

## Aluminum Electrolytic Capacitors Axial High Temperature

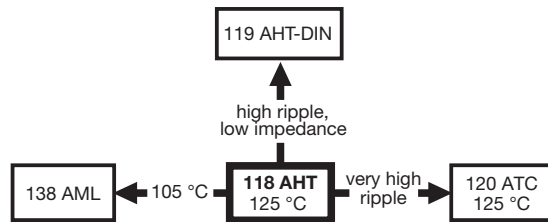


Fig. 1

| QUICK REFERENCE DATA   |                               |                       |
|--|-------------------------------|-----------------------|
| DESCRIPTION  | VALUE                         |                       |
| Nominal case sizes<br>( $\varnothing$ 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, $C_R$   | 4.7 $\mu$ F to 10 000 $\mu$ F |                       |
| Tolerance on $C_R$   | $\pm$ 20 %                    |                       |
| Rated voltage range, $U_R$   | 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 $I_R$ applied                                   | 500 000 h                     | 1 000 000 h           |
| Shelf life at 0 V, 125 °C:<br>$U_R$ = 6.3 V to 63 V<br>$U_R$ = 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         |

### 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  $\varnothing$  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)


**RoHS  
COMPLIANT**

### 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  $\mu$ F)
- Tolerance on rated capacitance, code letter in accordance with IEC 60062 (M for  $\pm$  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)

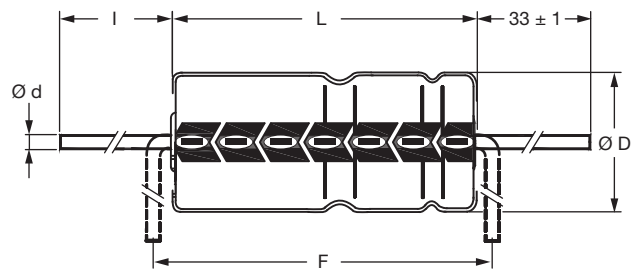
| <b>SELECTION CHART FOR <math>C_R</math>, <math>U_R</math>, AND RELEVANT NOMINAL CASE SIZES (<math>\varnothing D \times L</math> in mm)</b> |           |           |           |           |           |           |           |           |
|--|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| $C_R$<br>( $\mu F$ )   | $U_R$ (V) |           |           |           |           |           |           |           |
|  | 6.3       | 10        | 16        | 25        | 40        | 63        | 100       | 200       |
| 4.7  | -         | -         | -         | -         | -         | 6.5 x 18  | 6.5 x 18  | -         |
| 10   | -         | -         | -         | -         | -         | 6.5 x 18  | 6.5 x 18  | -         |
| 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  $21 \text{ mm} \times 38 \text{ mm}$

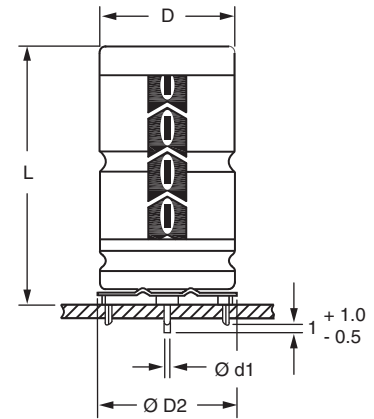
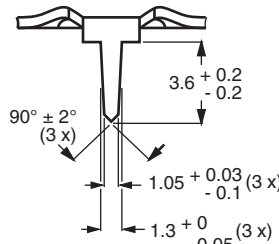
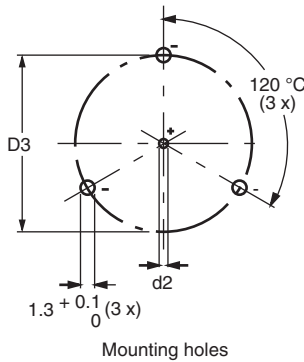
Fig. 3 - Form AA

**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  | 00        | 0.8                       | 55 ± 1 | 10.5                | 30.5              | 35                | 4.8      | 340                  | -       | 500     |
| 12.5 x 30  | 01        | 0.8                       | 55 ± 1 | 13.0                | 30.5              | 35                | 7.4      | 260                  | -       | 400     |
| 15 x 30  | 02        | 0.8                       | 55 ± 1 | 15.5                | 30.5              | 35                | 11.7     | 200                  | -       | 250     |
| 18 x 30  | 03        | 0.8                       | 55 ± 1 | 18.5                | 30.5              | 35                | 12.9     | 120                  | -       | -       |
| 18 x 38  | 04        | 0.8                       | 34 ± 1 | 18.5                | 39.5              | 44                | 19       | 125                  | -       | -       |
| 21 x 38  | 05        | 0.8                       | 34 ± 1 | 21.5                | 39.5              | 44                | 24       | 100                  | -       | -       |

**Note**

- Detailed tape dimensions see section "Packaging".



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  | 02        | 0.8                    | 1.0 + 0.4 | 15.5                | 17.5                 | 16.5 ± 0.2 | 33                | ≈ 8.6    | 200                  |
| 18 x 30  | 03        | 0.8                    | 1.0 + 0.4 | 18.5                | 19.5                 | 18.5 ± 0.2 | 33                | ≈ 11.5   | 240                  |
| 18 x 38  | 04        | 0.8                    | 1.0 + 0.4 | 18.5                | 19.5                 | 18.5 ± 0.2 | 42                | ≈ 14.0   | 100                  |
| 21 x 38  | 05        | 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                                       | 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                                      | 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 |
| <b>Voltage</b>                     |                                   |   |               |
| Surge voltage                      |                                   | $U_S \leq 1.15 \times U_R$  |               |
| Reverse voltage                    |                                   | $U_{rev} \leq 1 \text{ V}$  |               |
| <b>Current</b>                     |                                   |   |               |
| Leakage current                    | After 1 min at $U_R$              | $I_{L1} \leq 0.006 C_R \times U_R + 4 \mu\text{A}$ or $20 \mu\text{A}$ (whichever is greater) |               |
|                                    | After 5 min at $U_R$              | $I_{L5} \leq 0.002 C_R \times U_R + 4 \mu\text{A}$  |               |
| <b>Inductance</b>                  |                                   |   |               |
| Equivalent series inductance (ESL) | Case $\varnothing D \times L$ 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 |
| $U_R$  | $T_{amb} > 85 \text{ }^\circ\text{C}$ to $125 \text{ }^\circ\text{C}$ | 6.3    | 10 | 16 | 25 | 40 | 63  | 100 | 200 | V    |
| $U_{R2}$                                       | $T_{amb} \leq 85 \text{ }^\circ\text{C}$                              | 10     | 16 | 25 | 40 | 63 | 100 | 125 | 250 | V    |

**Note**

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

**CAPACITANCE**


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

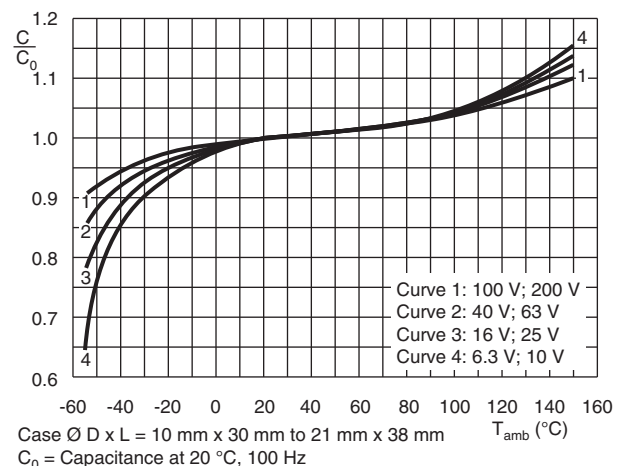


Fig. 6 - Typical multiplier of capacitance as a function of ambient temperature



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

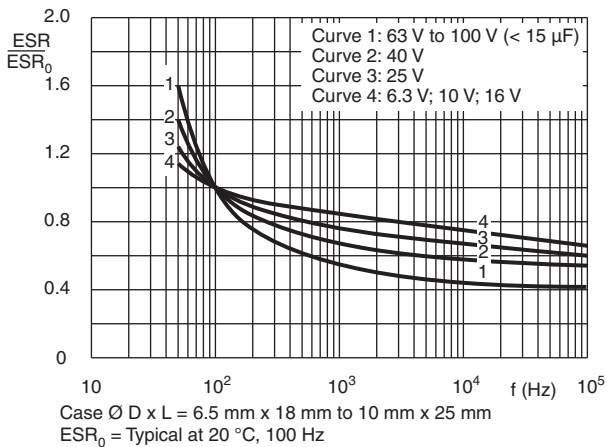


Fig. 11 - Typical multiplier of ESR as a function of frequency



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

**IMPEDANCE (Z)**



Fig. 13 - Typical impedance as a function of frequency

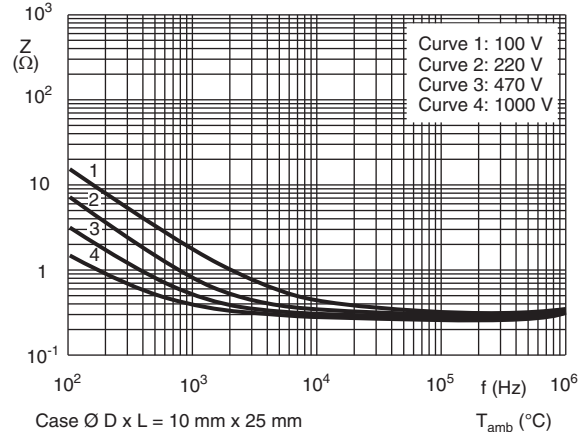


Fig. 14 - Typical impedance as a function of frequency



Fig. 15 - Typical impedance as a function of frequency

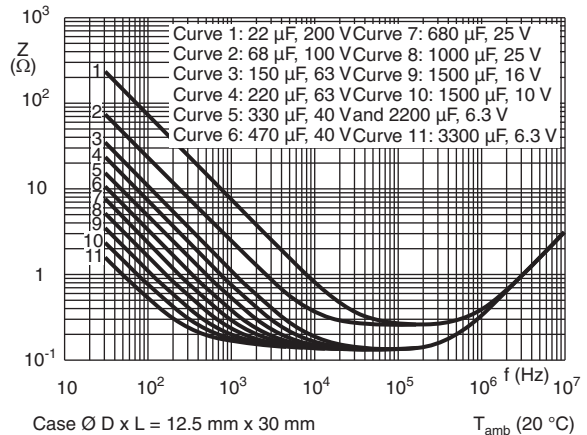


Fig. 16 - Typical impedance as a function of frequency



Fig. 17 - Typical impedance as a function of frequency

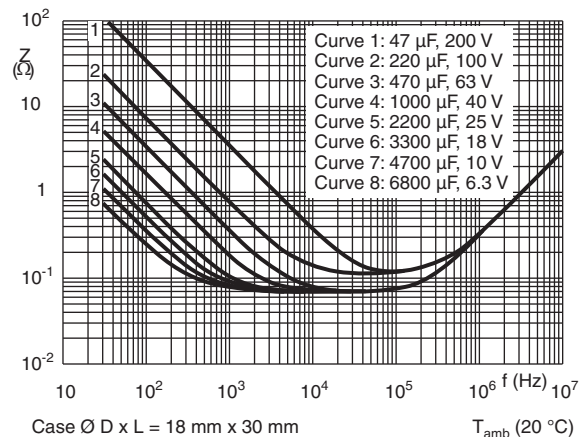


Fig. 18 - Typical impedance as a function of frequency



**RIPPLE CURRENT AND USEFUL LIFE**

Table 4

| ENDURANCE TEST DURATION AND USEFUL LIFE |                               |                                 |
|---|-------------------------------|---------------------------------|
| NOMINAL CASE SIZE<br>Ø D x L<br>(mm)    | ENDURANCE<br>AT 125 °C<br>(h) | USEFUL LIFE<br>AT 125 °C<br>(h) |
| 6.5 x 18                                | 2000                          | 4000                            |
| 8 x 18                                  | 2000                          | 4000                            |
| 10 x 18                                 | 2000                          | 4000                            |
| 10 x 25                                 | 2000                          | 4000                            |
| 10 x 30                                 | 3000                          | 8000                            |
| 12.5 x 30                               | 3000                          | 8000                            |
| 15 x 30                                 | 3000                          | 8000                            |
| 18 x 30                                 | 3000                          | 8000                            |
| 18 x 38                                 | 3000                          | 8000                            |
| 21 x 38                                 | 3000                          | 8000                            |

**Note**

- Multiplier of useful life code: MBC242



Fig. 19 - Multiplier of useful life as a function of ambient temperature and ripple current load

Table 5

| <b>MULTIPLIER OF RIPPLE CURRENT (<math>I_R</math>) AS A FUNCTION OF FREQUENCY</b> |                  |      |      |      |      |                |
|---|------------------|------|------|------|------|----------------|
| $U_R$<br>(V)  | FREQUENCY (Hz)   |      |      |      |      |                |
|   | 50               | 100  | 300  | 1000 | 3000 | $\geq 10\ 000$ |
|   | $I_R$ MULTIPLIER |      |      |      |      |                |
| 6.3   | 0.95             | 1.00 | 1.07 | 1.12 | 1.15 | 1.20           |
| 10  | 0.95             | 1.00 | 1.07 | 1.12 | 1.15 | 1.20           |
| 16  | 0.95             | 1.00 | 1.07 | 1.12 | 1.15 | 1.20           |
| 25  | 0.95             | 1.00 | 1.07 | 1.12 | 1.15 | 1.20           |
| 40  | 0.90             | 1.00 | 1.12 | 1.20 | 1.25 | 1.30           |
| 63  | 0.90             | 1.00 | 1.12 | 1.20 | 1.25 | 1.30           |
| 100   | 0.85             | 1.00 | 1.20 | 1.30 | 1.35 | 1.40           |
| 200   | 0.85             | 1.00 | 1.20 | 1.30 | 1.35 | 1.40           |

Table 6

| <b>TEST PROCEDURES AND REQUIREMENTS</b>        |   |   |  |
|--|---|---|--|
| TEST   |   | PROCEDURE<br>(quick reference)  | REQUIREMENTS   |
| NAME OF TEST                                   | REFERENCE                                   |   |  |
| Endurance                                      | IEC 60384-4 /<br>EN130300<br>subclause 4.13 | $T_{amb} = 125\ ^\circ\text{C}$ ; $U_R$ 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   | $U_R \leq 6.3\ \text{V}$ ; $\Delta\text{C}/\text{C}$ : +15 % / -30 %<br>$U_R > 6.3\ \text{V}$ ; $\Delta\text{C}/\text{C}$ : $\pm 15\ \%$<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               | $T_{amb} = 125\ ^\circ\text{C}$ ; $U_R$ 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 | $U_R \leq 6.3\ \text{V}$ ; $\Delta\text{C}/\text{C}$ : +45 % / -50 %<br>$U_R > 6.3\ \text{V}$ ; $\Delta\text{C}/\text{C}$ : $\pm 45\ \%$<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: $\leq 1\ \%$<br>( $200\ \text{V} \leq 3\ \%$ ) |
| Shelf life<br>(storage at high<br>temperature) | IEC 60384-4 /<br>EN130300<br>subclause 4.17 | $T_{amb} = 125\ ^\circ\text{C}$ ; 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  | $\Delta\text{C}/\text{C}$ , $\tan \delta$ , $Z$ :<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 | $T_{amb} = 125\ ^\circ\text{C}$ :<br>125 h at $U = -1\ \text{V}$<br>followed by 125 h at $U_R$  | $\Delta\text{C}/\text{C}$ : $\pm 20\ \%$<br>$\tan \delta \leq \text{spec. limit}$<br>$I_{L5} \leq \text{spec. limit}$  |

Statements about product lifetime are based on calculations and internal testing. They should only be interpreted as estimations. Also due to external factors, the lifetime in the field application may deviate from the calculated lifetime. In general, nothing stated herein shall be construed as a guarantee of durability.



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