

## Aluminum Electrolytic Capacitors Axial Miniature, Long-Life

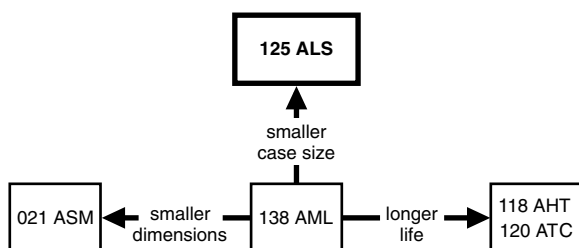


Fig. 1

| 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>         | 47 µF to 18 000 µF                         |                                            |
| Tolerance on C <sub>R</sub>                     | ± 20 %                                     |                                            |
| Rated voltage range, U <sub>R</sub>             | 10 V to 63 V                               |                                            |
| Category temperature range                      | -40 °C to +105 °C                          |                                            |
| Endurance test at 105 °C                        | 3000 h                                     | 5000 h                                     |
| Useful life at 105 °C                           | 5000 h                                     | 10 000 h                                   |
| Useful life at 40 °C,<br>I <sub>R</sub> applied | 1.3 x I <sub>R</sub> applied:<br>200 000 h | 1.8 x I <sub>R</sub> applied:<br>500 000 h |
| Shelf life at 0 V, 105 °C                       | 500 h                                      |                                            |
| Based on sectional<br>specification             | IEC 60384-4 / EN130 300                    |                                            |
| Climatic category IEC 60068                     | 40 / 105 / 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 Ø 15 mm x 30 mm available for automatic insertion
- Charge and discharge proof
- Long useful life: 5000 h to 10 000 h at 105 °C, high reliability
- High ripple current capability
- Miniaturized, high CV-product per unit volume
- AEC-Q200 qualified
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)

AUTOMOTIVE  
GRADE

**RoHS**  
COMPLIANT

### APPLICATIONS

- Industrial, automotive, EDP and telecommunication
- Smoothing, filtering, buffering in SMPS; coupling, decoupling, timing
- Portable and mobile equipment (small size, low mass)
- Stand-by applications
- Low mounting height boards, vibration and shock resistant

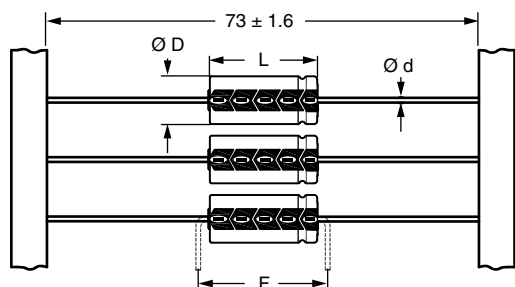
### MARKING

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)
- Upper category temperature (105 °C)
- Date code, in accordance with IEC 60062
- Code for factory of origin
- Name of manufacturer
- Negative terminal identification
- Series number (125)

| <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> |                             |           |           |           |           |
|--------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|-----------|-----------|-----------|-----------|
| <b><math>C_R</math><br/>(<math>\mu F</math>)</b>                                                                                           | <b><math>U_R</math> (V)</b> |           |           |           |           |
|                                                                                                                                            | <b>10</b>                   | <b>16</b> | <b>25</b> | <b>40</b> | <b>63</b> |
| 47                                                                                                                                         | -                           | -         | -         | -         | 6.5 x 18  |
| 82                                                                                                                                         | -                           | -         | -         | 6.5 x 18  | -         |
| 100                                                                                                                                        | -                           | -         | -         | -         | 8 x 18    |
| 120                                                                                                                                        | -                           | -         | -         | -         | 10 x 18   |
| 150                                                                                                                                        | -                           | -         | -         | 8 x 18    | -         |
| 180                                                                                                                                        | -                           | -         | 6.5 x 18  | 10 x 18   | 10 x 25   |
| 220                                                                                                                                        | -                           | -         | -         | -         | 10 x 30   |
| 270                                                                                                                                        | -                           | -         | -         | 10 x 25   | -         |
| 330                                                                                                                                        | -                           | 6.5 x 18  | -         | -         | -         |
| 390                                                                                                                                        | -                           | -         | 10 x 18   | 10 x 30   | -         |
| 470                                                                                                                                        | 6.5 x 18                    | -         | -         | -         | 12.5 x 30 |
| 560                                                                                                                                        | -                           | 8 x 18    | -         | -         | -         |
| 680                                                                                                                                        | -                           | -         | -         | -         | 15 x 30   |
| 820                                                                                                                                        | 8 x 18                      | -         | 10 x 25   | 12.5 x 30 | -         |
| 1000                                                                                                                                       | 10 x 18                     | 10 x 18   | 10 x 30   | 15 x 30   | 18 x 30   |
| 1200                                                                                                                                       | -                           | 10 x 25   | -         | -         | -         |
| 1500                                                                                                                                       | 10 x 25                     | -         | -         | 18 x 30   | 18 x 38   |
| 1800                                                                                                                                       | -                           | 10 x 30   | -         | -         | -         |
| 2200                                                                                                                                       | 10 x 30                     | -         | 12.5 x 30 | 18 x 38   | 21 x 38   |
| 2700                                                                                                                                       | -                           | 12.5 x 30 | 15 x 30   | -         | -         |
| 3300                                                                                                                                       | -                           | 15 x 30   | -         | 21 x 38   | -         |
| 3900                                                                                                                                       | 12.5 x 30                   | -         | 18 x 30   | -         | -         |
| 4700                                                                                                                                       | 15 x 30                     | -         | -         | -         | -         |
| 5600                                                                                                                                       | -                           | 18 x 30   | -         | -         | -         |
| 6800                                                                                                                                       | -                           | 18 x 30   | 18 x 38   | -         | -         |
| 8200                                                                                                                                       | 18 x 30                     | -         | 21 x 38   | -         | -         |
| 10 000                                                                                                                                     | -                           | 18 x 38   | -         | -         | -         |
| 12 000                                                                                                                                     | 18 x 38                     | -         | -         | -         | -         |
| 15 000                                                                                                                                     | -                           | 21 x 38   | -         | -         | -         |
| 18 000                                                                                                                                     | 21 x 38                     | -         | -         | -         | -         |

## DIMENSIONS in millimeters AND AVAILABLE FORMS



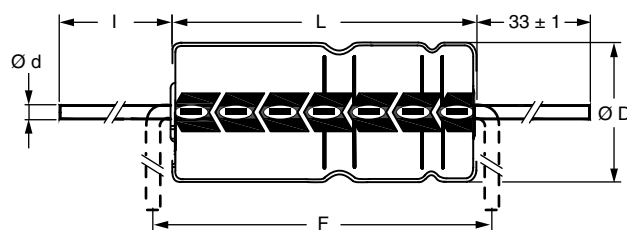
**Form BR:** Taped on reel

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  $21 \text{ mm} \times 38 \text{ mm}$

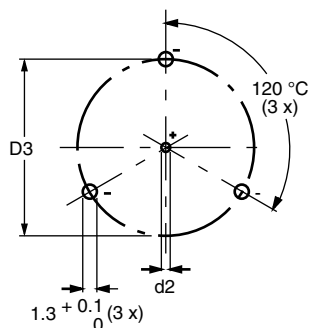
Fig. 3 - Form AA

**Table 1**

| <b>AXIAL; DIMENSIONS in millimeters, MASS AND PACKAGING QUANTITIES</b> |              |                            |            |                        |            |            |                |                      |            |            |
|------------------------------------------------------------------------|--------------|----------------------------|------------|------------------------|------------|------------|----------------|----------------------|------------|------------|
| NOMINAL CASE SIZE<br>$\varnothing D \times L$<br>(mm)                  | CASE<br>CODE | AXIAL: FORM AA, BA, AND BR |            |                        |            |            | MASS<br>(g)    | PACKAGING QUANTITIES |            |            |
|                                                                        |              | $\varnothing d$            | $l$        | $\varnothing D_{max.}$ | $L_{max.}$ | $F_{min.}$ |                | FORM<br>AA           | FORM<br>BA | FORM<br>BR |
| 6.5 x 18                                                               | 4            | 0.8                        | -          | 6.9                    | 18.5       | 25         | $\approx 1.3$  | -                    | 1000       | 1000       |
| 8 x 18                                                                 | 5            | 0.8                        | -          | 8.5                    | 18.5       | 25         | $\approx 1.7$  | -                    | 500        | 500        |
| 10 x 18                                                                | 6            | 0.8                        | -          | 10.5                   | 18.5       | 25         | $\approx 2.5$  | -                    | 500        | 500        |
| 10 x 25                                                                | 7            | 0.8                        | -          | 10.5                   | 25.5       | 30         | $\approx 3.3$  | -                    | 500        | 500        |
| 10 x 30                                                                | 00           | 0.8                        | $55 \pm 1$ | 10.5                   | 30.5       | 35         | $\approx 4.8$  | 340                  | -          | 500        |
| 12.5 x 30                                                              | 01           | 0.8                        | $55 \pm 1$ | 13.0                   | 30.5       | 35         | $\approx 7.4$  | 260                  | -          | 400        |
| 15 x 30                                                                | 02           | 0.8                        | $55 \pm 1$ | 15.5                   | 30.5       | 35         | $\approx 11.7$ | 200                  | -          | 250        |
| 18 x 30                                                                | 03           | 0.8                        | $55 \pm 1$ | 18.5                   | 30.5       | 35         | $\approx 12.9$ | 120                  | -          | -          |
| 18 x 38                                                                | 04           | 0.8                        | $34 \pm 1$ | 18.5                   | 39.5       | 44         | $\approx 19.0$ | 125                  | -          | -          |
| 21 x 38                                                                | 05           | 0.8                        | $34 \pm 1$ | 21.5                   | 39.5       | 44         | $\approx 24.0$ | 100                  | -          | -          |

**Note**

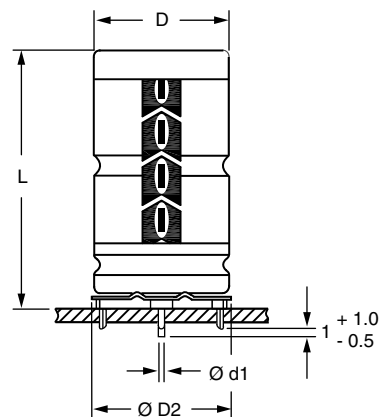
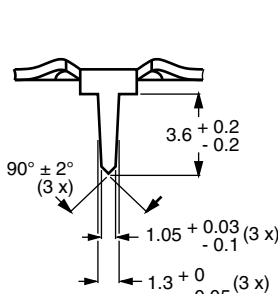
- For detailed tape dimensions refer to packaging information: [www.vishay.com/doc?28361](http://www.vishay.com/doc?28361)



Mounting holes

Case  $\varnothing D \times L = 15 \text{ mm} \times 30 \text{ mm}$  to  $21 \text{ mm} \times 38 \text{ mm}$ 

Especially for applications with severe shocks and vibrations


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

**Table 2**

| <b>MOUNTING RING; DIMENSIONS in millimeters, MASS AND PACKAGING QUANTITIES</b> |              |                        |                  |            |                         |                |            |                |                         |
|--------------------------------------------------------------------------------|--------------|------------------------|------------------|------------|-------------------------|----------------|------------|----------------|-------------------------|
| NOMINAL CASE SIZE<br>$\varnothing D \times L$                                  | CASE<br>CODE | MOUNTING RING: FORM MR |                  |            |                         |                |            | MASS<br>(g)    | PACKAGING<br>QUANTITIES |
|                                                                                |              | $\varnothing d1$       | $\varnothing d2$ | $D_{max.}$ | $\varnothing D2_{max.}$ | $D3$           | $L_{max.}$ |                |                         |
| 15 x 30                                                                        | 02           | 0.8                    | $1.0 + 0.4$      | 15.5       | 17.5                    | $16.5 \pm 0.2$ | 33         | $\approx 11.7$ | 200                     |
| 18 x 30                                                                        | 03           | 0.8                    | $1.0 + 0.4$      | 18.5       | 19.5                    | $18.5 \pm 0.2$ | 33         | $\approx 12.9$ | 240                     |
| 18 x 38                                                                        | 04           | 0.8                    | $1.0 + 0.4$      | 18.5       | 19.5                    | $18.5 \pm 0.2$ | 42         | $\approx 19.0$ | 100                     |
| 21 x 38                                                                        | 05           | 0.8                    | $1.0 + 0.4$      | 21.5       | 22.5                    | $21.5 \pm 0.2$ | 42         | $\approx 24.0$ | 100                     |

| ELECTRICAL DATA |                                                                                          |
|-----------------|------------------------------------------------------------------------------------------|
| SYMBOL          | DESCRIPTION                                                                              |
| $C_R$           | Rated capacitance at 100 Hz, tolerance $\pm 20\%$                                        |
| $I_R$           | Rated RMS ripple current at 100 Hz, 105 °C                                               |
| $I_{L5}$        | Max. leakage current after 5 min at $U_R$                                                |
| $\tan \delta$   | Max. dissipation factor at 100 Hz                                                        |
| ESR             | Equivalent series resistance at 100 Hz (calculated from $\tan \delta_{\max}$ and $C_R$ ) |
| Z               | Max. impedance at 10 kHz or 100 kHz                                                      |

**Note**

- Unless otherwise specified, all electrical values in Table 3 apply at  $T_{\text{amb}} = 20\text{ °C}$ ,  $P = 86\text{ kPa}$  to  $106\text{ kPa}$ ,  $RH = 45\%$  to  $75\%$

**Table 3**

| ELECTRICAL DATA AND ORDERING INFORMATION |                                      |                                                          |                                   |                                        |                         |                               |                             |                            |                             |                            |                             |
|------------------------------------------|--------------------------------------|----------------------------------------------------------|-----------------------------------|----------------------------------------|-------------------------|-------------------------------|-----------------------------|----------------------------|-----------------------------|----------------------------|-----------------------------|
| $U_R$<br>(V)                             | $C_R$<br>100 Hz<br>( $\mu\text{F}$ ) | NOMINAL<br>CASE SIZE<br>$\varnothing D \times L$<br>(mm) | $I_R$<br>10 kHz<br>105 °C<br>(mA) | $I_{L5}$<br>5 min<br>( $\mu\text{A}$ ) | $\tan \delta$<br>100 Hz | ESR<br>100 Hz<br>( $\Omega$ ) | Z<br>10 kHz<br>( $\Omega$ ) | ORDERING CODE MAL2125..... |                             |                            |                             |
|                                          |                                      |                                                          |                                   |                                        |                         |                               |                             | 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 |
| 10                                       | 470                                  | 6.5 x 18                                                 | 420                               | 29                                     | 0.24                    | 0.564                         | 0.91                        | -                          | 24471E3                     | 34471E3                    | -                           |
|                                          | 820                                  | 8 x 18                                                   | 660                               | 37                                     | 0.24                    | 0.308                         | 0.43                        | -                          | 24821E3                     | 34821E3                    | -                           |
|                                          | 1000                                 | 10 x 18                                                  | 900                               | 40                                     | 0.26                    | 0.292                         | 0.35                        | -                          | 24102E3                     | 34102E3                    | -                           |
|                                          | 1500                                 | 10 x 25                                                  | 1140                              | 50                                     | 0.26                    | 0.195                         | 0.2                         | -                          | 24152E3                     | 34152E3                    | -                           |
|                                          | 2200                                 | 10 x 30                                                  | 2200                              | 64                                     | 0.24                    | 0.145                         | 0.26                        | 14222E3                    | 24222E3                     | -                          | -                           |
|                                          | 3900                                 | 12.5 x 30                                                | 2750                              | 98                                     | 0.26                    | 0.088                         | 0.19                        | 14392E3                    | 24392E3                     | -                          | -                           |
|                                          | 4700                                 | 15 x 30                                                  | 3080                              | 114                                    | 0.28                    | 0.079                         | 0.13                        | 14472E3                    | 24472E3                     | -                          | 44472E3                     |
|                                          | 8200                                 | 18 x 30                                                  | 3360                              | 192                                    | 0.36                    | 0.056                         | 0.11                        | 14822E3                    | -                           | -                          | 44822E3                     |
|                                          | 12 000                               | 18 x 38                                                  | 4230                              | 260                                    | 0.44                    | 0.049                         | 0.074                       | 14123E3                    | -                           | -                          | 44123E3                     |
|                                          | 18 000                               | 21 x 38                                                  | 4790                              | 380                                    | 0.56                    | 0.041                         | 0.058                       | 14183E3                    | -                           | -                          | 44183E3                     |
| 16                                       | 330                                  | 6.5 x 18                                                 | 400                               | 31                                     | 0.20                    | 0.643                         | 1.25                        | -                          | 25331E3                     | 35331E3                    | -                           |
|                                          | 560                                  | 8 x 18                                                   | 510                               | 38                                     | 0.20                    | 0.379                         | 0.73                        | -                          | 25561E3                     | 35561E3                    | -                           |
|                                          | 1000                                 | 10 x 18                                                  | 730                               | 52                                     | 0.22                    | 0.239                         | 0.34                        | -                          | 25102E3                     | 35102E3                    | -                           |
|                                          | 1200                                 | 10 x 25                                                  | 1080                              | 58                                     | 0.22                    | 0.199                         | 0.3                         | -                          | 25122E3                     | 35122E3                    | -                           |
|                                          | 1800                                 | 10 x 30                                                  | 2100                              | 78                                     | 0.18                    | 0.133                         | 0.27                        | 15182E3                    | 25182E3                     | -                          | -                           |
|                                          | 2700                                 | 12.5 x 30                                                | 2650                              | 106                                    | 0.20                    | 0.098                         | 0.19                        | 15272E3                    | 25272E3                     | -                          | -                           |
|                                          | 3300                                 | 15 x 30                                                  | 2940                              | 126                                    | 0.22                    | 0.088                         | 0.14                        | 15332E3                    | 25332E3                     | -                          | 45332E3                     |
|                                          | 5600                                 | 18 x 30                                                  | 3290                              | 199                                    | 0.26                    | 0.062                         | 0.1                         | 15562E3                    | -                           | -                          | 45562E3                     |
|                                          | 6800                                 | 18 x 30                                                  | 3430                              | 238                                    | 0.28                    | 0.055                         | 0.1                         | 15682E3                    | -                           | -                          | 45682E3                     |
|                                          | 10 000                               | 18 x 38                                                  | 4350                              | 340                                    | 0.36                    | 0.048                         | 0.062                       | 15103E3                    | -                           | -                          | 45103E3                     |
|                                          | 15 000                               | 21 x 38                                                  | 4590                              | 500                                    | 0.46                    | 0.041                         | 0.057                       | 15153E3                    | -                           | -                          | 45153E3                     |
| 25                                       | 180                                  | 6.5 x 18                                                 | 350                               | 29                                     | 0.18                    | 1.032                         | 1.2                         | -                          | 26181E3                     | 36181E3                    | -                           |
|                                          | 390                                  | 10 x 18                                                  | 600                               | 40                                     | 0.18                    | 0.476                         | 0.55                        | -                          | 26391E3                     | 36391E3                    | -                           |
|                                          | 820                                  | 10 x 25                                                  | 970                               | 61                                     | 0.18                    | 0.226                         | 0.26                        | -                          | 26821E3                     | 36821E3                    | -                           |
|                                          | 1000                                 | 10 x 30                                                  | 2100                              | 70                                     | 0.16                    | 0.212                         | 0.26                        | 16102E3                    | 26102E3                     | -                          | -                           |
|                                          | 2200                                 | 12.5 x 30                                                | 2600                              | 130                                    | 0.18                    | 0.109                         | 0.18                        | 16222E3                    | 26222E3                     | -                          | -                           |
|                                          | 2700                                 | 15 x 30                                                  | 3740                              | 155                                    | 0.18                    | 0.088                         | 0.13                        | 16272E3                    | 26272E3                     | -                          | 46272E3                     |
|                                          | 3900                                 | 18 x 30                                                  | 4310                              | 215                                    | 0.20                    | 0.068                         | 0.1                         | 16392E3                    | -                           | -                          | 46392E3                     |
|                                          | 6800                                 | 18 x 38                                                  | 4350                              | 360                                    | 0.26                    | 0.051                         | 0.071                       | 16682E3                    | -                           | -                          | 46682E3                     |
|                                          | 8200                                 | 21 x 38                                                  | 4470                              | 450                                    | 0.30                    | 0.046                         | 0.058                       | 16822E3                    | -                           | -                          | 46822E3                     |

**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) | I <sub>R</sub><br>10 kHz<br>105 °C<br>(mA) | 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 MAL2125..... |                             |                            |                             |
|-----------------------|----------------------------------|-----------------------------------------|--------------------------------------------|----------------------------------|-----------------|----------------------|--------------------|----------------------------|-----------------------------|----------------------------|-----------------------------|
|                       |                                  |                                         |                                            |                                  |                 |                      |                    | 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 |
| 40                    | 82                               | 6.5 x 18                                | 270                                        | 27                               | 0.10            | 1.617                | 2.1                | -                          | 27829E3                     | 37829E3                    | -                           |
|                       | 150                              | 8 x 18                                  | 400                                        | 32                               | 0.10            | 0.884                | 1.2                | -                          | 27151E3                     | 37151E3                    | -                           |
|                       | 180                              | 10 x 18                                 | 550                                        | 34                               | 0.10            | 0.737                | 0.615              | -                          | 27181E3                     | 37181E3                    | -                           |
|                       | 270                              | 10 x 25                                 | 780                                        | 42                               | 0.10            | 0.474                | 0.41               | -                          | 27271E3                     | 37271E3                    | -                           |
|                       | 390                              | 10 x 30                                 | 1990                                       | 51                               | 0.10            | 0.34                 | 0.32               | 17391E3                    | 27391E3                     | -                          | -                           |
|                       | 820                              | 12.5 x 30                               | 2550                                       | 81                               | 0.10            | 0.175                | 0.18               | 17821E3                    | 27821E3                     | -                          | -                           |
|                       | 1000                             | 15 x 30                                 | 2840                                       | 100                              | 0.12            | 0.159                | 0.12               | 17102E3                    | 27102E3                     | -                          | 47102E3                     |
|                       | 1500                             | 18 x 30                                 | 3150                                       | 140                              | 0.12            | 0.106                | 0.098              | 17152E3                    | -                           | -                          | 47152E3                     |
|                       | 2200                             | 18 x 38                                 | 4130                                       | 196                              | 0.14            | 0.084                | 0.069              | 17222E3                    | -                           | -                          | 47222E3                     |
|                       | 3300                             | 21 x 38                                 | 4170                                       | 284                              | 0.16            | 0.064                | 0.061              | 17332E3                    | -                           | -                          | 47332E3                     |
| 63                    | 47                               | 6.5 x 18                                | 230                                        | 26                               | 0.08            | 2.258                | 3.6                | -                          | 28479E3                     | 38479E3                    | -                           |
|                       | 100                              | 8 x 18                                  | 340                                        | 33                               | 0.08            | 1.061                | 1.7                | -                          | 28101E3                     | 38101E3                    | -                           |
|                       | 120                              | 10 x 18                                 | 530                                        | 35                               | 0.08            | 0.884                | 1.2                | -                          | 28121E3                     | 38121E3                    | -                           |
|                       | 180                              | 10 x 25                                 | 720                                        | 43                               | 0.08            | 0.589                | 0.8                | -                          | 28181E3                     | 38181E3                    | -                           |
|                       | 220                              | 10 x 30                                 | 1560                                       | 48                               | 0.08            | 0.482                | 0.44               | 18221E3                    | 28221E3                     | -                          | -                           |
|                       | 470                              | 12.5 x 30                               | 2150                                       | 79                               | 0.08            | 0.226                | 0.31               | 18471E3                    | 28471E3                     | -                          | -                           |
|                       | 680                              | 15 x 30                                 | 2510                                       | 106                              | 0.08            | 0.156                | 0.16               | 18681E3                    | 28681E3                     | -                          | 48681E3                     |
|                       | 1000                             | 18 x 30                                 | 2860                                       | 146                              | 0.10            | 0.133                | 0.12               | 18102E3                    | -                           | -                          | 48102E3                     |
|                       | 1500                             | 18 x 38                                 | 3720                                       | 209                              | 0.10            | 0.088                | 0.086              | 18152E3                    | -                           | -                          | 48152E3                     |
|                       | 2200                             | 21 x 38                                 | 3780                                       | 297                              | 0.12            | 0.072                | 0.072              | 18222E3                    | -                           | -                          | 48222E3                     |

**ADDITIONAL ELECTRICAL DATA**

| PARAMETER                          | CONDITIONS                    | VALUE                                                           |               |
|------------------------------------|-------------------------------|-----------------------------------------------------------------|---------------|
|                                    |                               | AXIAL                                                           | MOUNTING RING |
| Voltage                            |                               |                                                                 |               |
| Surge voltage                      |                               | U <sub>s</sub> ≤ 1.15 x U <sub>R</sub>                          |               |
| Reverse voltage                    |                               | U <sub>rev</sub> ≤ 1 V                                          |               |
| Current                            |                               |                                                                 |               |
| Leakage current                    | After 1 min at U <sub>R</sub> | I <sub>L1</sub> ≤ 0.006 C <sub>R</sub> x U <sub>R</sub> + 20 μA |               |
|                                    | After 5 min at U <sub>R</sub> | I <sub>L5</sub> ≤ 0.002 C <sub>R</sub> x U <sub>R</sub> + 20 μA |               |
| 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    |

## CAPACITANCE (C)

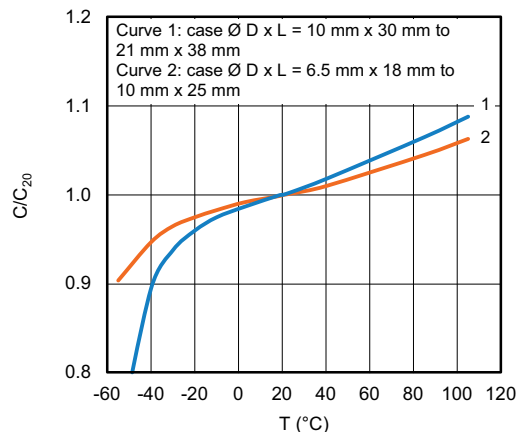


Fig. 5 - Typical multiplier of capacitance as a function of ambient temperature ( $C_{20}$  = capacitance at 20 °C, 100 Hz)

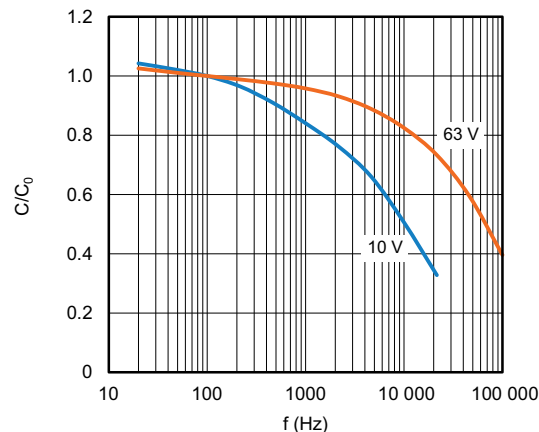


Fig. 6 - Typical multiplier of capacitance as a function of frequency ( $C_0$  = typical capacitance at 100 Hz at 20 °C)

## EQUIVALENT SERIES RESISTANCE (ESR)

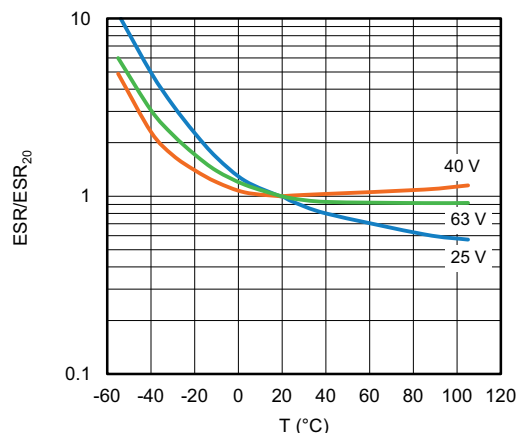


Fig. 7 - Typical multiplier of ESR as a function of ambient temperature ( $ESR_{20}$  = typical ESR at 100 Hz at 20 °C)

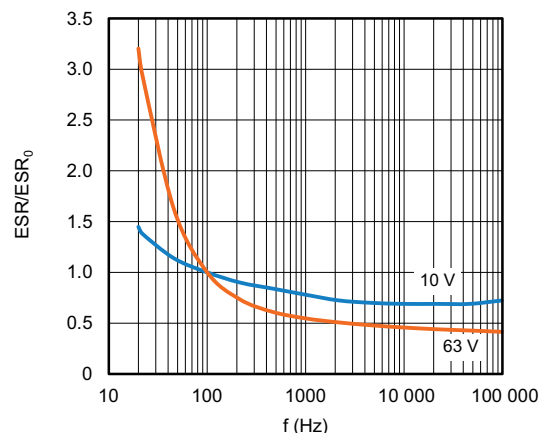


Fig. 8 - Typical multiplier of ESR as a function of frequency ( $ESR_0$  = typical ESR at 100 Hz at 20 °C)

## IMPEDANCE (Z)

Table 4

| IMPEDANCE VS. CAPACITANCE VALUES (Case Ø D x L = 6.5 mm x 18 mm to 10 mm x 25 mm) |                                                |        |        |        |        |
|-----------------------------------------------------------------------------------|------------------------------------------------|--------|--------|--------|--------|
| $T_{amb}$                                                                         | $Z \times C_R (\Omega \times \mu F)$ AT 10 kHz |        |        |        |        |
|                                                                                   | 10 V                                           | 16 V   | 25 V   | 40 V   | 63 V   |
| +20 °C                                                                            | ≤ 200                                          | ≤ 160  | ≤ 120  | ≤ 90   | ≤ 80   |
| -25 °C                                                                            | ≤ 1200                                         | ≤ 750  | ≤ 560  | ≤ 450  | ≤ 550  |
| -40 °C                                                                            | ≤ 3200                                         | ≤ 2000 | ≤ 1500 | ≤ 1200 | ≤ 1500 |

## RIPPLE CURRENT AND USEFUL LIFE

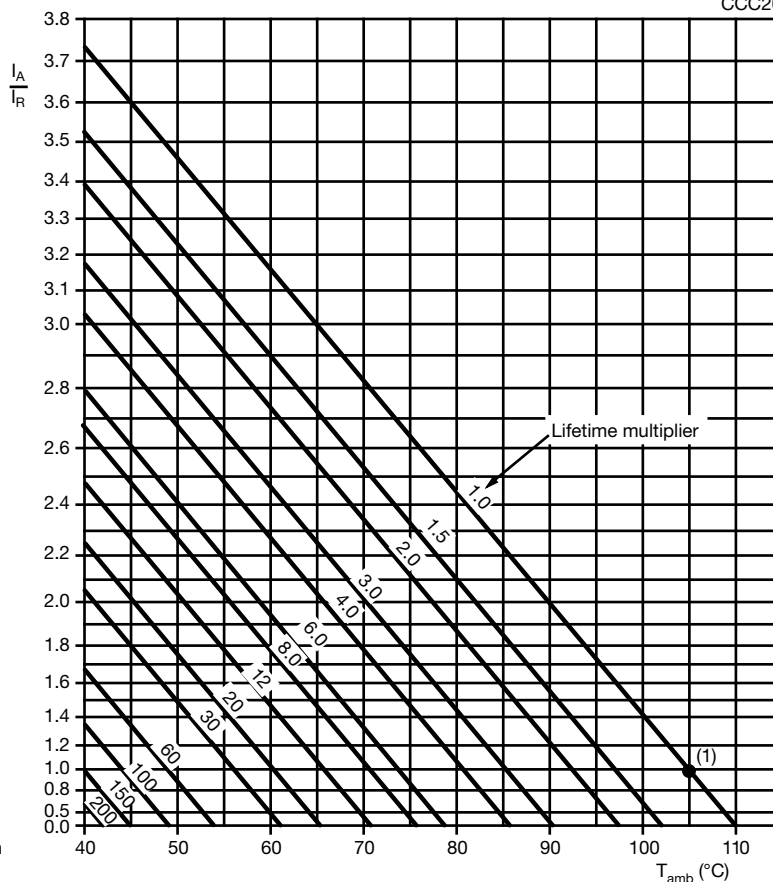
Table 5

| ENDURANCE TEST DURATION AND USEFUL LIFE |                               |                                 |
|-----------------------------------------|-------------------------------|---------------------------------|
| NOMINAL CASE SIZE<br>Ø D x L<br>(mm)    | ENDURANCE<br>AT 105 °C<br>(h) | USEFUL LIFE<br>AT 105 °C<br>(h) |
| 6.5 x 18                                | 3000                          | 5000                            |
| 8 x 18                                  | 3000                          | 5000                            |
| 10 x 18                                 | 3000                          | 5000                            |
| 10 x 25                                 | 3000                          | 5000                            |
| 10 x 30                                 | 5000                          | 10 000                          |
| 12.5 x 30                               | 5000                          | 10 000                          |
| 15 x 30                                 | 5000                          | 10 000                          |
| 18 x 30                                 | 5000                          | 10 000                          |
| 18 x 38                                 | 5000                          | 10 000                          |
| 21 x 38                                 | 5000                          | 10 000                          |

### Note

- Multiplier of useful life code: CCC206

CCC206



$I_A$  = actual ripple current at 100 Hz  
 $I_R$  = rated ripple current at 100 Hz, 105 °C

<sup>(1)</sup> Useful life at 105 °C and  $I_R$  applied:  
 Case Ø D x L = 6.5 mm x 18 mm to 10 mm x 25 mm: 5000 h  
 Case Ø D x L = 10 mm x 30 mm to 21 mm x 38 mm: 10 000 h

Fig. 9 - Multiplier of useful life as a function of ambient temperature and ripple current load

Table 6

| MULTIPLIER OF RIPPLE CURRENT ( $I_R$ ) AS A FUNCTION OF FREQUENCY |                  |      |      |      |      |                |
|-------------------------------------------------------------------|------------------|------|------|------|------|----------------|
| $U_R$<br>(V)                                                      | FREQUENCY (Hz)   |      |      |      |      |                |
|                                                                   | 50               | 100  | 300  | 1000 | 3000 | $\geq 10\ 000$ |
|                                                                   | $I_R$ MULTIPLIER |      |      |      |      |                |
| 10                                                                | 0.79             | 0.83 | 0.89 | 0.93 | 0.96 | 1.00           |
| 16                                                                | 0.69             | 0.77 | 0.86 | 0.92 | 0.96 | 1.00           |
| 25                                                                | 0.69             | 0.77 | 0.86 | 0.92 | 0.96 | 1.00           |
| 40                                                                | 0.61             | 0.71 | 0.86 | 0.93 | 0.96 | 1.00           |
| 63                                                                | 0.61             | 0.71 | 0.86 | 0.93 | 0.96 | 1.00           |

Table 7

| TEST PROCEDURES AND REQUIREMENTS               |                                              |                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                               |
|------------------------------------------------|----------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| TEST                                           |                                              | PROCEDURE<br>(quick reference)                                                                                                                                                | REQUIREMENTS                                                                                                                                                                                                                                                                                                  |
| NAME OF TEST                                   | REFERENCE                                    |                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                               |
| Endurance                                      | IEC 60384-4 /<br>EN130300<br>subclause 4.13  | $T_{amb} = 105\ ^\circ\text{C}$ ; $U_R$ applied;<br>Case $\emptyset$ D x L:<br>6.5 mm x 18 mm to 10 mm x 25 mm: 3000 h;<br>10 mm x 30 mm to 21 mm x 38 mm: 5000 h             | $U_R \leq 10\ \text{V}$ ; $\Delta C/C$ : +15 % / -30 %<br>$U_R > 10\ \text{V}$ ; $\Delta C/C$ : $\pm 15\ \%$<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                | $T_{amb} = 105\ ^\circ\text{C}$ ; $U_R$ and $I_R$ applied;<br>Case $\emptyset$ D x L:<br>6.5 mm x 18 mm to 10 mm x 25 mm: 5000 h;<br>10 mm x 30 mm to 21 mm x 38 mm: 10 000 h | $U_R \leq 10\ \text{V}$ ; $\Delta C/C$ : +45 % / -50 %<br>$U_R > 10\ \text{V}$ ; $\Delta C/C$ : $\pm 45\ \%$<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 open circuit<br>total failure percentage: $\leq 1\ \%$ |
| Shelf life<br>(storage at<br>high temperature) | IEC 60384-4 /<br>EN130300,<br>subclause 4.17 | $T_{amb} = 105\ ^\circ\text{C}$ ; no voltage applied;<br>500 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>$I_{L5} \leq 2 \times \text{spec. limit}$                                                                                                                                                                              |

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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