

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

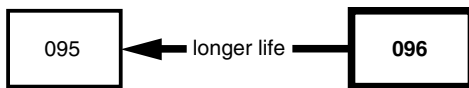


Fig. 1

| 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)

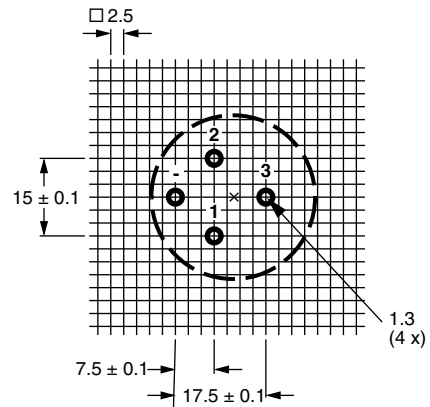


Fig. 3 - Mounting hole diagram viewed from component side
(Case Ø D = 35 mm)

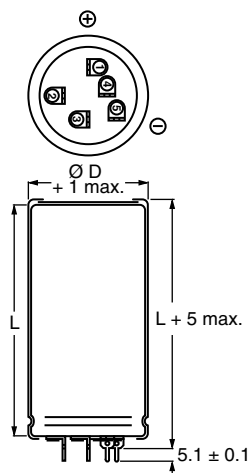


Fig. 4 - Printed wiring pin version
(Case Ø D = 40 mm)

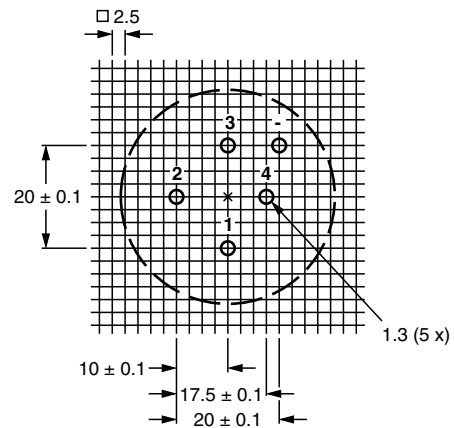


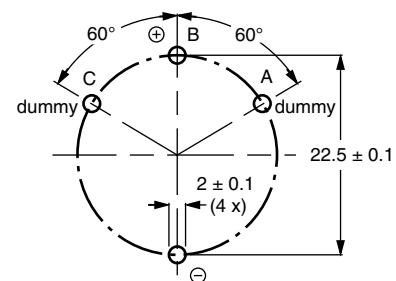
Fig. 5 - Mounting hole diagram viewed from component side
(Case Ø D = 40 mm)

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 |
| 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

CCC205-05

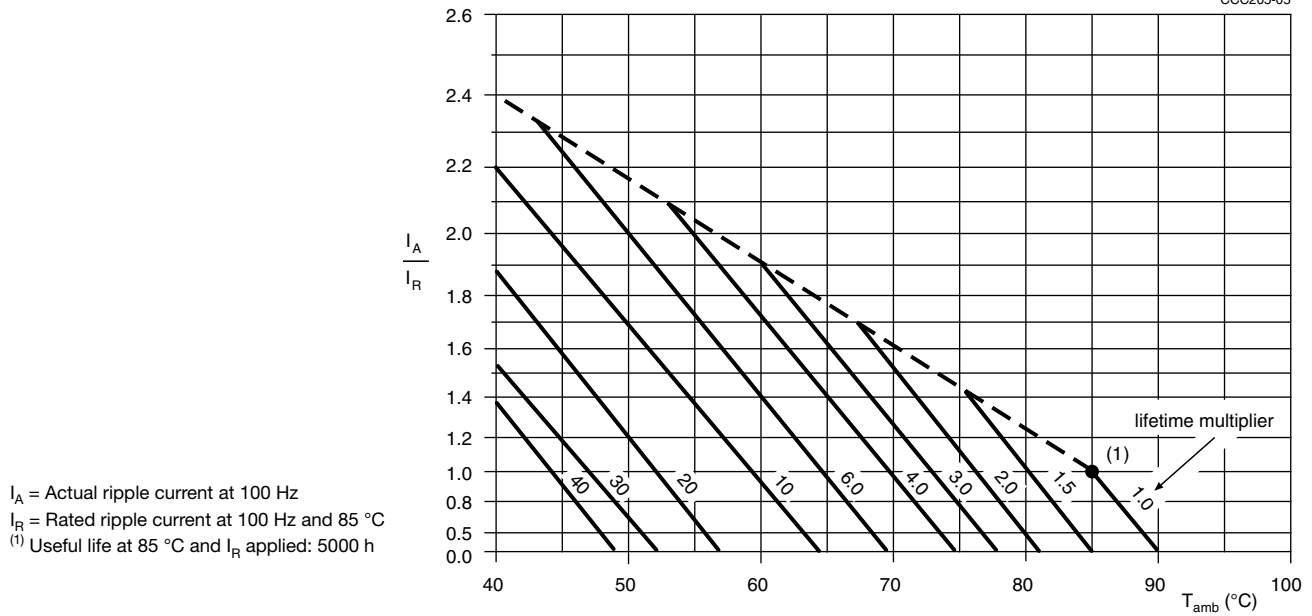


Fig. 8 - Multiplier of useful life as a function of ambient temperature and ripple current load

Table 3

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

Table 4

| 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 | $\Delta C/C: \pm 10\%$ $ESR \leq 1.2 \times \text{spec. limit}$ $I_{L5} \leq 2 \times \text{spec. limit}$ |



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