 | 105 | 176 | 25 | 230 x 230 x 120 |
| 45 x 40 | 46 | 42 | - | 88 | 36 | TBD |
| 45 x 50 | 46 | 52 | - | 119 | 36 | 377 x 375 x 77 |
| 45 x 60 | 46 | 62 | - | 150 | 36 | 377 x 375 x 87 |
| 45 x 70 | 46 | 72 | - | 170 | 36 | 377 x 375 x 97 |
| 45 x 80 | 46 | 82 | - | 190 | 36 | 377 x 375 x 107 |
| 45 x 100 | 46 | 102 | - | 250 | 36 | 377 x 375 x 127 |

| ELECTRICAL DATA | |
|-----------------|--|
| SYMBOL | DESCRIPTION |
| C _R | Rated capacitance at 100 Hz |
| I _R | Rated RMS ripple current at 100 Hz and 85 °C |
| I _{L5} | Max. leakage current after 5 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 096 series

820 µF / 385 V;

Printed wiring:

Ordering code: MAL2 096 18821 E3

Former 12NC: 2222 096 18821

4-terminal snap-in:

Ordering code: MAL2 096 68821 E3

Former 12NC: 2222 096 68821

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) | ESR 100 Hz (mΩ) | Z _{max.} 10 kHz (mΩ) | CATALOG NUMBER MAL2096..... | |
| | | | | | | | 4T-SI | PW |
| 350 | 820 | 35 x 50 | 4.0 | 578 | 126 | 82 | 15821E3 | 65821E3 |
| | 820 | 40 x 40 | 3.8 | 578 | 134 | 90 | 25821E3 | 75821E3 |
| | 1000 | 35 x 60 | 4.7 | 704 | 104 | 67 | 15102E3 | 65102E3 |
| | 1000 | 40 x 50 | 4.8 | 704 | 108 | 72 | 25102E3 | 75102E3 |
| | 1200 | 35 x 70 | 5.3 | 844 | 87 | 57 | 15122E3 | 65122E3 |
| | 1200 | 40 x 60 | 5.4 | 844 | 90 | 59 | 25122E3 | 75122E3 |
| | 1500 | 35 x 80 | 6.0 | 1054 | 71 | 47 | 15152E3 | 65152E3 |
| | 1500 | 40 x 70 | 6.2 | 1054 | 73 | 49 | 25152E3 | 75152E3 |
| | 1500 | 45 x 60 | 6.3 | 1054 | 76 | 52 | 35152E3 | - |
| | 1800 | 40 x 80 | 6.9 | 1264 | 62 | 41 | 25182E3 | 75182E3 |
| | 1800 | 45 x 60 | 6.6 | 1264 | 68 | 48 | 35182E3 | - |
| | 2200 | 40 x 100 | 8.2 | 1544 | 51 | 34 | 25222E3 | 75222E3 |
| | 2200 | 45 x 70 | 7.4 | 1544 | 57 | 41 | 35222E3 | - |
| | 2700 | 45 x 100 | 9.2 | 1894 | 44 | 30 | 35272E3 | - |



| 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) | ESR 100 Hz (mΩ) | Z _{max.} 10 kHz (mΩ) | CATALOG NUMBER MAL2096..... | |
| | | | | | | | 4T-SI | PW |
| 385 | 680 | 35 x 50 | 3.7 | 528 | 140 | 88 | 18681E3 | 68681E3 |
| | 680 | 40 x 50 | 4.2 | 528 | 140 | 87 | 28681E3 | 78681E3 |
| | 820 | 35 x 60 | 4.4 | 635 | 116 | 73 | 18821E3 | 68821E3 |
| | 820 | 40 x 50 | 4.5 | 635 | 120 | 76 | 28821E3 | 78821E3 |
| | 1000 | 35 x 70 | 5.0 | 774 | 96 | 60 | 18102E3 | 68102E3 |
| | 1000 | 40 x 60 | 5.1 | 774 | 99 | 63 | 28102E3 | 78102E3 |
| | 1200 | 35 x 80 | 5.5 | 928 | 81 | 51 | 18122E3 | 68122E3 |
| | 1200 | 40 x 70 | 5.7 | 928 | 83 | 53 | 28122E3 | 78122E3 |
| | 1500 | 40 x 80 | 6.5 | 1159 | 68 | 43 | 28152E3 | 78152E3 |
| | 1500 | 45 x 60 | 6.2 | 1159 | 74 | 50 | 38152E3 | - |
| | 1800 | 40 x 100 | 7.7 | 1390 | 56 | 36 | 28182E3 | 78182E3 |
| | 1800 | 45 x 70 | 7.0 | 1390 | 62 | 43 | 38182E3 | - |
| | 2200 | 40 x 100 | 8.2 | 1698 | 49 | 32 | 28222E3 | 78222E3 |
| | 2700 | 45 x 100 | 9.1 | 2083 | 43 | 29 | 38272E3 | - |
| 400 | 680 | 35 x 60 | 4.1 | 548 | 134 | 82 | 16681E3 | 66681E3 |
| | 680 | 40 x 50 | 4.2 | 548 | 138 | 85 | 26681E3 | 76681E3 |
| | 820 | 35 x 60 | 4.4 | 660 | 114 | 71 | 16821E3 | 66821E3 |
| | 820 | 40 x 50 | 4.5 | 660 | 119 | 75 | 26821E3 | 76821E3 |
| | 1000 | 35 x 70 | 5.0 | 804 | 94 | 59 | 16102E3 | 66102E3 |
| | 1000 | 40 x 60 | 5.1 | 804 | 97 | 62 | 26102E3 | 76102E3 |
| | 1000 | 45 x 50 | 5.1 | 804 | 103 | 67 | 36102E3 | - |
| | 1200 | 35 x 80 | 5.5 | 964 | 80 | 50 | 16122E3 | 66122E3 |
| | 1200 | 40 x 70 | 5.7 | 964 | 82 | 52 | 26122E3 | 76122E3 |
| | 1200 | 45 x 60 | 5.9 | 964 | 85 | 55 | 36122E3 | - |
| | 1500 | 35 x 100 | 7.1 | 1204 | 64 | 40 | 16152E3 | 66152E3 |
| | 1500 | 40 x 80 | 6.5 | 1204 | 67 | 43 | 26152E3 | 76152E3 |
| | 1500 | 45 x 70 | 6.6 | 1204 | 69 | 46 | 36152E3 | - |
| | 1800 | 40 x 100 | 7.7 | 1444 | 56 | 35 | 26182E3 | 76182E3 |
| | 1800 | 45 x 80 | 7.3 | 1444 | 59 | 39 | 36182E3 | - |
| | 2200 | 45 x 100 | 8.6 | 1764 | 48 | 32 | 36222E3 | - |
| 2700 | 45 x 100 | 9.1 | 2164 | 42 | 29 | 36272E3 | - | |
| 420 | 680 | 35 x 60 | 4.1 | 575 | 137 | 85 | 14681E3 | 64681E3 |
| | 680 | 40 x 50 | 4.2 | 575 | 141 | 89 | 24681E3 | 74681E3 |
| | 820 | 35 x 70 | 4.6 | 693 | 114 | 71 | 14821E3 | 64821E3 |
| | 820 | 40 x 60 | 4.7 | 693 | 117 | 74 | 24821E3 | 74821E3 |
| | 1000 | 35 x 80 | 5.1 | 844 | 95 | 59 | 14102E3 | 64102E3 |
| | 1000 | 40 x 60 | 5.1 | 844 | 100 | 64 | 24102E3 | 74102E3 |
| | 1200 | 40 x 70 | 5.7 | 1012 | 84 | 54 | 24122E3 | 74122E3 |
| | 1500 | 40 x 100 | 7.2 | 1264 | 66 | 42 | 24152E3 | 74152E3 |
| | 1500 | 45 x 70 | 6.6 | 1264 | 71 | 48 | 34152E3 | - |
| | 1800 | 40 x 100 | 7.6 | 1516 | 57 | 37 | 24182E3 | 74182E3 |
| | 1800 | 45 x 80 | 7.2 | 1516 | 60 | 40 | 34182E3 | - |
| | 2200 | 45 x 100 | 8.5 | 1852 | 49 | 33 | 34222E3 | - |



| 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) | ESR 100 Hz (mΩ) | Z _{max.} 10 kHz (mΩ) | CATALOG NUMBER MAL2096..... | |
| | | | | | | | 4T-SI | PW |
| 450 | 560 | 35 x 60 | 3.8 | 508 | 155 | 94 | 17561E3 | 67561E3 |
| | 680 | 35 x 70 | 4.2 | 616 | 129 | 78 | 17681E3 | 67681E3 |
| | 680 | 40 x 50 | 4.2 | 616 | 136 | 85 | 27681E3 | 77681E3 |
| | 820 | 35 x 80 | 4.8 | 742 | 108 | 66 | 17821E3 | 67821E3 |
| | 820 | 40 x 60 | 4.7 | 742 | 112 | 70 | 27821E3 | 77821E3 |
| | 1000 | 35 x 100 | 6.0 | 904 | 89 | 54 | 17102E3 | 67102E3 |
| | 1000 | 40 x 70 | 5.3 | 904 | 93 | 58 | 27102E3 | 77102E3 |
| | 1000 | 45 x 60 | 5.5 | 904 | 97 | 62 | 37102E3 | - |
| | 1200 | 40 x 80 | 6.0 | 1084 | 78 | 49 | 27122E3 | 77122E3 |
| | 1200 | 45 x 70 | 6.1 | 1084 | 81 | 52 | 37122E3 | - |
| | 1500 | 40 x 100 | 7.2 | 1354 | 63 | 39 | 27152E3 | 77152E3 |
| | 1500 | 45 x 80 | 6.8 | 1354 | 67 | 43 | 37152E3 | - |
| | 1800 | 45 x 100 | 8.0 | 1624 | 55 | 35 | 37182E3 | - |
| 500 | 390 | 35 x 60 | 2.9 | 394 | 475 | 421 | 19391E3 | 69391E3 |
| | 470 | 35 x 70 | 3.3 | 474 | 395 | 350 | 19471E3 | 69471E3 |
| | 560 | 35 x 70 | 3.6 | 564 | 333 | 296 | 19561E3 | 69561E3 |
| | 560 | 40 x 60 | 3.7 | 564 | 336 | 299 | 29561E3 | 79561E3 |
| | 680 | 35 x 80 | 4.1 | 684 | 275 | 245 | 19681E3 | 69681E3 |
| | 680 | 40 x 70 | 4.2 | 684 | 277 | 247 | 29681E3 | 79681E3 |
| | 820 | 35 x 100 | 5.1 | 824 | 229 | 203 | 19821E3 | 69821E3 |
| | 820 | 40 x 80 | 4.7 | 824 | 231 | 206 | 29821E3 | 79821E3 |
| | 1000 | 40 x 100 | 5.6 | 1004 | 189 | 169 | 29102E3 | 79102E3 |
| | 1000 | 45 x 70 | 5.3 | 1004 | 195 | 176 | 39102E3 | - |
| | 1200 | 45 x 100 | 6.4 | 1204 | 160 | 144 | 39122E3 | - |
| | 1500 | 45 x 100 | 7.0 | 1504 | 131 | 118 | 39152E3 | - |

| ADDITIONAL ELECTRICAL DATA | | |
|------------------------------------|-------------------------------|--|
| PARAMETER | CONDITIONS | VALUE |
| Voltage | | |
| Surge voltage | ≥ 350 V versions | U _s = 1.1 x U _R |
| Reverse voltage | | U _{rev} ≤ 1 |
| 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 | Ca. 20 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: CCC205-05

CCC205-05

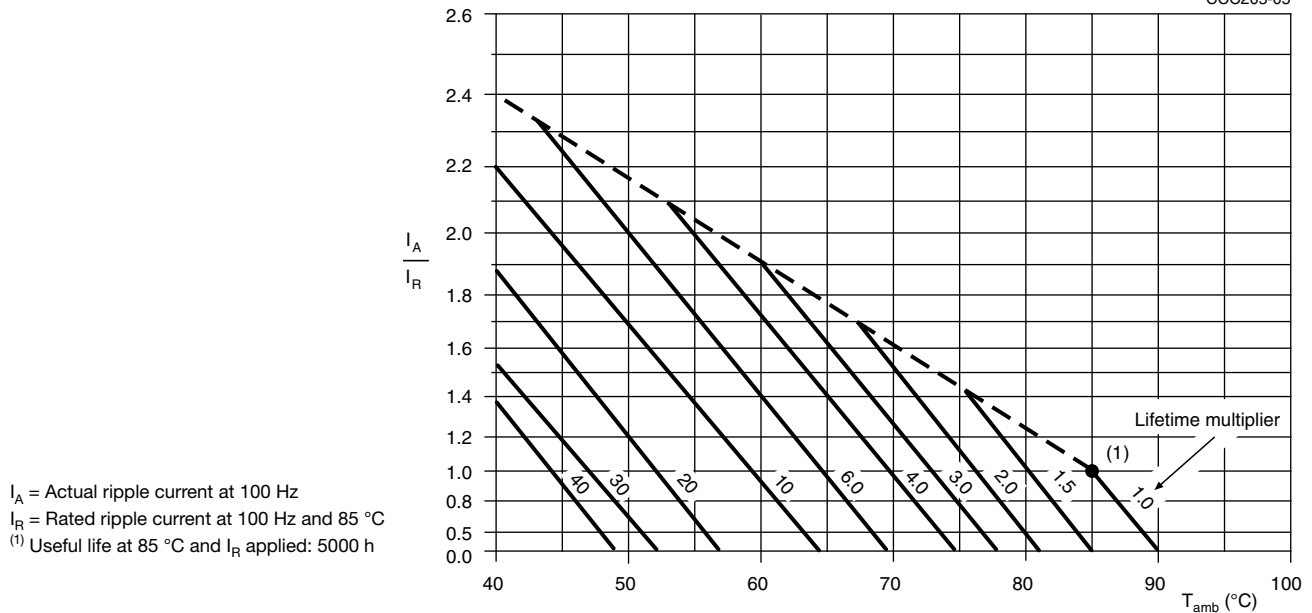


Fig. 8 - Multiplier of useful life as a function of ambient temperature and ripple current load

Table 4

| MULTIPLIER OF RIPPLE CURRENT (I_R) AS A FUNCTION OF FREQUENCY | | | | | |
|---|-----|-----|-----|------|--------|
| FREQUENCY (Hz) | | | | | |
| 50 | 100 | 200 | 400 | 1000 | 10 000 |
| I_R MULTIPLIER | | | | | |
| 0.9 | 1.0 | 1.2 | 1.3 | 1.4 | 1.5 |

Table 5

| TEST PROCEDURES AND REQUIREMENTS | | | |
|----------------------------------|---------------------------------------|---|--|
| TEST | | PROCEDURE (quick reference) | REQUIREMENTS |
| NAME OF TEST | REFERENCE | | |
| Endurance | IEC 60384-4 / EN130300 subclause 4.13 | $T_{amb} = 85\text{ °C}$; U_R applied 2000 h | $\Delta C/C: \pm 10\%$ $ESR \leq 1.3 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ |
| Useful life | CECC 30301 subclause 4.13 | $T_{amb} = 85\text{ °C}$; U_R and I_R applied; 5000 h | $\Delta C/C: \pm 30\%$ $ESR \leq 3 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit, no visible damage total failure percentage: $\leq 3\%$ |
| Shelf life | IEC 60384-4 / EN130300 subclause 4.17 | $T_{amb} = 85\text{ °C}$; no voltage applied; 1000 h After test: U_R to be applied for 30 min 24 h to 48 h before measurement | $\Delta C/C: \pm 10\%$ $ESR \leq 1.2 \times \text{spec. limit}$ $I_{L5} \leq 2 \times \text{spec. limit}$ |

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.



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