

Aluminum Electrolytic Capacitors Power Standard Miniature Snap-In

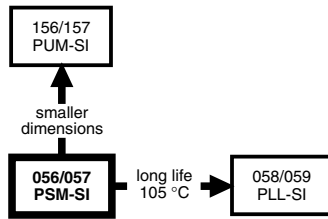


Fig. 1

| QUICK REFERENCE DATA | | |
|---|-----------------------------|------------------|
| DESCRIPTION | VALUE | |
| | 056 | 057 |
| Nominal case size (Ø D x L in mm) | 22 x 25 to 35 x 50 | |
| Rated capacitance range (E6 series), C _R | 470 µF to 68 000 µF | 47 µF to 1500 µF |
| Tolerance on C _R | ± 20 % | |
| Rated voltage range, U _R ⁽¹⁾ | 10 V to 100 V | 200 V to 450 V |
| Category temperature range | -40 °C to +85 °C | -25 °C to +85 °C |
| Endurance test at 85 °C | 5000 h (450 V: 2000 h) | |
| Useful life at 85 °C | 12 000 h (450 V: 5000 h) | |
| Useful life at 40 °C and 1.4 x I _R applied | 210 000 h (450 V: 90 000 h) | |
| Shelf life at 0 V, 85 °C | 500 h | |
| Max. RMS value of ripple voltage | n/a | 12 V |
| Based on sectional specification | IEC 60384-4 / EN130300 | |
| Climatic category IEC 60068 | 40 / 085 / 056 | 25 / 085 / 56 |

Note
⁽¹⁾ A 420 V range is available on request

| SELECTION CHART FOR C _R , U _R , AND RELEVANT NOMINAL CASE SIZES FOR 056 SERIES (Ø D x L in mm) | | | | | | | |
|--|--------------------|----|----|----|---------|---------|---------|
| C _R (µF) | U _R (V) | | | | | | |
| | 10 | 16 | 25 | 40 | 50 | 63 | 100 |
| 470 | - | - | - | - | - | - | 22 x 25 |
| 680 | - | - | - | - | - | - | 22 x 30 |
| 1000 | - | - | - | - | - | 22 x 25 | 25 x 30 |
| | - | - | - | - | - | - | 22 x 40 |
| 1500 | - | - | - | - | 22 x 25 | 22 x 30 | 30 x 30 |
| | - | - | - | - | - | - | 25 x 40 |

FEATURES

- Long useful life: 12 000 h at 85 °C
- Low ESR
- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Large types, minimized dimensions, cylindrical aluminum case, insulated with a blue sleeve
- Pressure relief on the top of the aluminum case
- 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 or in 2 digits according to IEC 60062)
- 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

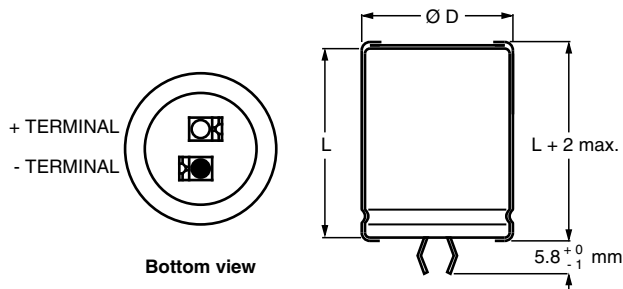


SELECTION CHART FOR C_R, U_R, AND RELEVANT NOMINAL CASE SIZES FOR 056 SERIES (∅ D x L in mm)

| C _R (μF) | U _R (V) | | | | | | |
|------------------------|--------------------|---------|---------|---------|---------|---------|---------|
| | 10 | 16 | 25 | 40 | 50 | 63 | 100 |
| 2200 | - | - | - | 22 x 25 | 22 x 30 | 25 x 30 | 30 x 40 |
| | - | - | - | - | - | 22 x 40 | 25 x 50 |
| 3300 | - | - | 22 x 25 | 22 x 30 | 25 x 30 | 30 x 30 | 35 x 40 |
| | - | - | - | - | 22 x 40 | 25 x 40 | 30 x 50 |
| 4700 | - | 22 x 25 | 22 x 30 | 25 x 30 | 30 x 30 | 30 x 40 | 35 x 50 |
| | - | - | - | 22 x 40 | 25 x 40 | 25 x 50 | - |
| 6800 | 22 x 25 | 22 x 30 | 25 x 30 | 30 x 30 | 30 x 40 | 35 x 40 | - |
| | - | - | 22 x 40 | 25 x 40 | 25 x 50 | 30 x 50 | - |
| 10 000 | 22 x 30 | 25 x 30 | 30 x 30 | 30 x 40 | 35 x 40 | 35 x 50 | - |
| | - | 22 x 40 | 25 x 40 | 25 x 50 | 30 x 50 | - | - |
| 15 000 | 25 x 30 | 30 x 30 | 30 x 40 | 35 x 40 | 35 x 50 | - | - |
| | 22 x 40 | 25 x 40 | 25 x 50 | 30 x 50 | - | - | - |
| 22 000 | 30 x 30 | 30 x 40 | 35 x 40 | 35 x 50 | - | - | - |
| | 25 x 40 | 25 x 50 | 30 x 50 | - | - | - | - |
| 33 000 | 30 x 40 | 35 x 40 | 35 x 50 | - | - | - | - |
| | 25 x 50 | 30 x 50 | - | - | - | - | - |
| 47 000 | 35 x 40 | 35 x 50 | - | - | - | - | - |
| | 30 x 50 | - | - | - | - | - | - |
| 68 000 | 35 x 50 | - | - | - | - | - | - |

SELECTION CHART FOR C_R, U_R, AND RELEVANT NOMINAL CASE SIZES FOR 057 SERIES (∅ D x L in mm)

| C _R (μF) | U _R (V) | | | | |
|------------------------|--------------------|---------|---------|---------|---------|
| | 200 | 250 | 385 | 400 | 450 |
| 47 | - | - | 22 x 25 | 22 x 25 | 22 x 30 |
| 68 | - | - | 22 x 30 | 22 x 30 | 22 x 30 |
| 100 | - | 22 x 25 | 25 x 30 | 25 x 30 | 30 x 30 |
| | - | - | 22 x 40 | 22 x 35 | 25 x 35 |
| | - | - | 22 x 35 | - | - |
| 150 | 22 x 25 | 22 x 30 | 30 x 30 | 30 x 30 | 25 x 50 |
| | - | - | 25 x 40 | - | 30 x 35 |
| | - | - | - | 25 x 40 | - |
| 220 | 22 x 30 | 25 x 30 | 30 x 45 | 30 x 35 | 35 x 40 |
| | - | 22 x 40 | 30 x 40 | 25 x 40 | 30 x 45 |
| | - | - | 30 x 35 | - | - |
| | - | - | 25 x 50 | - | - |
| 330 | 25 x 30 | 30 x 30 | 35 x 35 | 35 x 40 | 35 x 50 |
| | 22 x 40 | 25 x 40 | - | 35 x 50 | 35 x 45 |
| 470 | 30 x 30 | 30 x 40 | 35 x 50 | 35 x 50 | - |
| | 25 x 40 | 25 x 50 | 35 x 45 | - | - |
| 680 | 30 x 40 | 35 x 40 | - | - | - |
| | 25 x 50 | 30 x 50 | - | - | - |
| 1000 | 35 x 40 | 35 x 50 | - | - | - |
| | 30 x 50 | - | - | - | - |
| 1500 | 35 x 50 | - | - | - | - |

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

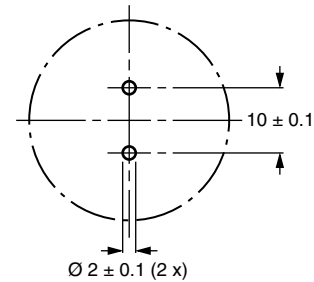
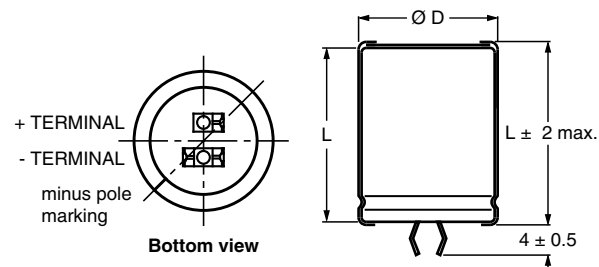
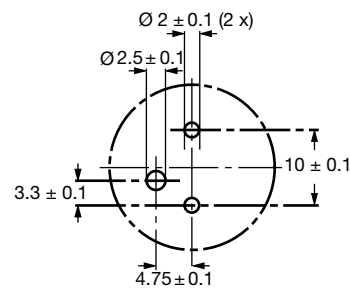


Fig. 3 - Mounting hole diagram

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.} | 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 |
| 22 x 35 | 23 | 37 | ≈ 20 | 100 | 260 x 250 x 49 |
| 22 x 40 | 23 | 42 | ≈ 23 | 100 | 260 x 250 x 54 |
| 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 |
| 25 x 50 | 26 | 52 | ≈ 38 | 100 | 290 x 280 x 64 |
| 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 |
| 30 x 45 | 31 | 47 | ≈ 45 | 100 | 340 x 330 x 59 |
| 30 x 50 | 31 | 52 | ≈ 50 | 100 | 340 x 330 x 64 |
| 35 x 35 | 36 | 37 | ≈ 48 | 50 | 390 x 198 x 49 |
| 35 x 40 | 36 | 42 | ≈ 55 | 50 | 390 x 198 x 54 |
| 35 x 45 | 36 | 47 | ≈ 63 | 50 | 390 x 198 x 59 |
| 35 x 50 | 36 | 52 | ≈ 72 | 50 | 390 x 198 x 64 |



| ELECTRICAL DATA | |
|-----------------|--|
| SYMBOL | DESCRIPTION |
| C _R | Rated capacitance at 100 Hz |
| I _R | Rated RMS ripple current at 100 Hz or ≥ 10 kHz and 85 °C |
| I _{L1} | Max. leakage current after 1 min at U _R |
| 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 Tables 2 and 3 apply at T_{amb} = 20 °C, P = 86 kPa to 106 kPa, RH = 45 % to 75 %

ORDERING EXAMPLE

Electrolytic capacitor 056 series

10 000 µF / 25 V; ± 20 %

Nominal case size: Ø 25 mm x 40 mm

2-terminal snap-in:

Ordering code: MAL2 05646103E3

Former 12NC: 2222 05646103

3-terminal snap-in:

Ordering code: MAL2 05626103E3

Former 12NC: 2222 05626103

Table 2

| ELECTRICAL DATA AND ORDERING INFORMATION FOR 056 SERIES | | | | | | | | | | |
|---|----------------------------------|---|--|--|----------------------------------|----------------------------------|-----------------------|---------------------|-------------------------------|---------|
| U _R (V) | C _R 100 Hz (µF) | NOMINAL CASE SIZE Ø D x L (mm) | I _R 100 Hz 85 °C (A) | I _R ≥ 10 kHz 85 °C (A) | I _{L1} 1 min (µA) | I _{L5} 5 min (µA) | ESR 100 Hz (mΩ) | Z 10 kHz (mΩ) | ORDERING CODE MAL2056..... | |
| | | | | | | | | | 2-TERM. | 3-TERM. |
| 10 | 6800 | 22 x 25 | 2.04 | 2.40 | 412 | 140 | 76 | 62 | 54682E3 | 74682E3 |
| | 10 000 | 22 x 30 | 2.56 | 3.02 | 608 | 205 | 56 | 45 | 54103E3 | 74103E3 |
| | 15 000 | 25 x 30 | 3.12 | 3.68 | 904 | 304 | 44 | 39 | 54153E3 | 74153E3 |
| | 15 000 | 22 x 40 | 3.39 | 4.00 | 904 | 304 | 41 | 34 | 44153E3 | 24153E3 |
| | 22 000 | 30 x 30 | 3.47 | 4.09 | 1324 | 444 | 44 | 37 | 54223E3 | 74223E3 |
| | 22 000 | 25 x 40 | 4.12 | 4.86 | 1324 | 444 | 34 | 28 | 44223E3 | 24223E3 |
| | 33 000 | 30 x 40 | 4.58 | 5.40 | 1984 | 664 | 32 | 28 | 54333E3 | 74333E3 |
| | 33 000 | 25 x 50 | 4.70 | 5.55 | 1984 | 664 | 30 | 27 | 44333E3 | 24333E3 |
| | 47 000 | 35 x 40 | 5.10 | 6.02 | 2824 | 944 | 31 | 26 | 54473E3 | 74473E3 |
| | 47 000 | 30 x 50 | 5.39 | 6.36 | 2824 | 944 | 28 | 24 | 44473E3 | 24473E3 |
| 68 000 | 35 x 50 | 5.88 | 6.94 | 4084 | 1364 | 28 | 23 | 54683E3 | 74683E3 | |
| 16 | 4700 | 22 x 25 | 2.01 | 2.37 | 455 | 154 | 79 | 62 | 55472E3 | 75472E3 |
| | 6800 | 22 x 30 | 2.54 | 3.00 | 657 | 222 | 57 | 45 | 55682E3 | 75682E3 |
| | 10 000 | 25 x 30 | 3.02 | 3.56 | 964 | 324 | 47 | 39 | 55103E3 | 75103E3 |
| | 10 000 | 22 x 40 | 3.28 | 3.87 | 964 | 324 | 44 | 34 | 45103E3 | 25103E3 |
| | 15 000 | 30 x 30 | 3.36 | 3.96 | 1444 | 484 | 47 | 37 | 55153E3 | 75153E3 |
| | 15 000 | 25 x 40 | 4.00 | 4.72 | 1444 | 484 | 34 | 28 | 45153E3 | 25153E3 |
| | 22 000 | 30 x 40 | 4.51 | 5.32 | 2116 | 708 | 33 | 28 | 55223E3 | 75223E3 |
| | 22 000 | 25 x 50 | 3.97 | 4.68 | 2116 | 708 | 42 | 41 | 45223E3 | 25223E3 |
| | 33 000 | 35 x 40 | 5.02 | 5.92 | 3172 | 1060 | 32 | 28 | 55333E3 | 75333E3 |
| | 33 000 | 30 x 50 | 4.75 | 5.61 | 3172 | 1060 | 36 | 34 | 45333E3 | 25333E3 |
| 47 000 | 35 x 50 | 5.34 | 6.30 | 4516 | 1508 | 34 | 32 | 55473E3 | 75473E3 | |
| 25 | 3300 | 22 x 25 | 1.88 | 2.22 | 499 | 169 | 89 | 61 | 56332E3 | 76332E3 |
| | 4700 | 22 x 30 | 2.37 | 2.80 | 709 | 239 | 65 | 45 | 56472E3 | 76472E3 |
| | 6800 | 25 x 30 | 2.81 | 3.32 | 1024 | 344 | 54 | 41 | 56682E3 | 76682E3 |
| | 6800 | 22 x 40 | 3.16 | 3.73 | 1024 | 344 | 47 | 38 | 46682E3 | 26682E3 |
| | 10 000 | 30 x 30 | 3.25 | 3.84 | 1504 | 504 | 50 | 38 | 56103E3 | 76103E3 |
| | 10 000 | 25 x 40 | 3.73 | 4.40 | 1504 | 504 | 39 | 30 | 46103E3 | 26103E3 |
| | 15 000 | 30 x 40 | 4.73 | 5.58 | 2254 | 754 | 30 | 28 | 56153E3 | 76153E3 |
| | 15 000 | 25 x 50 | 3.92 | 4.63 | 2254 | 754 | 43 | 39 | 46153E3 | 26153E3 |
| | 22 000 | 35 x 40 | 4.48 | 5.29 | 3304 | 1104 | 40 | 28 | 56223E3 | 76223E3 |
| | 22 000 | 30 x 50 | 4.96 | 5.85 | 3304 | 1104 | 36 | 23 | 46223E3 | 26223E3 |
| 33 000 | 35 x 50 | 4.98 | 5.88 | 4954 | 1654 | 39 | 33 | 56333E3 | 76333E3 | |



| ELECTRICAL DATA AND ORDERING INFORMATION FOR 056 SERIES | | | | | | | | | | |
|---|----------------------------------|---|--|--|----------------------------------|----------------------------------|-----------------------|---------------------|-------------------------------|---------|
| U _R (V) | C _R 100 Hz (μF) | NOMINAL CASE SIZE Ø D x L (mm) | I _R 100 Hz 85 °C (A) | I _R ≥ 10 kHz 85 °C (A) | I _{L1} 1 min (μA) | I _{L5} 5 min (μA) | ESR 100 Hz (mΩ) | Z 10 kHz (mΩ) | ORDERING CODE MAL2056..... | |
| | | | | | | | | | 2-TERM. | 3-TERM. |
| 40 | 2200 | 22 x 25 | 1.85 | 2.26 | 532 | 180 | 92 | 61 | 57222E3 | 77222E3 |
| | 3300 | 22 x 30 | 2.09 | 2.55 | 796 | 260 | 67 | 45 | 57332E3 | 77332E3 |
| | 4700 | 25 x 30 | 2.28 | 2.78 | 1132 | 380 | 82 | 70 | 57472E3 | 77472E3 |
| | 4700 | 22 x 40 | 3.10 | 3.78 | 1132 | 380 | 49 | 38 | 47472E3 | 27472E3 |
| | 6800 | 30 x 30 | 3.16 | 3.85 | 1636 | 548 | 53 | 38 | 57682E3 | 77682E3 |
| | 6800 | 25 x 40 | 3.06 | 3.73 | 1636 | 548 | 58 | 50 | 47682E3 | 27682E3 |
| | 10 000 | 30 x 40 | 4.20 | 5.12 | 2404 | 804 | 38 | 28 | 57103E3 | 77103E3 |
| | 10 000 | 25 x 50 | 3.88 | 4.73 | 2404 | 804 | 44 | 39 | 47103E3 | 27103E3 |
| | 15 000 | 35 x 40 | 4.05 | 4.94 | 3604 | 1204 | 49 | 41 | 57153E3 | 77153E3 |
| | 15 000 | 30 x 50 | 4.45 | 5.43 | 3604 | 1204 | 41 | 34 | 47153E3 | 27153E3 |
| | 22 000 | 35 x 50 | 4.86 | 5.93 | 5284 | 1764 | 40 | 33 | 57223E3 | 77223E3 |
| 50 | 1500 | 22 x 25 | 1.36 | 1.66 | 454 | 154 | 170 | 130 | 51152E3 | 71152E3 |
| | 2200 | 22 x 30 | 1.75 | 2.14 | 664 | 224 | 120 | 91 | 51222E3 | 71222E3 |
| | 3300 | 25 x 30 | 2.17 | 2.65 | 994 | 334 | 90 | 72 | 51332E3 | 71332E3 |
| | 3300 | 22 x 40 | 2.42 | 2.95 | 994 | 334 | 80 | 63 | 41332E3 | 21332E3 |
| | 4700 | 30 x 30 | 2.65 | 3.23 | 1414 | 474 | 75 | 63 | 51472E3 | 71472E3 |
| | 4700 | 25 x 40 | 2.89 | 3.53 | 1414 | 474 | 65 | 52 | 41472E3 | 21472E3 |
| | 6800 | 30 x 40 | 3.56 | 4.34 | 2044 | 684 | 53 | 45 | 51682E3 | 71682E3 |
| | 6800 | 25 x 50 | 3.75 | 4.58 | 2044 | 684 | 50 | 43 | 41682E3 | 21682E3 |
| | 10 000 | 35 x 40 | 4.05 | 4.94 | 3004 | 1004 | 49 | 42 | 51103E3 | 71103E3 |
| | 10 000 | 30 x 50 | 4.50 | 5.49 | 3004 | 1004 | 40 | 35 | 41103E3 | 21103E3 |
| | 15 000 | 35 x 50 | 4.98 | 6.08 | 4504 | 1504 | 39 | 33 | 51153E3 | 71153E3 |
| 63 | 1000 | 22 x 25 | 1.46 | 1.78 | 382 | 130 | 148 | 104 | 58102E3 | 78102E3 |
| | 1500 | 22 x 30 | 1.87 | 2.28 | 571 | 193 | 105 | 72 | 58152E3 | 78152E3 |
| | 2200 | 25 x 30 | 2.32 | 2.83 | 836 | 281 | 79 | 59 | 58222E3 | 78222E3 |
| | 2200 | 22 x 40 | 2.54 | 3.10 | 836 | 281 | 73 | 53 | 48222E3 | 28222E3 |
| | 3300 | 30 x 30 | 2.87 | 3.50 | 1251 | 420 | 64 | 50 | 58332E3 | 78332E3 |
| | 3300 | 25 x 40 | 3.14 | 3.83 | 1251 | 420 | 55 | 44 | 48332E3 | 28332E3 |
| | 4700 | 30 x 40 | 3.67 | 4.48 | 1780 | 596 | 50 | 38 | 58472E3 | 78472E3 |
| | 4700 | 25 x 50 | 3.71 | 4.53 | 1780 | 596 | 48 | 38 | 48472E3 | 28472E3 |
| | 6800 | 35 x 40 | 4.33 | 5.28 | 2574 | 861 | 43 | 38 | 58682E3 | 78682E3 |
| | 6800 | 30 x 50 | 4.75 | 5.80 | 2574 | 861 | 42 | 37 | 48682E3 | 28682E3 |
| | 10 000 | 35 x 50 | 5.26 | 6.42 | 3784 | 1264 | 35 | 30 | 58103E3 | 78103E3 |
| 100 | 470 | 22 x 25 | 0.77 | 0.94 | 286 | 98 | 535 | 470 | 59471E3 | 79471E3 |
| | 680 | 22 x 30 | 0.99 | 1.21 | 412 | 160 | 375 | 328 | 59681E3 | 79681E3 |
| | 1000 | 25 x 30 | 1.27 | 1.55 | 604 | 204 | 265 | 235 | 59102E3 | 79102E3 |
| | 1000 | 22 x 40 | 1.35 | 1.65 | 604 | 204 | 260 | 225 | 49102E3 | 29102E3 |
| | 1500 | 30 x 30 | 1.67 | 2.04 | 904 | 304 | 190 | 170 | 59152E3 | 79152E3 |
| | 1500 | 25 x 40 | 1.75 | 2.14 | 904 | 304 | 180 | 160 | 49152E3 | 29152E3 |
| | 2200 | 30 x 40 | 2.27 | 2.77 | 1324 | 444 | 130 | 120 | 59222E3 | 79222E3 |
| | 2200 | 25 x 50 | 2.30 | 2.80 | 1324 | 444 | 125 | 110 | 49222E3 | 29222E3 |
| | 3300 | 35 x 40 | 2.84 | 3.46 | 1984 | 664 | 100 | 95 | 59332E3 | 79332E3 |
| | 3300 | 30 x 50 | 2.97 | 3.62 | 1984 | 664 | 92 | 85 | 49332E3 | 29332E3 |
| | 4700 | 35 x 50 | 3.59 | 4.38 | 2824 | 677 | 75 | 70 | 59472E3 | 79472E3 |



Table 3

| ELECTRICAL DATA AND ORDERING INFORMATION FOR 057 SERIES | | | | | | | | | |
|---|-------------------------------|---|--|----------------------------------|----------------------------------|-----------------------|---------------------|-------------------------------|---------|
| U _R (V) | C _R 100 Hz (μF) | NOMINAL CASE SIZE Ø D X L (mm) | I _R 100 Hz 85 °C (A) | I _{L1} 1 min (μA) | I _{L5} 5 min (μA) | ESR 100 Hz (mΩ) | Z 10 kHz (mΩ) | ORDERING CODE MAL2057..... | |
| | | | | | | | | 2-TERM. | 3-TERM. |
| 200 | 150 | 22 x 25 | 0.77 | 184 | 64 | 950 | 620 | 52151E3 | 72151E3 |
| | 220 | 22 x 30 | 1.00 | 268 | 92 | 650 | 435 | 52221E3 | 72221E3 |
| | 330 | 25 x 30 | 1.36 | 400 | 136 | 430 | 310 | 52331E3 | 72331E3 |
| | 330 | 22 x 40 | 1.36 | 400 | 136 | 430 | 310 | 42331E3 | 22331E3 |
| | 470 | 30 x 30 | 1.80 | 568 | 192 | 310 | 230 | 52471E3 | 72471E3 |
| | 470 | 25 x 40 | 1.80 | 568 | 192 | 310 | 230 | 42471E3 | 22471E3 |
| | 680 | 30 x 40 | 2.39 | 820 | 276 | 210 | 180 | 52681E3 | 72681E3 |
| | 680 | 25 x 50 | 2.39 | 820 | 276 | 210 | 180 | 42681E3 | 22681E3 |
| | 1000 | 35 x 40 | 2.85 | 1204 | 404 | 160 | 135 | 52102E3 | 72102E3 |
| | 1000 | 30 x 50 | 2.85 | 1204 | 404 | 160 | 135 | 42102E3 | 22102E3 |
| | 1500 | 35 x 50 | 3.66 | 1804 | 604 | 120 | 105 | 52152E3 | 72152E3 |
| 250 | 100 | 22 x 25 | 0.63 | 154 | 54 | 1440 | 770 | 53101E3 | 73101E3 |
| | 150 | 22 x 30 | 0.83 | 229 | 79 | 960 | 520 | 53151E3 | 73151E3 |
| | 220 | 25 x 30 | 1.10 | 334 | 114 | 660 | 365 | 53221E3 | 73221E3 |
| | 220 | 22 x 40 | 1.10 | 334 | 114 | 660 | 365 | 43221E3 | 23221E3 |
| | 330 | 30 x 30 | 1.49 | 499 | 169 | 440 | 265 | 53331E3 | 73331E3 |
| | 330 | 25 x 40 | 1.49 | 499 | 169 | 440 | 265 | 43331E3 | 23331E3 |
| | 470 | 30 x 40 | 1.98 | 709 | 239 | 310 | 185 | 53471E3 | 73471E3 |
| | 470 | 25 x 50 | 1.98 | 709 | 239 | 310 | 185 | 43471E3 | 23471E3 |
| | 680 | 35 x 40 | 2.60 | 1024 | 344 | 240 | 145 | 53681E3 | 73681E3 |
| | 680 | 30 x 50 | 2.60 | 1024 | 344 | 240 | 145 | 43681E3 | 23681E3 |
| | 1000 | 35 x 50 | 3.12 | 1504 | 504 | 160 | 105 | 53102E3 | 73102E3 |
| 385 | 47 | 22 x 25 | 0.50 | 112 | 40 | 3000 | 1400 | 58479E3 | 78479E3 |
| | 68 | 22 x 30 | 0.63 | 161 | 56 | 2100 | 1000 | 58689E3 | 68689E3 |
| | 100 | 25 x 30 | 0.86 | 235 | 81 | 1400 | 780 | 58101E3 | 78101E3 |
| | 100 | 22 x 40 | 0.86 | 235 | 81 | 1400 | 780 | 48101E3 | 68101E3 |
| | 100 | 22 x 35 | 0.84 | 235 | 81 | 1400 | 780 | 38101E3 | 88101E3 |
| | 150 | 30 x 30 | 1.16 | 350 | 119 | 950 | 520 | 58151E3 | 78151E3 |
| | 150 | 25 x 40 | 1.16 | 350 | 119 | 950 | 520 | 48151E3 | 68151E3 |
| | 220 | 30 x 40 | 1.57 | 512 | 173 | 650 | 400 | 58221E3 | 78221E3 |
| | 220 | 30 x 35 | 1.50 | 512 | 173 | 650 | 400 | 38221E3 | 90051E3 |
| | 220 | 25 x 50 | 1.57 | 512 | 173 | 650 | 400 | 48221E3 | 68221E3 |
| | 330 | 35 x 35 | 1.73 | 766 | 258 | 480 | 280 | 68331E3 | 88331E3 |
| | 330 | 30 x 45 | 1.75 | 766 | 258 | 480 | 280 | 38331E3 | 78331E3 |
| | 470 | 35 x 50 | 2.40 | 1089 | 366 | 340 | 220 | 58471E3 | 78471E3 |
| | 470 | 35 x 45 | 2.29 | 1089 | 366 | 340 | 220 | 48471E3 | 28471E3 |
| 400 | 47 | 22 x 25 | 0.50 | 117 | 42 | 3000 | 1400 | 56479E3 | 76479E3 |
| | 68 | 22 x 30 | 0.63 | 167 | 58 | 2100 | 1000 | 56689E3 | 76689E3 |
| | 100 | 25 x 30 | 0.86 | 244 | 84 | 1400 | 780 | 56101E3 | 76101E3 |
| | 100 | 22 x 35 | 0.84 | 240 | 84 | 1400 | 780 | 36101E3 | 66101E3 |
| | 150 | 30 x 30 | 1.16 | 364 | 124 | 950 | 520 | 56151E3 | 90054E3 |
| | 150 | 25 x 40 | 1.16 | 364 | 124 | 950 | 520 | 46151E3 | 86151E3 |
| | 220 | 30 x 35 | 1.50 | 532 | 180 | 650 | 400 | 36221E3 | 90055E3 |
| | 220 | 25 x 50 | 1.57 | 532 | 180 | 650 | 400 | 46221E3 | 86221E3 |
| | 330 | 35 x 40 | 1.85 | 796 | 268 | 480 | 280 | 56331E3 | 76331E3 |
| | 330 | 30 x 50 | 1.85 | 796 | 268 | 480 | 280 | 46331E3 | 26331E3 |
| | 470 | 35 x 50 | 2.40 | 1132 | 380 | 340 | 220 | 56471E3 | 76471E3 |
| | 450 | 47 | 22 x 30 | 0.26 | 131 | 45 | 5600 | 4400 | 67479E3 |
| 68 | | 22 x 30 | 0.33 | 188 | 65 | 3900 | 3100 | 57689E3 | 77689E3 |
| 100 | | 30 x 30 | 0.48 | 274 | 94 | 2600 | 2100 | 57101E3 | 77101E3 |
| 100 | | 25 x 35 | 0.46 | 274 | 94 | 2600 | 2100 | 37101E3 | 17101E3 |
| 150 | | 30 x 35 | 0.66 | 409 | 140 | 1600 | 1300 | 37151E3 | 17151E3 |
| 150 | | 25 x 50 | 0.70 | 409 | 140 | 1600 | 1300 | 47151E3 | 27151E3 |
| 220 | | 35 x 40 | 0.92 | 598 | 202 | 1100 | 900 | 57221E3 | 77221E3 |
| 220 | | 30 x 45 | 0.73 | 598 | 202 | 1100 | 900 | 37221E3 | 17221E3 |
| 330 | | 35 x 50 | 1.26 | 895 | 301 | 700 | 600 | 57331E3 | 77331E3 |
| 330 | | 35 x 45 | 1.20 | 895 | 301 | 700 | 600 | 47331E3 | 27331E3 |

| ADDITIONAL ELECTRICAL DATA | | |
|------------------------------------|----------------------|--|
| PARAMETER | CONDITIONS | VALUE |
| Voltage | | |
| Surge voltage | ≤ 250 V versions | $U_s = 1.15 \times U_R$ |
| | ≥ 385 V versions | $U_s = 1.1 \times U_R$ |
| 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 |

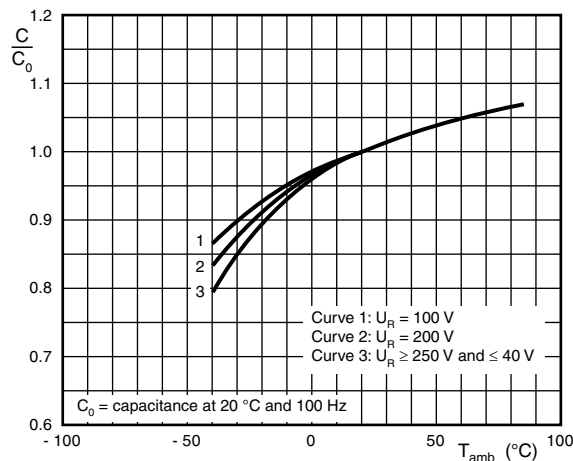
CAPACITANCE (C)


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

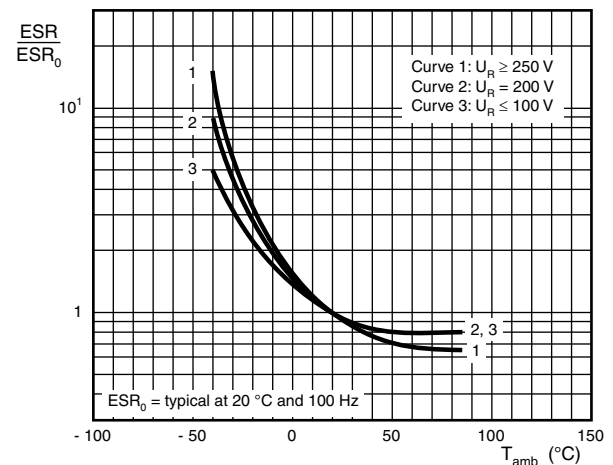
EQUIVALENT SERIES RESISTANCE (ESR)


Fig. 8 - Typical multiplier of ESR as a function of ambient temperature

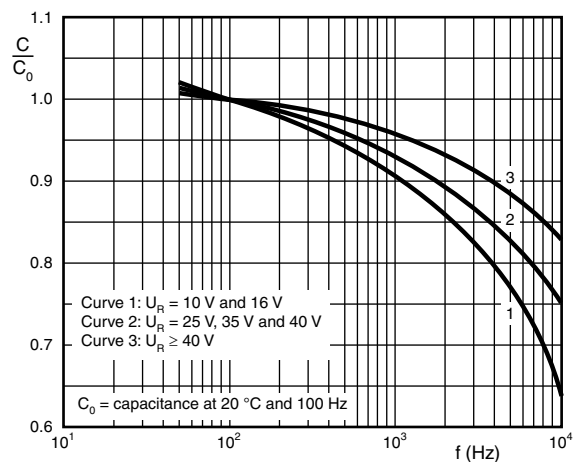


Fig. 7 - Typical multiplier of capacitance as a function of frequency

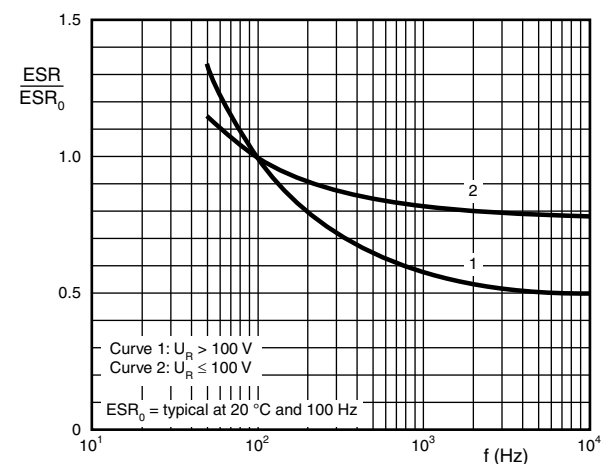


Fig. 9 - Typical multiplier of ESR as a function of frequency

IMPEDANCE (Z)

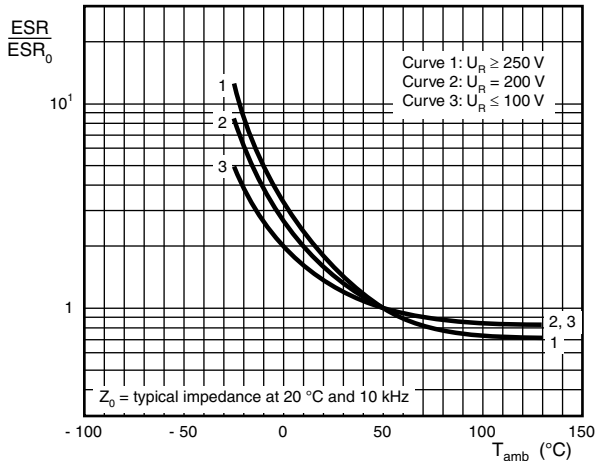


Fig. 10 - Typical multiplier of impedance as a function of ambient temperature

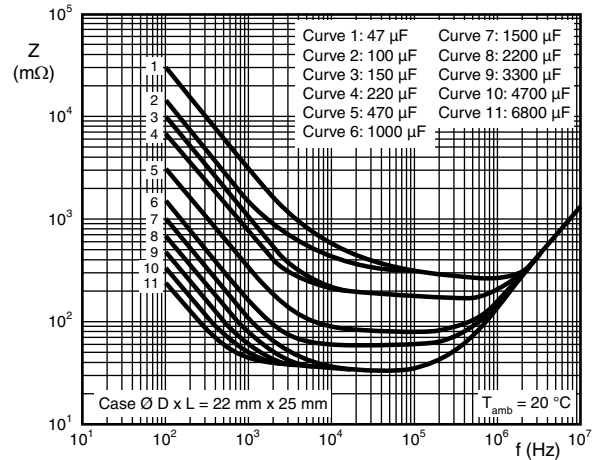


Fig. 13 - Typical impedance as a function of frequency

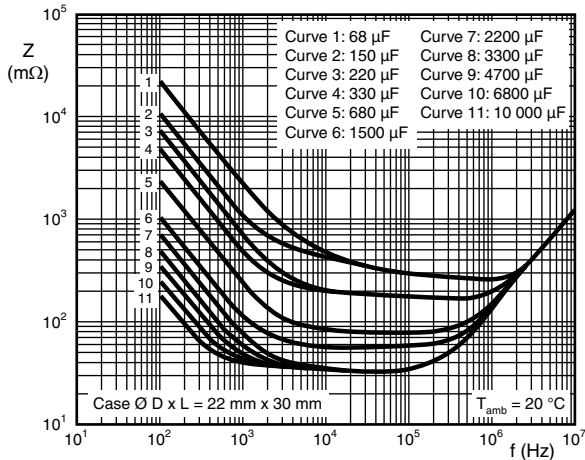


Fig. 11 - Typical impedance as a function of frequency

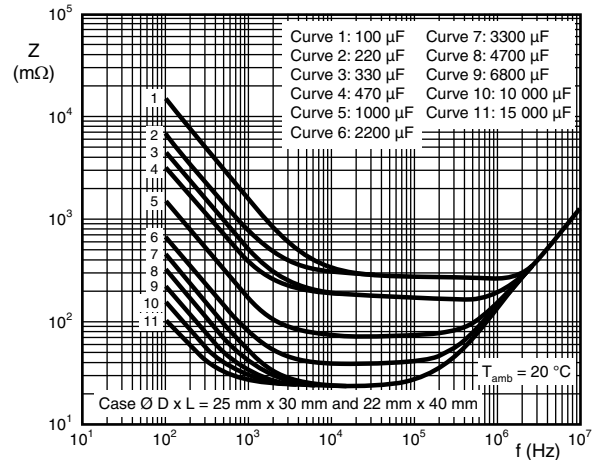


Fig. 14 - Typical impedance as a function of frequency

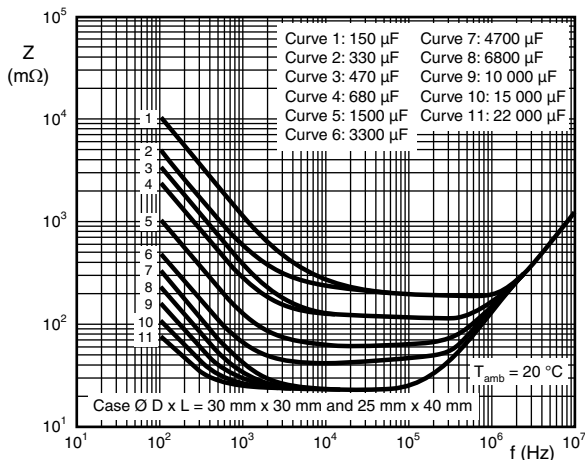


Fig. 12 - Typical impedance as a function of frequency

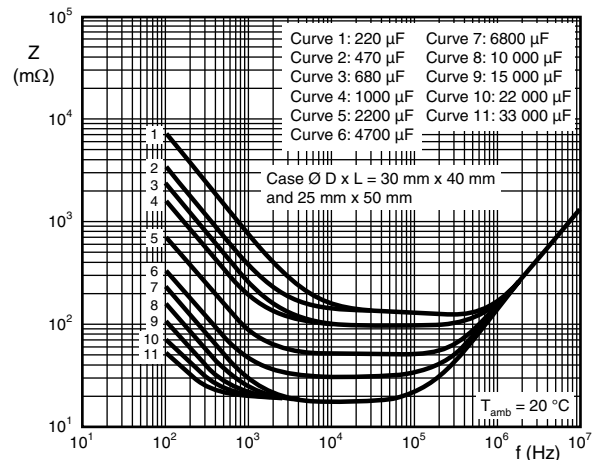


Fig. 15 - Typical impedance as a function of frequency

IMPEDANCE (Z)

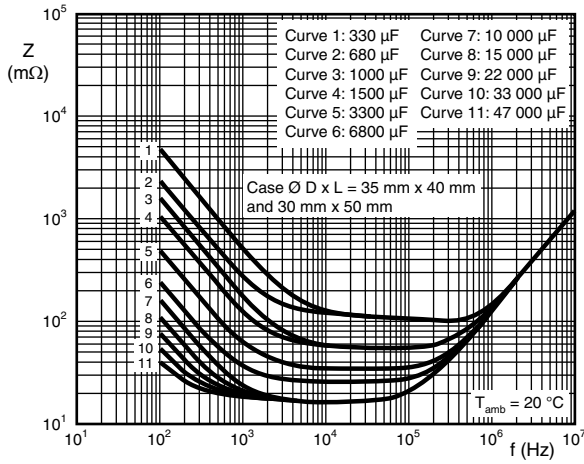


Fig. 16 - Typical impedance as a function of frequency

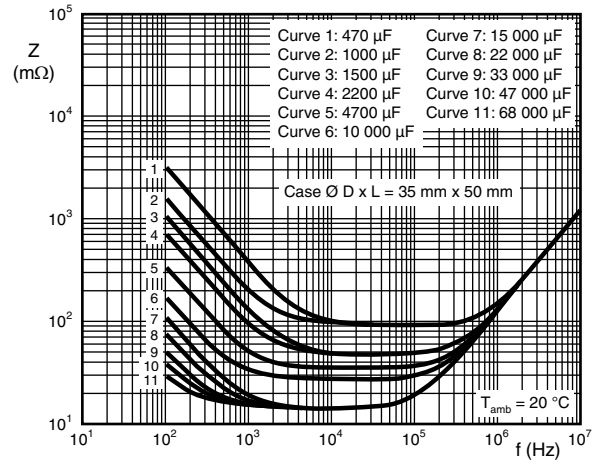
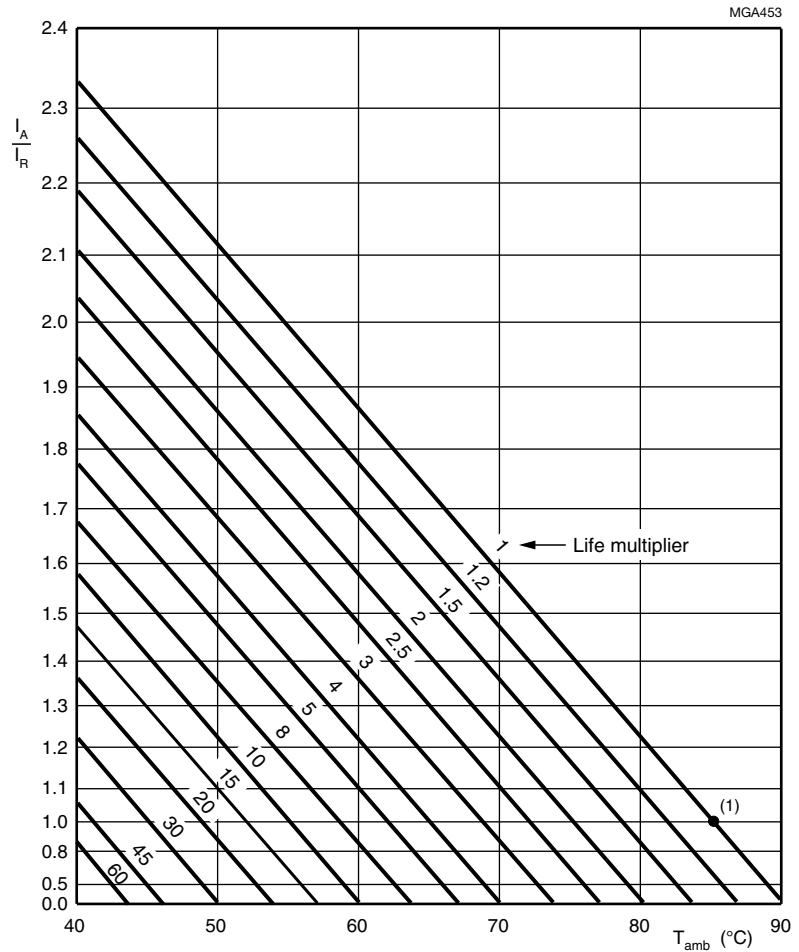


Fig. 17 - Typical impedance as a function of frequency

RIPPLE CURRENT AND USEFUL LIFE



I_A = actual ripple current at 100 Hz and 85 $^{\circ}\text{C}$
 I_R = rated ripple current at 100 Hz and 85 $^{\circ}\text{C}$

(1) Useful life at 85 $^{\circ}\text{C}$ and I_R applied:
 12 000 h (450 V types: 5000 h)

Fig. 18 - 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 | $\geq 10\ 000$ |
| | I_R MULTIPLIER | | | | | | | |
| 10 | 0.93 | 1.00 | 1.04 | 1.07 | 1.11 | 1.13 | 1.15 | 1.18 |
| 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 |
| 63 | 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 |
| 200 | 0.86 | 1.00 | 1.13 | 1.21 | 1.29 | 1.32 | 1.35 | 1.40 |
| 250 | 0.86 | 1.00 | 1.13 | 1.21 | 1.29 | 1.32 | 1.35 | 1.40 |
| 385 | 0.86 | 1.00 | 1.13 | 1.21 | 1.29 | 1.32 | 1.35 | 1.40 |
| 400 | 0.86 | 1.00 | 1.13 | 1.21 | 1.29 | 1.32 | 1.35 | 1.40 |
| 450 | 0.86 | 1.00 | 1.13 | 1.21 | 1.29 | 1.32 | 1.35 | 1.40 |

Table 5

| ENDURANCE TEST DURATION AND USEFUL LIFE | | |
|--|---------------------------|-----------------------------|
| U_R (V) | ENDURANCE AT 85 °C (h) | USEFUL LIFE AT 85 °C (h) |
| 10 | 5000 | 12 000 |
| 16 | 5000 | 12 000 |
| 25 | 5000 | 12 000 |
| 40 | 5000 | 12 000 |
| 63 | 5000 | 12 000 |
| 100 | 5000 | 12 000 |
| 200 | 5000 | 12 000 |
| 250 | 5000 | 12 000 |
| 385 | 5000 | 12 000 |
| 400 | 5000 | 12 000 |
| 450 | 2000 | 5000 |

Note

- Multiplier of useful life code: MGA453

Table 6

| TEST PROCEDURES AND REQUIREMENTS | | | |
|--|---|--|--|
| TEST | | PROCEDURE (quick reference) | REQUIREMENTS |
| NAME OF TEST | REFERENCE | | |
| Endurance | IEC 60384-4 / EN130300 subclause 4.13 | $T_{amb} = 85\ ^\circ\text{C}$; U_R applied; 5000 h (450 V types: 2000 h) | $U_R \leq 100\ \text{V}$; $\Delta\text{C}/\text{C}: \pm 15\ \%$ $U_R > 100\ \text{V}$; $\Delta\text{C}/\text{C}: \pm 10\ \%$ $\text{ESR} \leq 1.3 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ |
| Useful life | CECC 30301 subclause 1.8.1 | $T_{amb} = 85\ ^\circ\text{C}$; U_R and I_R applied; 12 000 h (450 V types: 5000 h) | $U_R \leq 100\ \text{V}$; $\Delta\text{C}/\text{C}: \pm 45\ \%$ $U_R > 100\ \text{V}$; $\Delta\text{C}/\text{C}: \pm 30\ \%$ $\text{ESR} \leq 3 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit, no visible damage total failure percentage: $U_R \leq 100\ \text{V}$; $\leq 1\ \%$ $U_R > 100\ \text{V}$; $\leq 3\ \%$ |
| Shelf life (storage at high temperature) | IEC 60384-4 / EN130300 subclause 4.17 | $T_{amb} = 85\ ^\circ\text{C}$; no voltage applied; 500 h after test: U_R to be applied for 30 min, 24 h to 48 h before measurement | $\Delta\text{C}/\text{C}: \pm 10\ \%$ $\text{ESR} \leq 1.2 \times \text{spec. limit}$ $I_{L5} \leq 2 \times \text{spec. limit}$ |

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.



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.