

## Aluminum Capacitors Axial High Temperature

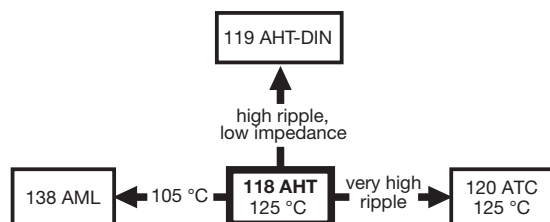


Fig. 1


**RoHS**  
COMPLIANT

### FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Axial leads, cylindrical aluminum case, insulated with a blue sleeve
- Mounting ring version not available in insulated form
- Taped versions up to case Ø 15 mm x 30 mm available for automatic insertion
- Charge and discharge proof
- Extra long useful life: Up to 8000 h at 125 °C, high reliability
- Extended temperature range: 125 °C (usable up to 150 °C)
- Miniaturized, high CV-product per unit volume
- Material categorization: For definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)

### APPLICATIONS

- Automotive, industrial and telecommunication
- Smoothing, filtering, coupling, decoupling, timing
- For use after very long storage (10 years) without voltage applied
- Portable and mobile equipment (small size, low mass)
- Low mounting height boards, vibration and shock resistant
- Outdoor applications, e.g. aerial amplifiers

### MARKING

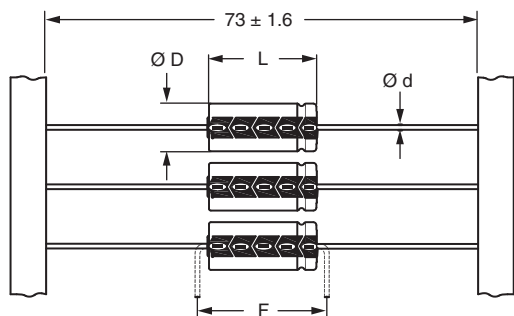
The capacitors are marked (where possible) with the following information:

- Rated capacitance (in µF)
- Tolerance on rated capacitance, code letter in accordance with IEC 60062 (M for ± 20 %)
- Rated voltage (in V) at 125 °C and 85 °C
- Date code, in accordance with IEC 60062
- Code indicating factory of origin
- Name of manufacturer
- Negative terminal identification
- Series number (118)

| QUICK REFERENCE DATA                                                                             |                        |                        |
|--------------------------------------------------------------------------------------------------|------------------------|------------------------|
| DESCRIPTION                                                                                      | VALUE                  |                        |
| Nominal case sizes<br>(Ø D x L in mm)                                                            | 6.5 x 18<br>to 10 x 25 | 10 x 30<br>to 21 x 38  |
| Rated capacitance range, C <sub>R</sub>                                                          | 1 µF to 10 000 µF      |                        |
| Tolerance on C <sub>R</sub>                                                                      | ± 20 %                 |                        |
| Rated voltage range, U <sub>R</sub>                                                              | 6.3 V to 200 V         |                        |
| Category temperature range                                                                       | - 40 °C to<br>+ 125 °C | - 55 °C to<br>+ 125 °C |
| Endurance test at 150 °C<br>(6.3 V to 100 V)                                                     | 500 h                  | 500 h                  |
| Endurance test at 125 °C                                                                         | 2000 h                 | 3000 h                 |
| Useful life at 125 °C                                                                            | 4000 h                 | 8000 h                 |
| Useful life at 40 °C,<br>1.8 x I <sub>R</sub> applied                                            | 500 000 h              | 1 000 000 h            |
| Shelf life at 0 V, 125 °C:<br>U <sub>R</sub> = 6.3 V to 63 V<br>U <sub>R</sub> = 100 V and 200 V | 500 h<br>100 h         |                        |
| Based on sectional<br>specification                                                              | IEC 60384-4/EN130300   |                        |
| Climatic category IEC 60068                                                                      | 40/125/56              | 55/125/56              |

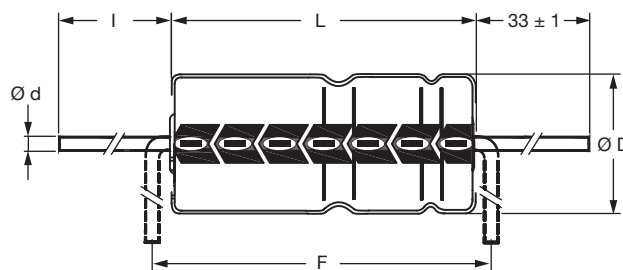
| <b>SELECTION CHART FOR <math>C_R</math>, <math>U_R</math>, AND RELEVANT NOMINAL CASE SIZES (<math>\varnothing D \times L</math> in mm)</b> |           |           |           |           |           |           |           |           |
|--------------------------------------------------------------------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| $C_R$<br>( $\mu F$ )                                                                                                                       | $U_R$ (V) |           |           |           |           |           |           |           |
|                                                                                                                                            | 6.3       | 10        | 16        | 25        | 40        | 63        | 100       | 200       |
| 1.0                                                                                                                                        | -         | -         | -         | -         | -         | 6.5 x 18  | -         | -         |
| 2.2                                                                                                                                        | -         | -         | -         | -         | -         | 6.5 x 18  | -         | 6.5 x 18  |
| 4.7                                                                                                                                        | -         | -         | -         | -         | -         | 6.5 x 18  | 6.5 x 18  | 8 x 18    |
| 10                                                                                                                                         | -         | -         | -         | -         | -         | 6.5 x 18  | 6.5 x 18  | 10 x 25   |
| 15                                                                                                                                         | -         | -         | -         | -         | -         | -         | -         | 10 x 30   |
| 22                                                                                                                                         | -         | -         | -         | -         | -         | 6.5 x 18  | 8 x 18    | 12.5 x 30 |
| 33                                                                                                                                         | -         | -         | -         | -         | -         | -         | 10 x 25   | 15 x 30   |
| 47                                                                                                                                         | -         | -         | -         | -         | 6.5 x 18  | 8 x 18    | 10 x 25   | 18 x 30   |
|                                                                                                                                            | -         | -         | -         | -         | -         | -         | 10 x 30   | -         |
| 68                                                                                                                                         | -         | -         | -         | -         | -         | -         | 12.5 x 30 | 18 x 38   |
| 100                                                                                                                                        | -         | -         | -         | 6.5 x 18  | 8 x 18    | 10 x 25   | 12.5 x 30 | 21 x 38   |
|                                                                                                                                            | -         | -         | -         | -         | -         | 10 x 30   | -         | -         |
| 150                                                                                                                                        | -         | -         | -         | -         | 10 x 18   | 12.5 x 30 | 15 x 30   | -         |
| 220                                                                                                                                        | -         | 6.5 x 18  | 8 x 18    | 10 x 18   | 10 x 25   | 12.5 x 30 | 18 x 30   | -         |
|                                                                                                                                            | -         | -         | -         | -         | 10 x 30   | -         | -         | -         |
| 330                                                                                                                                        | -         | 8 x 18    | 10 x 18   | 10 x 25   | 12.5 x 30 | 15 x 30   | 18 x 38   | -         |
| 470                                                                                                                                        | -         | 8 x 18    | 10 x 18   | 10 x 25   | 12.5 x 30 | 18 x 30   | 21 x 38   | -         |
|                                                                                                                                            | -         | -         | -         | 10 x 30   | -         | -         | -         | -         |
| 680                                                                                                                                        | -         | -         | 10 x 30   | 12.5 x 30 | 15 x 30   | 18 x 38   | -         | -         |
| 1000                                                                                                                                       | 10 x 18   | 10 x 25   | 12.5 x 30 | 12.5 x 30 | 18 x 30   | 21 x 38   | -         | -         |
|                                                                                                                                            | -         | 10 x 30   | -         | -         | -         | -         | -         | -         |
| 1500                                                                                                                                       | 10 x 25   | 12.5 x 30 | 12.5 x 30 | 15 x 30   | 18 x 38   | -         | -         | -         |
| 2200                                                                                                                                       | -         | 12.5 x 30 | 15 x 30   | 18 x 30   | 21 x 38   | -         | -         | -         |
| 3300                                                                                                                                       | -         | 15 x 30   | 18 x 30   | 18 x 38   | -         | -         | -         | -         |
| 4700                                                                                                                                       | -         | 18 x 30   | 18 x 38   | 21 x 38   | -         | -         | -         | -         |
| 6800                                                                                                                                       | -         | 18 x 38   | 21 x 38   | -         | -         | -         | -         | -         |
| 10 000                                                                                                                                     | -         | 21 x 38   | -         | -         | -         | -         | -         | -         |

## DIMENSIONS in millimeters AND AVAILABLE FORMS



**Form BR:** Taped on reel  
Case  $\varnothing D \times L = 6.5 \text{ mm} \times 18 \text{ mm}$  to  $15 \text{ mm} \times 30 \text{ mm}$   
**Form BA:** Taped in box (ammopack)  
Case  $\varnothing D \times L = 6.5 \text{ mm} \times 18 \text{ mm}$  to  $10 \text{ mm} \times 25 \text{ mm}$

Fig. 2 - Forms BA and BR



**Form AA:** Axial in box  
Case  $\varnothing D \times L = 10 \text{ mm} \times 30 \text{ mm}$  to  $21 \text{ mm} \times 38 \text{ mm}$

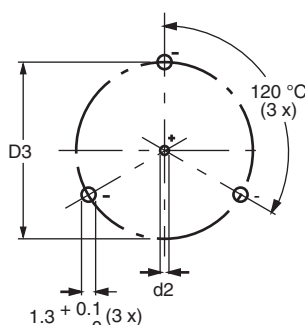
Fig. 3 - Form AA

**Table 1**

| <b>AXIAL; DIMENSIONS in millimeters, MASS AND PACKAGING QUANTITIES</b> |           |                           |        |                     |                   |                   |          |                      |         |         |
|------------------------------------------------------------------------|-----------|---------------------------|--------|---------------------|-------------------|-------------------|----------|----------------------|---------|---------|
| NOMINAL CASE SIZE<br>Ø D x L                                           | CASE CODE | AXIAL: FORM AA, BA AND BR |        |                     |                   |                   | MASS (g) | PACKAGING QUANTITIES |         |         |
|                                                                        |           | Ø d                       | l      | Ø D <sub>max.</sub> | L <sub>max.</sub> | F <sub>min.</sub> |          | FORM AA              | FORM BA | FORM BR |
| 6.5 x 18                                                               | 4         | 0.8                       | -      | 6.9                 | 18.5              | 25                | 1.3      | -                    | 1000    | 1000    |
| 8 x 18                                                                 | 5         | 0.8                       | -      | 8.5                 | 18.5              | 25                | 1.7      | -                    | 500     | 500     |
| 10 x 18                                                                | 6         | 0.8                       | -      | 10.5                | 18.5              | 25                | 2.5      | -                    | 500     | 500     |
| 10 x 25                                                                | 7         | 0.8                       | -      | 10.5                | 25.5              | 30                | 3.3      | -                    | 500     | 500     |
| 10 x 30                                                                | 0         | 0.8                       | 55 ± 1 | 10.5                | 30.5              | 35                | 4.8      | 340                  | -       | 500     |
| 12.5 x 30                                                              | 1         | 0.8                       | 55 ± 1 | 13.0                | 30.5              | 35                | 7.4      | 260                  | -       | 400     |
| 15 x 30                                                                | 2         | 0.8                       | 55 ± 1 | 15.5                | 30.5              | 35                | 11.7     | 200                  | -       | 250     |
| 18 x 30                                                                | 3         | 0.8                       | 55 ± 1 | 18.5                | 30.5              | 35                | 12.9     | 120                  | -       | -       |
| 18 x 38                                                                | 4         | 0.8                       | 55 ± 1 | 18.5                | 39.5              | 44                | 19       | 125                  | -       | -       |
| 21 x 38                                                                | 5         | 0.8                       | 55 ± 1 | 21.5                | 39.5              | 44                | 24       | 100                  | -       | -       |

**Note**

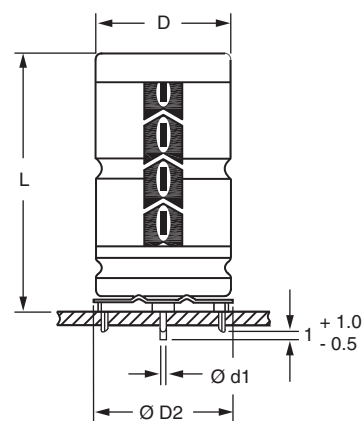
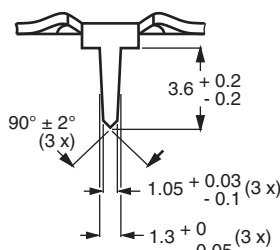
- Detailed tape dimensions see section “Packaging”.



Mounting holes

Case Ø D x L = 15 mm x 30 mm to 21 mm x 38 mm

Especially for applications with severe shocks and vibrations


Fig. 4 - Mounting hole diagram and outline; **Form MR:** With mounting ring and pins

| <b>MOUNTING RING; DIMENSIONS in millimeters, MASS AND PACKAGING QUANTITIES</b> |           |                        |           |                     |                      |            |                   |          |                      |
|--------------------------------------------------------------------------------|-----------|------------------------|-----------|---------------------|----------------------|------------|-------------------|----------|----------------------|
| NOMINAL CASE SIZE<br>Ø D x L                                                   | CASE CODE | MOUNTING RING: FORM MR |           |                     |                      |            |                   | MASS (g) | PACKAGING QUANTITIES |
|                                                                                |           | Ø d1                   | Ø d2      | Ø D <sub>max.</sub> | Ø D2 <sub>max.</sub> | D3         | L <sub>max.</sub> |          |                      |
| 15 x 30                                                                        | 2         | 0.8                    | 1.0 + 0.4 | 15.5                | 17.5                 | 16.5 ± 0.2 | 33                | ≈ 8.6    | 200                  |
| 18 x 30                                                                        | 3         | 0.8                    | 1.0 + 0.4 | 18.5                | 19.5                 | 18.5 ± 0.2 | 33                | ≈ 11.5   | 240                  |
| 18 x 38                                                                        | 4         | 0.8                    | 1.0 + 0.4 | 18.5                | 19.5                 | 18.5 ± 0.2 | 42                | ≈ 14.0   | 100                  |
| 21 x 38                                                                        | 5         | 0.8                    | 1.0 + 0.4 | 21.5                | 22.5                 | 21.5 ± 0.2 | 42                | ≈ 19.0   | 100                  |

| <b>ELECTRICAL DATA</b> |                                                                                                    |
|------------------------|----------------------------------------------------------------------------------------------------|
| SYMBOL                 | DESCRIPTION                                                                                        |
| C <sub>R</sub>         | Rated capacitance at 100 Hz, tolerance ± 20 %                                                      |
| I <sub>R</sub>         | Rated RMS ripple current at 100 Hz, 125 °C                                                         |
| I <sub>L1</sub>        | Max. leakage current after 1 min at U <sub>R</sub>                                                 |
| I <sub>L5</sub>        | Max. leakage current after 5 min at U <sub>R</sub>                                                 |
| tan δ                  | Max. dissipation factor at 100 Hz                                                                  |
| ESR                    | Equivalent series resistance at 100 Hz (calculated from tan δ <sub>max.</sub> and C <sub>R</sub> ) |
| Z                      | Max. impedance at 10 kHz                                                                           |

**Note**

- Unless otherwise specified, all electrical values in Table 2 apply at T<sub>amb</sub> = 20 °C, P = 86 kPa to 106 kPa, RH = 45 % to 75 %.

**ORDERING EXAMPLE**

Electrolytic capacitor 118 series

1000 µF/10 V; ± 20 %

Nominal case size: Ø 10 mm x 30 mm; Form BR

Ordering code: MAL211824102E3

Former 12NC: 2222 118 24102



Table 2

| ELECTRICAL DATA AND ORDERING INFORMATION |                                  |                                         |              |                                            |                                  |                                  |                 |                      |                    |                            |                             |                            |                             |
|------------------------------------------|----------------------------------|-----------------------------------------|--------------|--------------------------------------------|----------------------------------|----------------------------------|-----------------|----------------------|--------------------|----------------------------|-----------------------------|----------------------------|-----------------------------|
| U <sub>R</sub><br>(V)                    | C <sub>R</sub><br>100 Hz<br>(μF) | NOMINAL<br>CASE SIZE<br>Ø D x L<br>(mm) | CASE<br>CODE | I <sub>R</sub><br>100 Hz<br>125 °C<br>(mA) | I <sub>L1</sub><br>1 min<br>(μA) | I <sub>L5</sub><br>5 min<br>(μA) | tan δ<br>100 Hz | ESR<br>100 Hz<br>(Ω) | Z<br>10 kHz<br>(Ω) | ORDERING CODE MAL2118..... |                             |                            |                             |
|                                          |                                  |                                         |              |                                            |                                  |                                  |                 |                      |                    | IN BOX<br>FORM AA          | TAPED<br>ON REEL<br>FORM BR | TAPED<br>IN BOX<br>FORM BA | MOUNTING<br>RING<br>FORM MR |
| 6.3                                      | 1000                             | 10 x 18                                 | 6            | 251                                        | 42                               | 17                               | 0.50            | 0.790                | 0.80               | -                          | 23102E3                     | 33102E3                    | -                           |
|                                          | 1500                             | 10 x 25                                 | 7            | 352                                        | 61                               | 23                               | 0.50            | 0.530                | 0.53               | -                          | 90502E3                     | 90503E3                    | -                           |
| 10                                       | 220                              | 6.5 x 18                                | 4            | 109                                        | 20                               | 8.4                              | 0.35            | 2.530                | 2.10               | -                          | 24221E3                     | 34221E3                    | -                           |
|                                          | 330                              | 8 x 18                                  | 5            | 150                                        | 24                               | 11                               | 0.35            | 1.690                | 1.40               | -                          | 24331E3                     | 34331E3                    | -                           |
|                                          | 470                              | 8 x 18                                  | 5            | 179                                        | 32                               | 13                               | 0.35            | 1.190                | 1.00               | -                          | 24471E3                     | 34471E3                    | -                           |
|                                          | 1000                             | 10 x 25                                 | 7            | 343                                        | 64                               | 24                               | 0.35            | 0.560                | 0.55               | -                          | 90504E3                     | 90505E3                    | -                           |
|                                          | 1000                             | 10 x 30                                 | 00           | 550                                        | 64                               | 24                               | 0.32            | 0.505                | 0.45               | 14102E3                    | 24102E3                     | -                          | -                           |
|                                          | 1500                             | 12.5 x 30                               | 01           | 740                                        | 94                               | 34                               | 0.32            | 0.340                | 0.28               | 14152E3                    | 24152E3                     | -                          | -                           |
|                                          | 2200                             | 12.5 x 30                               | 01           | 830                                        | 136                              | 48                               | 0.40            | 0.290                | 0.27               | 14222E3                    | 24222E3                     | -                          | -                           |
|                                          | 3300                             | 15 x 30                                 | 02           | 1070                                       | 202                              | 70                               | 0.40            | 0.190                | 0.18               | 14332E3                    | 24332E3                     | -                          | 44332E3                     |
|                                          | 4700                             | 18 x 30                                 | 03           | 1350                                       | 286                              | 98                               | 0.46            | 0.155                | 0.15               | 14472E3                    | -                           | -                          | 44472E3                     |
|                                          | 6800                             | 18 x 38                                 | 04           | 1730                                       | 412                              | 140                              | 0.53            | 0.100                | 0.10               | 14682E3                    | -                           | -                          | 44682E3                     |
|                                          | 10 000                           | 21 x 38                                 | 05           | 1860                                       | 604                              | 200                              | 0.53            | 0.084                | 0.10               | 14103E3                    | -                           | -                          | 44103E3                     |
| 16                                       | 220                              | 8 x 18                                  | 5            | 145                                        | 25                               | 11                               | 0.25            | 1.810                | 1.50               | -                          | 25221E3                     | 35221E3                    | -                           |
|                                          | 330                              | 10 x 18                                 | 6            | 204                                        | 36                               | 15                               | 0.25            | 1.210                | 1.20               | -                          | 25331E3                     | 35331E3                    | -                           |
|                                          | 470                              | 10 x 18                                 | 6            | 243                                        | 49                               | 19                               | 0.25            | 0.850                | 0.83               | -                          | 25471E3                     | 35471E3                    | -                           |
|                                          | 680                              | 10 x 30                                 | 00           | 510                                        | 69                               | 30                               | 0.22            | 0.525                | 0.45               | 15681E3                    | 25681E3                     | -                          | -                           |
|                                          | 1000                             | 12.5 x 30                               | 01           | 720                                        | 100                              | 36                               | 0.22            | 0.345                | 0.28               | 15102E3                    | 25102E3                     | -                          | -                           |
|                                          | 1500                             | 12.5 x 30                               | 01           | 790                                        | 148                              | 52                               | 0.29            | 0.305                | 0.27               | 15152E3                    | 25152E3                     | -                          | -                           |
|                                          | 2200                             | 15 x 30                                 | 02           | 1010                                       | 215                              | 74                               | 0.29            | 0.205                | 0.18               | 15222E3                    | 25222E3                     | -                          | 45222E3                     |
|                                          | 3300                             | 18 x 30                                 | 03           | 1300                                       | 321                              | 110                              | 0.34            | 0.165                | 0.15               | 15332E3                    | -                           | -                          | 45332E3                     |
|                                          | 4700                             | 18 x 38                                 | 04           | 1670                                       | 455                              | 150                              | 0.34            | 0.105                | 0.10               | 15472E3                    | -                           | -                          | 45472E3                     |
|                                          | 6800                             | 21 x 38                                 | 05           | 1790                                       | 657                              | 220                              | 0.38            | 0.088                | 0.10               | 15682E3                    | -                           | -                          | 45682E3                     |
| 25                                       | 100                              | 6.5 x 18                                | 4            | 102                                        | 20                               | 9                                | 0.18            | 2.860                | 2.30               | -                          | 26101E3                     | 36101E3                    | -                           |
|                                          | 220                              | 10 x 18                                 | 6            | 196                                        | 37                               | 15                               | 0.18            | 1.300                | 1.25               | -                          | 26221E3                     | 36221E3                    | -                           |
|                                          | 330                              | 10 x 25                                 | 7            | 274                                        | 54                               | 21                               | 0.18            | 0.870                | 0.82               | -                          | 26331E3                     | 36331E3                    | -                           |
|                                          | 470                              | 10 x 25                                 | 7            | 327                                        | 75                               | 28                               | 0.18            | 0.610                | 0.57               | -                          | 90508E3                     | 90509E3                    | -                           |
|                                          | 470                              | 10 x 30                                 | 00           | 490                                        | 75                               | 28                               | 0.18            | 0.610                | 0.50               | 16471E3                    | 26471E3                     | -                          | -                           |
|                                          | 680                              | 12.5 x 30                               | 01           | 680                                        | 106                              | 38                               | 0.18            | 0.420                | 0.30               | 16681E3                    | 26681E3                     | -                          | -                           |
|                                          | 1000                             | 12.5 x 30                               | 01           | 760                                        | 154                              | 54                               | 0.24            | 0.375                | 0.28               | 16102E3                    | 26102E3                     | -                          | -                           |
|                                          | 1500                             | 15 x 30                                 | 02           | 980                                        | 229                              | 79                               | 0.25            | 0.263                | 0.22               | 16152E3                    | 26152E3                     | -                          | 46152E3                     |
|                                          | 2200                             | 18 x 30                                 | 03           | 1240                                       | 334                              | 110                              | 0.26            | 0.185                | 0.17               | 16222E3                    | -                           | -                          | 46222E3                     |
|                                          | 3300                             | 18 x 38                                 | 04           | 1610                                       | 499                              | 170                              | 0.26            | 0.120                | 0.11               | 16332E3                    | -                           | -                          | 46332E3                     |
|                                          | 4700                             | 21 x 38                                 | 05           | 1710                                       | 709                              | 240                              | 0.28            | 0.095                | 0.10               | 16472E3                    | -                           | -                          | 46472E3                     |
|                                          |                                  |                                         |              |                                            |                                  |                                  |                 |                      |                    |                            |                             |                            |                             |
| 40                                       | 47                               | 6.5 x 18                                | 4            | 89.8                                       | 20                               | 7.8                              | 0.11            | 3.720                | 2.80               | -                          | 27479E3                     | 37479E3                    | -                           |
|                                          | 100                              | 8 x 18                                  | 5            | 147                                        | 28                               | 12                               | 0.11            | 1.750                | 1.30               | -                          | 27101E3                     | 37101E3                    | -                           |
|                                          | 150                              | 10 x 18                                 | 6            | 207                                        | 40                               | 16                               | 0.11            | 1.170                | 1.00               | -                          | 27151E3                     | 37151E3                    | -                           |
|                                          | 220                              | 10 x 25                                 | 7            | 287                                        | 57                               | 22                               | 0.11            | 0.800                | 0.68               | -                          | 90511E3                     | 90512E3                    | -                           |
|                                          | 220                              | 10 x 30                                 | 00           | 390                                        | 57                               | 22                               | 0.10            | 0.700                | 0.55               | 17221E3                    | 27221E3                     | -                          | -                           |
|                                          | 330                              | 12.5 x 30                               | 01           | 570                                        | 83                               | 30                               | 0.10            | 0.430                | 0.33               | 17331E3                    | 27331E3                     | -                          | -                           |
|                                          | 470                              | 12.5 x 30                               | 01           | 620                                        | 117                              | 42                               | 0.11            | 0.380                | 0.30               | 17471E3                    | 27471E3                     | -                          | -                           |
|                                          | 680                              | 15 x 30                                 | 02           | 810                                        | 167                              | 58                               | 0.11            | 0.255                | 0.23               | 17681E3                    | 27681E3                     | -                          | 47681E3                     |
|                                          | 1000                             | 18 x 30                                 | 03           | 1070                                       | 244                              | 84                               | 0.13            | 0.205                | 0.18               | 17102E3                    | -                           | -                          | 47102E3                     |
|                                          | 1500                             | 18 x 38                                 | 04           | 1390                                       | 364                              | 120                              | 0.13            | 0.130                | 0.11               | 17152E3                    | -                           | -                          | 47152E3                     |
|                                          | 2200                             | 21 x 38                                 | 05           | 1540                                       | 532                              | 180                              | 0.15            | 0.105                | 0.10               | 17222E3                    | -                           | -                          | 47222E3                     |
|                                          |                                  |                                         |              |                                            |                                  |                                  |                 |                      |                    |                            |                             |                            |                             |



| ELECTRICAL DATA AND ORDERING INFORMATION |                                  |                                         |              |                                            |                                  |                                  |                 |                      |                    |                            |                             |                            |                             |
|------------------------------------------|----------------------------------|-----------------------------------------|--------------|--------------------------------------------|----------------------------------|----------------------------------|-----------------|----------------------|--------------------|----------------------------|-----------------------------|----------------------------|-----------------------------|
| U <sub>R</sub><br>(V)                    | C <sub>R</sub><br>100 Hz<br>(μF) | NOMINAL<br>CASE SIZE<br>Ø D x L<br>(mm) | CASE<br>CODE | I <sub>R</sub><br>100 Hz<br>125 °C<br>(mA) | I <sub>L1</sub><br>1 min<br>(μA) | I <sub>L5</sub><br>5 min<br>(μA) | tan δ<br>100 Hz | ESR<br>100 Hz<br>(Ω) | Z<br>10 kHz<br>(Ω) | ORDERING CODE MAL2118..... |                             |                            |                             |
|                                          |                                  |                                         |              |                                            |                                  |                                  |                 |                      |                    | IN BOX<br>FORM AA          | TAPED<br>ON REEL<br>FORM BR | TAPED<br>IN BOX<br>FORM BA | MOUNTING<br>RING<br>FORM MR |
| 63                                       | 1.0                              | 6.5 x 18                                | 4            | 16.4                                       | 20                               | 4.1                              | 0.07            | 110                  | 22.0               | -                          | 28108E3                     | 38108E3                    | -                           |
|                                          | 2.2                              | 6.5 x 18                                | 4            | 24.3                                       | 20                               | 4.3                              | 0.07            | 51.0                 | 15.0               | -                          | 28228E3                     | 38228E3                    | -                           |
|                                          | 4.7                              | 6.5 x 18                                | 4            | 35.6                                       | 20                               | 4.6                              | 0.07            | 24.0                 | 8.90               | -                          | 28478E3                     | 38478E3                    | -                           |
|                                          | 10                               | 6.5 x 18                                | 4            | 51.9                                       | 20                               | 5.3                              | 0.07            | 11.0                 | 5.60               | -                          | 28109E3                     | 38109E3                    | -                           |
|                                          | 22                               | 6.5 x 18                                | 4            | 77.0                                       | 20                               | 6.8                              | 0.07            | 5.10                 | 3.20               | -                          | 28229E3                     | 38229E3                    | -                           |
|                                          | 47                               | 8 x 18                                  | 5            | 126                                        | 22                               | 9.9                              | 0.07            | 2.40                 | 1.50               | -                          | 28479E3                     | 38479E3                    | -                           |
|                                          | 100                              | 10 x 25                                 | 7            | 243                                        | 42                               | 17                               | 0.07            | 1.10                 | 0.70               | -                          | 90513E3                     | 90514E3                    | -                           |
|                                          | 100                              | 10 x 30                                 | 00           | 340                                        | 42                               | 17                               | 0.07            | 1.91                 | 1.62               | 18101E3                    | 28101E3                     | -                          | -                           |
|                                          | 150                              | 12.5 x 30                               | 01           | 490                                        | 61                               | 23                               | 0.07            | 1.00                 | 0.79               | 18151E3                    | 28151E3                     | -                          | -                           |
|                                          | 220                              | 12.5 x 30                               | 01           | 550                                        | 87                               | 32                               | 0.08            | 0.94                 | 0.82               | 18221E3                    | 28221E3                     | -                          | -                           |
|                                          | 330                              | 15 x 30                                 | 02           | 730                                        | 129                              | 46                               | 0.09            | 0.63                 | 0.56               | 18331E3                    | 28331E3                     | -                          | 48331E3                     |
|                                          | 470                              | 18 x 30                                 | 03           | 970                                        | 182                              | 63                               | 0.09            | 0.44                 | 0.39               | 18471E3                    | -                           | -                          | 48471E3                     |
|                                          | 680                              | 18 x 38                                 | 04           | 1230                                       | 261                              | 90                               | 0.09            | 0.30                 | 0.26               | 18681E3                    | -                           | -                          | 48681E3                     |
|                                          | 1000                             | 21 x 38                                 | 05           | 1400                                       | 383                              | 130                              | 0.10            | 0.16                 | 0.20               | 18102E3                    | -                           | -                          | 48102E3                     |
| 100                                      | 4.7                              | 6.5 x 18                                | 4            | 36                                         | 20                               | 4.9                              | 0.07            | 24.0                 | 19.0               | -                          | 29478E3                     | 39478E3                    | -                           |
|                                          | 10                               | 6.5 x 18                                | 4            | 52                                         | 20                               | 6.0                              | 0.07            | 11.0                 | 9.00               | -                          | 29109E3                     | 39109E3                    | -                           |
|                                          | 22                               | 8 x 18                                  | 5            | 91                                         | 20                               | 8.4                              | 0.07            | 5.10                 | 4.00               | -                          | 29229E3                     | 39229E3                    | -                           |
|                                          | 33                               | 10 x 25                                 | 7            | 140                                        | 24                               | 11                               | 0.07            | 3.40                 | 2.70               | -                          | 29339E3                     | 39339E3                    | -                           |
|                                          | 47                               | 10 x 25                                 | 7            | 170                                        | 33                               | 13                               | 0.07            | 2.60                 | 2.00               | -                          | 90535E3                     | 90536E3                    | -                           |
|                                          | 47                               | 10 x 30                                 | 00           | 240                                        | 33                               | 13                               | 0.08            | 2.60                 | 2.00               | 19479E3                    | 29479E3                     | -                          | -                           |
|                                          | 68                               | 12.5 x 30                               | 01           | 320                                        | 45                               | 18                               | 0.08            | 1.80                 | 1.20               | 19689E3                    | 29689E3                     | -                          | -                           |
|                                          | 100                              | 12.5 x 30                               | 01           | 380                                        | 64                               | 24                               | 0.09            | 1.40                 | 1.15               | 19101E3                    | 29101E3                     | -                          | -                           |
|                                          | 150                              | 15 x 30                                 | 02           | 500                                        | 94                               | 34                               | 0.10            | 0.94                 | 0.78               | 19151E3                    | 29151E3                     | -                          | 49151E3                     |
|                                          | 220                              | 18 x 30                                 | 03           | 690                                        | 136                              | 48                               | 0.10            | 0.66                 | 0.55               | 19221E3                    | -                           | -                          | 49221E3                     |
|                                          | 330                              | 18 x 38                                 | 04           | 890                                        | 202                              | 70                               | 0.10            | 0.45                 | 0.37               | 19331E3                    | -                           | -                          | 49331E3                     |
|                                          | 470                              | 21 x 38                                 | 05           | 1050                                       | 286                              | 98                               | 0.10            | 0.33                 | 0.28               | 19471E3                    | -                           | -                          | 49471E3                     |
| 200                                      | 2.2                              | 6.5 x 18                                | 4            | 27                                         | 20                               | 4.9                              | 0.06            | 44.0                 | 23.0               | -                          | 90537E3                     | 90538E3                    | -                           |
|                                          | 4.7                              | 8 x 18                                  | 5            | 46                                         | 20                               | 5.9                              | 0.06            | 21.0                 | 11.0               | -                          | 90539E3                     | 90541E3                    | -                           |
|                                          | 10                               | 10 x 25                                 | 7            | 85                                         | 20                               | 8.0                              | 0.06            | 9.40                 | 5.00               | -                          | 90542E3                     | 90543E3                    | -                           |
|                                          | 15                               | 10 x 30                                 | 00           | 150                                        | 22                               | 10                               | 0.046           | 4.76                 | 3.75               | 92159E3                    | 90012E3                     | -                          | -                           |
|                                          | 22                               | 12.5 x 30                               | 01           | 210                                        | 31                               | 13                               | 0.046           | 3.17                 | 2.22               | 92229E3                    | 90013E3                     | -                          | -                           |
|                                          | 33                               | 15 x 30                                 | 02           | 290                                        | 44                               | 17                               | 0.046           | 2.11                 | 1.11               | 92339E3                    | 90014E3                     | -                          | 90002E3                     |
|                                          | 47                               | 18 x 30                                 | 03           | 390                                        | 61                               | 23                               | 0.046           | 1.48                 | 0.60               | 92479E3                    | -                           | -                          | 90003E3                     |
|                                          | 68                               | 18 x 38                                 | 04           | 500                                        | 86                               | 31                               | 0.046           | 1.02                 | 0.42               | 92689E3                    | -                           | -                          | 90004E3                     |
|                                          | 100                              | 21 x 38                                 | 05           | 610                                        | 124                              | 44                               | 0.046           | 0.96                 | 0.39               | 92101E3                    | -                           | -                          | 90005E3                     |

| ADDITIONAL ELECTRICAL DATA         |                      |                                                                                                  |               |
|------------------------------------|----------------------|--------------------------------------------------------------------------------------------------|---------------|
| PARAMETER                          | CONDITIONS           | VALUE                                                                                            |               |
|                                    |                      | AXIAL                                                                                            | MOUNTING RING |
| Voltage                            |                      |                                                                                                  |               |
| Surge voltage                      |                      | $U_s \leq 1.15 \times U_R$                                                                       |               |
| Reverse voltage                    |                      | $U_{rev} \leq 1 \text{ V}$                                                                       |               |
| Current                            |                      |                                                                                                  |               |
| Leakage current                    | After 1 min at $U_R$ | $I_{L1} \leq 0.006 C_R \times U_R + 4 \mu\text{A}$ or $20 \mu\text{A}$<br>(whichever is greater) |               |
|                                    | 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) | Case Ø D x L mm:     |                                                                                                  |               |
|                                    | 6.5 x 18             | Typ. 15 nH                                                                                       | -             |
|                                    | 8 x 18               | Typ. 35 nH                                                                                       | -             |
|                                    | 10 x 18              | Typ. 69 nH                                                                                       | -             |
|                                    | 10 x 25              | Typ. 38 nH                                                                                       | -             |
|                                    | 10 x 30              | Typ. 38 nH                                                                                       | -             |
|                                    | 12.5 x 30            | Typ. 46 nH                                                                                       | -             |
|                                    | 15 x 30              | Typ. 48 nH                                                                                       | Typ. 39 nH    |
|                                    | 18 x 30              | Typ. 50 nH                                                                                       | Typ. 39 nH    |
|                                    | 18 x 38              | Typ. 54 nH                                                                                       | Typ. 39 nH    |
|                                    | 21 x 38              | Typ. 59 nH                                                                                       | Typ. 39 nH    |

Table 3

| UPRATING VALUES AT REDUCED AMBIENT TEMPERATURE |                                                     |        |    |    |    |    |     |     |     |      |
|------------------------------------------------|-----------------------------------------------------|--------|----|----|----|----|-----|-----|-----|------|
| SYMBOL                                         | CONDITIONS                                          | VALUES |    |    |    |    |     |     |     | UNIT |
| $U_R$                                          | $T_{amb} > 85^\circ\text{C}$ to $125^\circ\text{C}$ | 6.3    | 10 | 16 | 25 | 40 | 63  | 100 | 200 | V    |
| $U_{R2}$                                       | $T_{amb} \leq 85^\circ\text{C}$                     | 10     | 16 | 25 | 40 | 63 | 100 | 125 | 250 | V    |

**Note**

- For applications at ambient temperatures of  $\leq 85^\circ\text{C}$ , the rated voltage ( $U_R$ ) may be raised to  $U_{R2}$ .

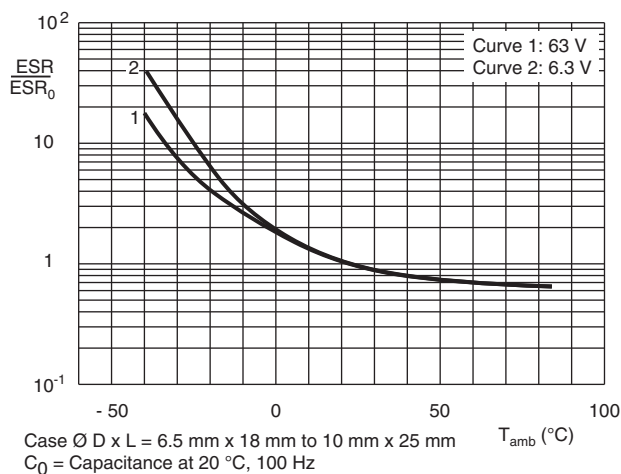
**CAPACITANCE**


Fig. 5 - Typical multiplier of capacitance as a function of ambient temperature

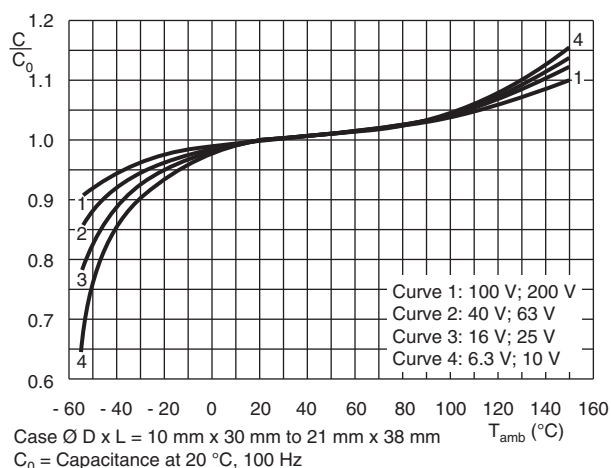


Fig. 6 - Typical multiplier of capacitance as a function of ambient temperature

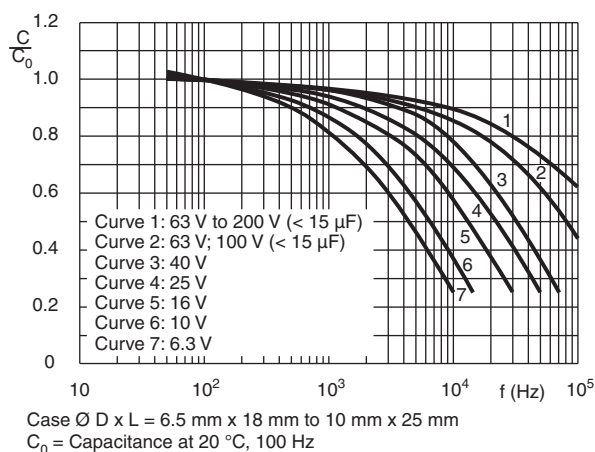


Fig. 7 - Typical multiplier of capacitance as a function of frequency

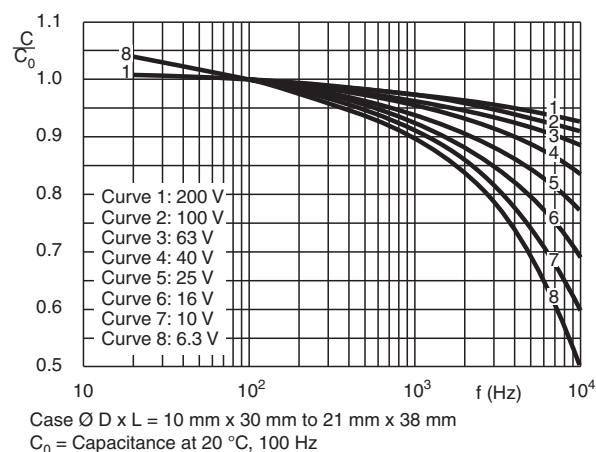


Fig. 8 - Typical multiplier of capacitance as a function of frequency

## EQUIVALENT SERIES RESISTANCE (ESR)

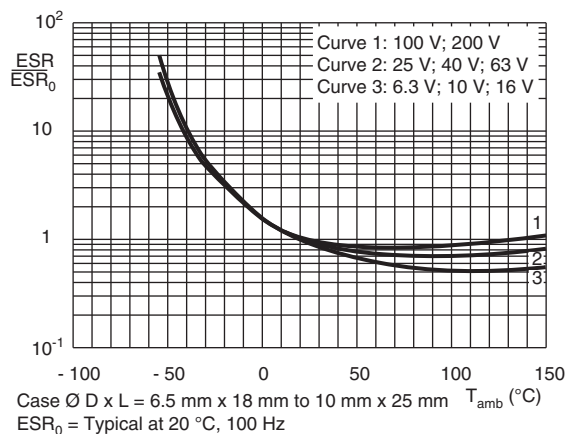


Fig. 9 - Typical multiplier of ESR as a function of ambient temperature

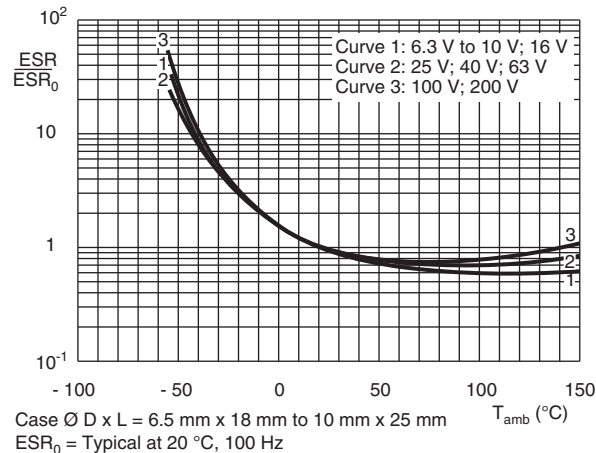


Fig. 10 - Typical multiplier of ESR as a function of ambient temperature

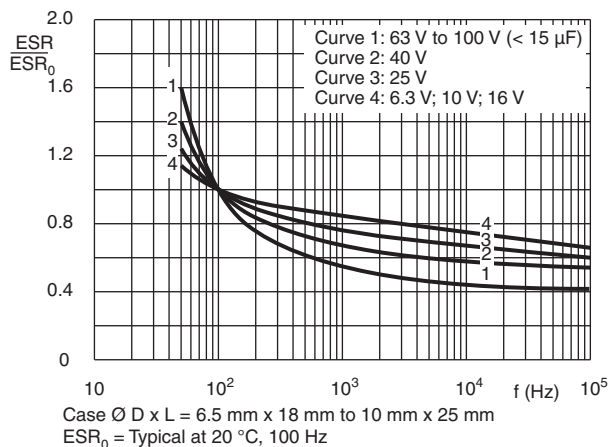


Fig. 11 - Typical multiplier of ESR as a function of frequency

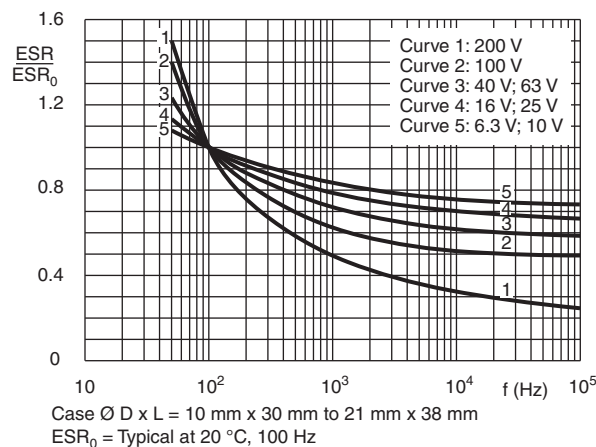


Fig. 12 - Typical multiplier of ESR as a function of frequency

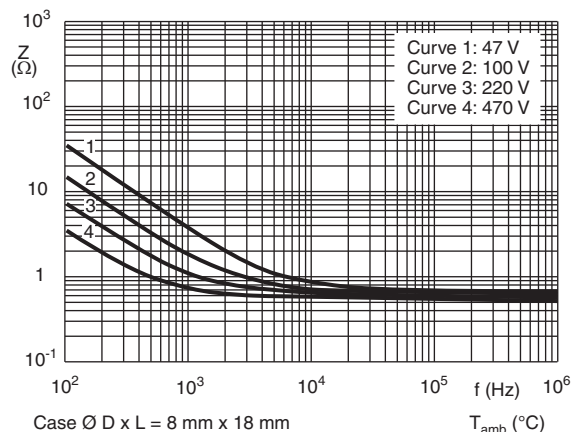
**IMPEDANCE (Z)**


Fig. 13 - Typical impedance as a function of frequency

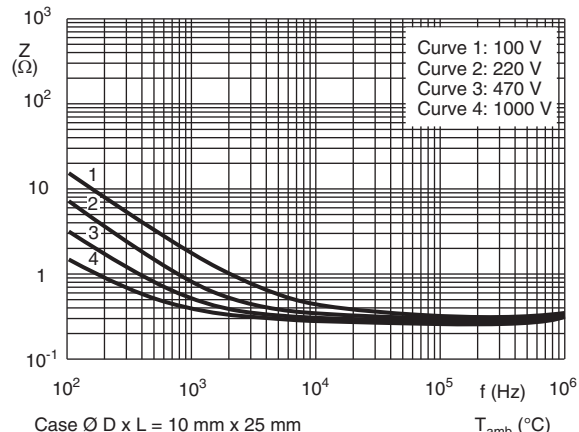


Fig. 14 - Typical impedance as a function of frequency

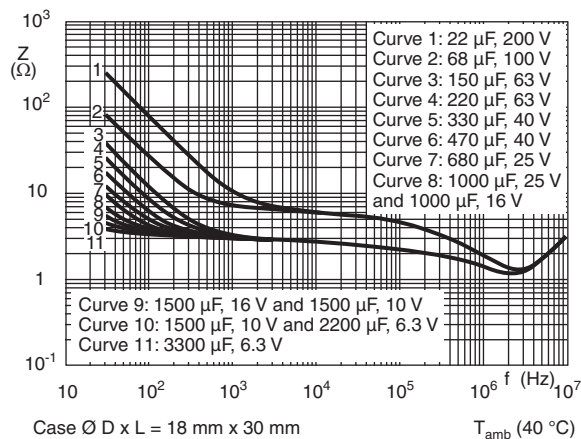


Fig. 15 - Typical impedance as a function of frequency

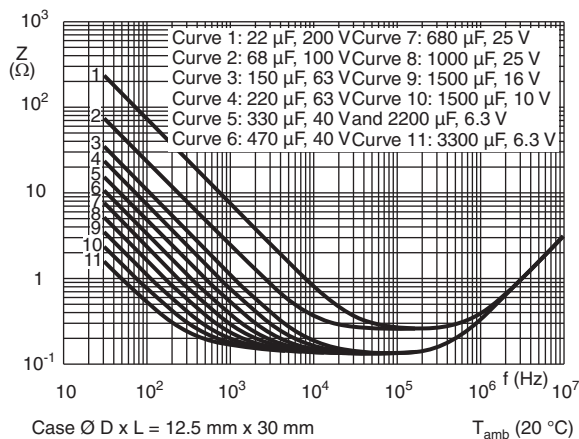


Fig. 16 - Typical impedance as a function of frequency

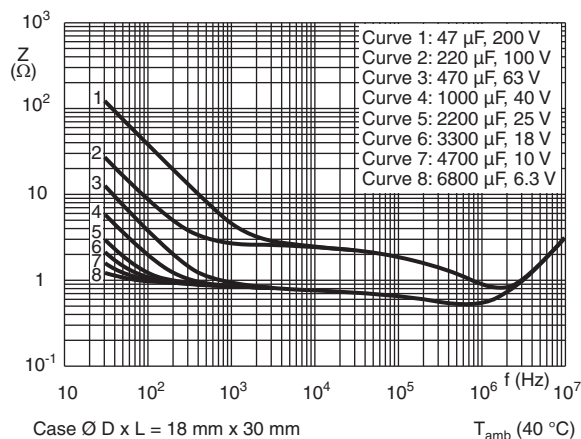


Fig. 17 - Typical impedance as a function of frequency

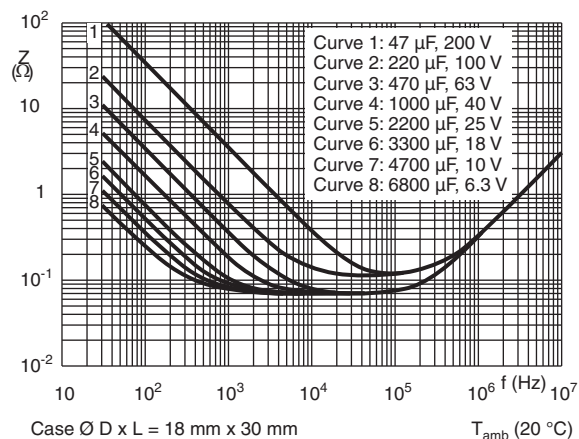


Fig. 18 - Typical impedance as a function of frequency

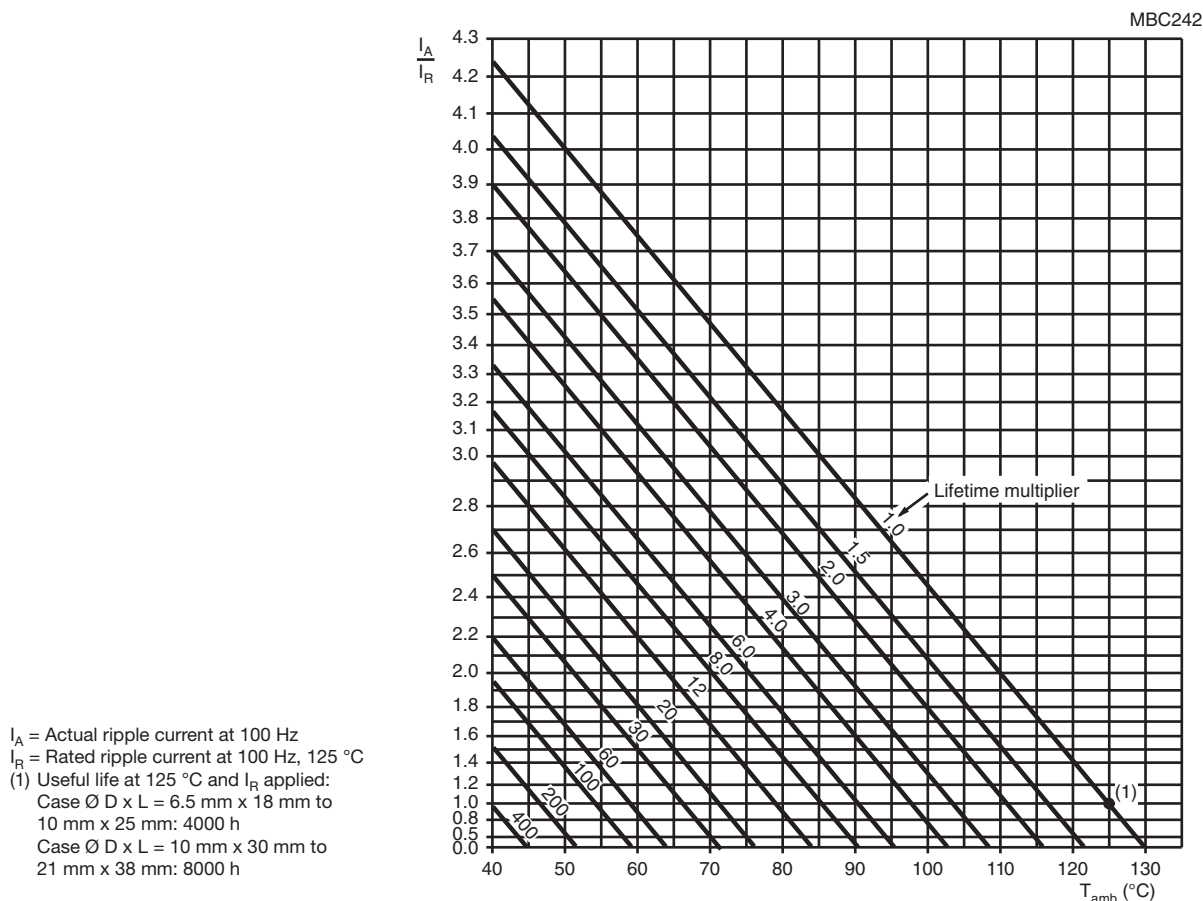
**RIPPLE CURRENT AND USEFUL LIFE**


Fig. 19 - 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<br>(Hz)                                                 | $I_R$ MULTIPLIER                       |                                       |                                         |
|                                                                   | $U_R = 6.3 \text{ V TO } 25 \text{ V}$ | $U_R = 40 \text{ V TO } 63 \text{ V}$ | $U_R = 100 \text{ V TO } 200 \text{ V}$ |
| 50                                                                | 0.95                                   | 0.90                                  | 0.85                                    |
| 100                                                               | 1.00                                   | 1.00                                  | 1.00                                    |
| 300                                                               | 1.07                                   | 1.12                                  | 1.20                                    |
| 1000                                                              | 1.12                                   | 1.20                                  | 1.30                                    |
| 3000                                                              | 1.15                                   | 1.25                                  | 1.35                                    |
| $\geq 10\,000$                                                    | 1.20                                   | 1.30                                  | 1.40                                    |

Table 5

| TEST PROCEDURES AND REQUIREMENTS               |                                            |                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                  |
|------------------------------------------------|--------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| TEST                                           |                                            | PROCEDURE<br>(quick reference)                                                                                                                                                                                                                                                                                  | REQUIREMENTS                                                                                                                                                                                                                                                                                                                                                     |
| NAME OF TEST                                   | REFERENCE                                  |                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                  |
| Endurance                                      | IEC 60384-4/<br>EN130300<br>subclause 4.13 | $T_{amb} = 125\text{ }^{\circ}\text{C}$ ; $U_R$ applied;<br>Case sizes:<br>6.5 mm x 18 mm to 10 mm x 25 mm: 2000 h;<br>10 mm x 30 mm to 21 mm x 38 mm: 3000 h                                                                                                                                                   | $U_R \leq 6.3\text{ V}$ ; $\Delta C/C$ : + 15 %/- 30 %<br>$U_R > 6.3\text{ V}$ ; $\Delta C/C$ : $\pm 15\text{ }%$<br>$\tan \delta \leq 1.3 \times \text{spec. limit}$<br>$Z \leq 2 \times \text{spec. limit}$<br>$I_{L5} \leq \text{spec. limit}$                                                                                                                |
| Useful life                                    | CECC 30301<br>subclause 1.8.1              | $T_{amb} = 125\text{ }^{\circ}\text{C}$ ; $U_R$ and $I_R$ applied;<br>Case $\varnothing D \times L = 6.5\text{ mm} \times 18\text{ mm}$ to $10\text{ mm} \times 25\text{ mm}$ :<br>4000 h<br>Case $\varnothing D \times L = 10\text{ mm} \times 30\text{ mm}$ to $21\text{ mm} \times 38\text{ mm}$ :<br>8000 h | $U_R \leq 6.3\text{ V}$ ; $\Delta C/C$ : + 45 %/- 50 %<br>$U_R > 6.3\text{ V}$ ; $\Delta C/C$ : $\pm 45\text{ }%$<br>$\tan \delta \leq 3 \times \text{spec. limit}$<br>$Z \leq 3 \times \text{spec. limit}$<br>$I_{L5} \leq \text{spec. limit}$<br>no short or open circuit<br>total failure percentage: $\leq 1\text{ }%$<br>( $200\text{ V} \leq 3\text{ }%$ ) |
| Shelf life<br>(storage at high<br>temperature) | IEC 60384-4/<br>EN130300<br>subclause 4.17 | $T_{amb} = 125\text{ }^{\circ}\text{C}$ ; no voltage applied;<br>$U_R = 6.3\text{ V}$ to $63\text{ V}$ : 500 h;<br>$U_R = 100\text{ V}$ and $200\text{ V}$ : 100 h<br>After test: $U_R$ to be applied for 30 min,<br>24 h to 48 h before measurement                                                            | $\Delta C/C$ , $\tan \delta$ , $Z$ :<br>For requirements<br>see "Endurance test" above<br>$I_{L5} \leq 2 \times \text{spec. limit}$                                                                                                                                                                                                                              |
| Reverse voltage                                | IEC 60384-4/<br>EN130300<br>subclause 4.15 | $T_{amb} = 125\text{ }^{\circ}\text{C}$ :<br>125 h at $U = -1\text{ V}$<br>followed by 125 h at $U_R$                                                                                                                                                                                                           | $\Delta C/C$ : $\pm 20\text{ }%$<br>$\tan \delta \leq \text{spec. limit}$<br>$I_{L5} \leq \text{spec. limit}$                                                                                                                                                                                                                                                    |



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