



Aluminum Capacitors Axial Long-Life, DIN-Based



Fig. 1

| QUICK REFERENCE DATA | | | |
|--|----------------------|---------------------|--------------------|
| DESCRIPTION | VALUE | | |
| Nominal case sizes (Ø D x L in mm) | 6.5 x 18 and 8 x 18 | 10 x 18 and 10 x 25 | 10 x 30 to 21 x 38 |
| Rated capacitance range, C _R | 1 µF to 4700 µF | | |
| Tolerance on C _R | -10 % to +50 % | | |
| Rated voltage range, U _R | 10 V to 160 V | | |
| Category temperature range | -40 °C to +85 °C | | |
| Endurance test at 105 °C | 2000 h | 2000 h | - |
| Endurance test at 85 °C | 6000 h | 8000 h | 8000 h |
| Useful life at 105 °C | 3000 h | 3000 h | - |
| Useful life at 85 °C | 10 000 h | 15 000 h | 15 000 h |
| Useful life at 40 °C, 1.8 x I _R applied | 160 000 h | 240 000 h | 240 000 h |
| Shelf life at 0 V, 85 °C | 500 h | | |
| Based on sectional specification | IEC 60384-4/EN130300 | | |
| Climatic category IEC 60068 | 40/085/56 | | |

| SELECTION CHART FOR C _R , U _R , AND RELEVANT NOMINAL CASE SIZES (Ø D x L in mm) | | | | | | | | |
|---|--------------------|----|----------|----|----------|----------|------------------------|--------------------------|
| C _R (µF) | U _R (V) | | | | | | | |
| | 10 | 16 | 25 | 40 | 63 | 100 | 160 | 250 |
| 1.0 | - | - | - | - | - | 6.5 x 18 | - | - |
| 2.2 | - | - | - | - | - | - | - | - |
| 4.7 | - | - | - | - | 6.5 x 18 | 6.5 x 18 | - | - |
| 10 | - | - | - | - | 6.5 x 18 | - | - | - |
| | - | - | - | - | - | - | - | 10 x 30 ⁽¹⁾ |
| 22 | - | - | 6.5 x 18 | - | 8 x 18 | - | 10 x 25 | 12.5 x 30 ⁽¹⁾ |
| | - | - | - | - | - | - | 10 x 30 ⁽¹⁾ | - |

Note

⁽¹⁾ For these CV-values see datasheet 041 - 043 ASH (www.vishay.com/doc?28329)

FEATURES

- Long useful life: up to 15 000 h at 85 °C
- Taped versions up to case Ø 15 mm x 30 mm available for automatic insertion
- Charge and discharge proof
- 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
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912



**RoHS
COMPLIANT**

APPLICATIONS

- General industrial, power supplies, telecommunication, EDP
- Coupling, decoupling, timing; smoothing, filtering and buffering in SMPS
- For use where low mounting height is important
- 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 (T for -10 % to +50 %)
- Rated voltage (in V)
- Upper category temperature (85 °C)
- Date code, in accordance with IEC 60062
- Code for factory of origin
- Name of manufacturer
- Negative terminal identification
- Series number (132 or 133)

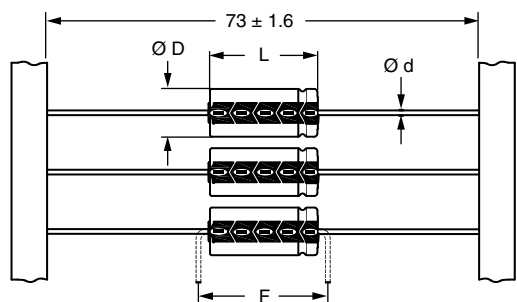


| SELECTION CHART FOR C_R , U_R , AND RELEVANT NOMINAL CASE SIZES ($\varnothing D \times L$ in mm) | | | | | | | | |
|---|-----------|-----------|-----------|-----------|---------|-----------|------------------------|------------------------|
| C_R (μF) | U_R (V) | | | | | | | |
| | 10 | 16 | 25 | 40 | 63 | 100 | 160 | 250 |
| 47 | - | 6.5 x 18 | - | 8 x 18 | 10 x 18 | 10 x 25 | 15 x 30 ⁽¹⁾ | 18 x 30 ⁽¹⁾ |
| | - | - | - | - | - | 10 x 30 | - | - |
| 68 | - | - | - | - | 10 x 30 | 12.5 x 30 | 15 x 30 ⁽¹⁾ | 18 x 38 ⁽¹⁾ |
| 100 | - | 8 x 18 | - | 10 x 18 | 10 x 30 | 15 x 30 | 18 x 30 ⁽¹⁾ | 21 x 38 ⁽¹⁾ |
| 150 | - | - | - | 12.5 x 30 | 15 x 30 | 18 x 30 | 18 x 38 ⁽¹⁾ | - |
| 220 | - | 10 x 18 | 10 x 25 | 12.5 x 30 | 15 x 30 | 18 x 38 | 21 x 38 ⁽¹⁾ | - |
| | - | - | 12.5 x 30 | - | - | - | - | - |
| 330 | - | 10 x 25 | 12.5 x 30 | 15 x 30 | 18 x 30 | 18 x 38 | - | - |
| | - | 12.5 x 30 | - | - | - | - | - | - |
| 470 | 12.5 x 30 | 10 x 25 | 12.5 x 30 | 15 x 30 | 18 x 38 | 21 x 38 | - | - |
| | - | 12.5 x 30 | - | - | - | - | - | - |
| 680 | 12.5 x 30 | 15 x 30 | 18 x 30 | 18 x 30 | 21 x 38 | - | - | - |
| 1000 | 15 x 30 | 15 x 30 | 18 x 30 | 18 x 38 | 21 x 38 | - | - | - |
| 1500 | 18 x 30 | 18 x 30 | 18 x 38 | 21 x 38 | - | - | - | - |
| 2200 | 18 x 30 | 18 x 38 | 21 x 38 | 21 x 38 | - | - | - | - |
| 3300 | 18 x 38 | 21 x 38 | - | - | - | - | - | - |
| 4700 | 21 x 38 | 21 x 38 | - | - | - | - | - | - |

Note

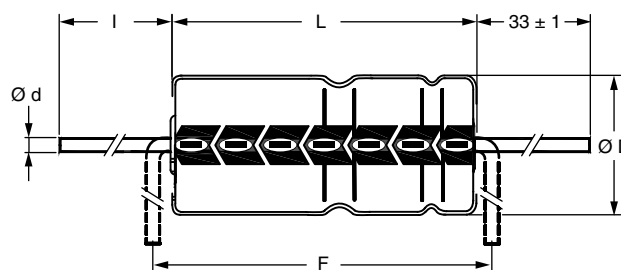
(1) For these CV-values see datasheet 041 - 043 ASH (www.vishay.com/doc?28329)

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

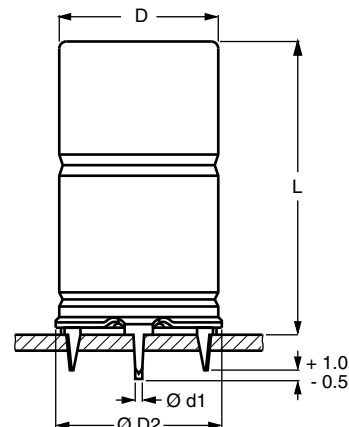
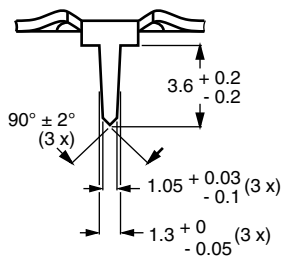
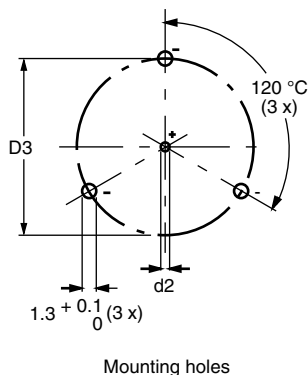
Fig. 3 - Form AA

Table 1

| AXIAL; DIMENSIONS in millimeters, MASS, AND PACKAGING QUANTITIES | | | | | | | | | | |
|--|-----------|---------------------------|--------|------------------------|------------|------------|----------|----------------------|---------|---------|
| NOMINAL CASE SIZE $\varnothing D \times L$ | CASE CODE | AXIAL FORM AA, BA, AND BR | | | | | MASS (g) | PACKAGING QUANTITIES | | |
| | | $\varnothing d$ | l | $\varnothing D_{max.}$ | $L_{max.}$ | $F_{min.}$ | | 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 | ≈ 19.0 | 125 | - | - |
| 21 x 38 | 05 | 0.8 | 34 ± 1 | 21.5 | 39.5 | 44 | ≈ 24.0 | 100 | - | - |

Note

• For detailed tape dimensions, please see www.vishay.com/doc?28361.



Mounting holes

Case $\varnothing D \times L = 15 \text{ mm} \times 30 \text{ mm}$ to $21 \text{ mm} \times 38 \text{ mm}$
 Case not insulated (insulation on request)
 Especially for applications with severe shocks and vibrations

Fig. 4 - Mounting hole diagram and outline; **form MR:** with mounting rings and pins

Table 2

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

| ELECTRICAL DATA | |
|-----------------|--|
| SYMBOL | DESCRIPTION |
| C_R | Rated capacitance at 100 Hz, tolerance -10 %/+50 % |
| I_R | Rated RMS ripple current at 100 Hz, 85 °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 |

Note

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

ORDERING EXAMPLE

Electrolytic capacitor 132 series
 100 $\mu\text{F}/40 \text{ V}$; -10 %/+50 %
 Nominal case size: $\varnothing 10 \text{ mm} \times 18 \text{ mm}$; form BR
 Ordering code: MAL213227101E3
 Former 12NC: 2222 132 27101



Table 3

| ELECTRICAL DATA AND ORDERING INFORMATION | | | | | | | | | | | | |
|--|----------------------------------|---|---|----------------------------------|-----------------|----------------------|--------------------|---------------------|-------------------------|-----------------------------|----------------------------|-----------------------------|
| U _R (V) | C _R 100 Hz (µF) | NOMINAL CASE SIZE Ø D x L (mm) | I _R 100 Hz 85 °C (mA) | I _{L5} 5 min (µA) | tan δ 100 Hz | ESR 100 Hz (Ω) | Z 10 kHz (Ω) | Z 100 kHz (Ω) | ORDERING CODE MAL2..... | | | |
| | | | | | | | | | IN BOX FORM AA | TAPED ON REEL FORM BR | TAPED IN BOX FORM BA | MOUNTING RING FORM MR |
| 10 | 470 | 12.5 x 30 | 350 | 9.4 | 0.18 | 0.61 | 0.26 | 0.60 | 13214471E3 | 13224471E3 | - | - |
| | 680 | 12.5 x 30 | 460 | 13.6 | 0.18 | 0.42 | 0.20 | 0.40 | 13214681E3 | 13224681E3 | - | - |
| | 1000 | 15 x 30 | 640 | 20 | 0.18 | 0.28 | 0.12 | - | 13214102E3 | 13224102E3 | - | 13244102E3 |
| | 1500 | 18 x 30 | 800 | 30 | 0.22 | 0.23 | 0.10 | - | 13214152E3 | - | - | 13244152E3 |
| | 2200 | 18 x 30 | 1100 | 44 | 0.22 | 0.16 | 0.09 | - | 13214222E3 | - | - | 13244222E3 |
| | 3300 | 18 x 38 | 1300 | 66 | 0.27 | 0.13 | 0.05 | - | 13214332E3 | - | - | 13244332E3 |
| | 4700 | 21 x 38 | 1800 | 94 | 0.27 | 0.09 | 0.05 | - | 13214472E3 | - | - | 13244472E3 |
| 16 | 47 | 6.5 x 18 | 95 | 5.5 | 0.14 | 4.7 | 2.6 | 2.2 | - | 13225479E3 | 13235479E3 | - |
| | 100 | 8 x 18 | 150 | 7.2 | 0.14 | 2.2 | 1.2 | 1.1 | - | 13225101E3 | 13235101E3 | - |
| | 220 | 10 x 18 | 250 | 11 | 0.14 | 1.0 | 0.55 | 0.55 | - | 13225221E3 | 13235221E3 | - |
| | 330 | 10 x 25 | 320 | 14.6 | 0.14 | 0.67 | 0.36 | 0.36 | - | 13290508E3 | 13290509E3 | - |
| | 330 | 12.5 x 30 | 320 | 10.6 | 0.14 | 0.67 | 0.36 | 0.60 | 13215331E3 | 13225331E3 | - | - |
| | 470 | 10 x 25 | 450 | 19 | 0.14 | 0.47 | 0.26 | 0.26 | - | 13290507E3 | 13290502E3 | - |
| | 470 | 12.5 x 30 | 450 | 15 | 0.14 | 0.47 | 0.26 | 0.40 | 13215471E3 | 13225471E3 | - | - |
| | 680 | 15 x 30 | 550 | 22 | 0.14 | 0.33 | 0.14 | - | 13215681E3 | 13225681E3 | - | 13245681E3 |
| | 1000 | 15 x 30 | 780 | 32 | 0.14 | 0.22 | 0.12 | - | 13215102E3 | 13225102E3 | - | 13245102E3 |
| | 1500 | 18 x 30 | 950 | 48 | 0.15 | 0.16 | 0.10 | - | 13215152E3 | - | - | 13245152E3 |
| | 2200 | 18 x 38 | 1300 | 70 | 0.15 | 0.11 | 0.06 | - | 13215222E3 | - | - | 13245222E3 |
| 3300 | 21 x 38 | 1600 | 110 | 0.15 | 0.07 | 0.05 | - | 13215332E3 | - | - | 13245332E3 | |
| 4700 | 21 x 38 | 2300 | 150 | 0.15 | 0.05 | 0.05 | - | 13215472E3 | - | - | 13245472E3 | |
| 25 | 22 | 6.5 x 18 | 60 | 5.1 | 0.11 | 8.0 | 4.1 | 2.9 | - | 13226229E3 | 13236229E3 | - |
| | 220 | 10 x 25 | 340 | 15 | 0.11 | 0.80 | 0.40 | 0.40 | - | 13290503E3 | 13290504E3 | - |
| | 220 | 12.5 x 30 | 340 | 11 | 0.11 | 0.80 | 0.40 | 0.60 | 13216221E3 | 13226221E3 | - | - |
| | 330 | 12.5 x 30 | 410 | 16.5 | 0.11 | 0.53 | 0.30 | 0.40 | 13216331E3 | 13226331E3 | - | - |
| | 470 | 12.5 x 30 | 560 | 24 | 0.11 | 0.37 | 0.20 | - | 13216471E3 | 13226471E3 | - | - |
| | 680 | 18 x 30 | 700 | 34 | 0.11 | 0.26 | 0.10 | - | 13216681E3 | - | - | 13246681E3 |
| | 1000 | 18 x 30 | 1000 | 50 | 0.11 | 0.17 | 0.10 | - | 13216102E3 | - | - | 13246102E3 |
| | 1500 | 18 x 38 | 1100 | 75 | 0.12 | 0.13 | 0.06 | - | 13216152E3 | - | - | 13246152E3 |
| 2200 | 21 x 38 | 1850 | 110 | 0.13 | 0.09 | 0.05 | - | 13216222E3 | - | - | 13246222E3 | |
| 40 | 47 | 8 x 18 | 120 | 7.8 | 0.09 | 3.0 | 1.6 | 1.4 | - | 13227479E3 | 13237479E3 | - |
| | 100 | 10 x 18 | 210 | 12 | 0.09 | 1.4 | 0.75 | 0.75 | - | 13227101E3 | 13237101E3 | - |
| | 150 | 10 x 25 | 310 | 16 | 0.09 | 0.95 | 0.50 | 0.50 | - | 13290511E3 | 13290512E3 | - |
| | 150 | 12.5 x 30 | 310 | 12 | 0.09 | 0.95 | 0.50 | 0.60 | 13217151E3 | 13227151E3 | - | - |
| | 220 | 12.5 x 30 | 410 | 17.5 | 0.09 | 0.65 | 0.34 | 0.40 | 13217221E3 | 13227221E3 | - | - |
| | 330 | 15 x 30 | 550 | 26 | 0.09 | 0.43 | 0.20 | - | 13217331E3 | 13227331E3 | - | 13247331E3 |
| | 470 | 15 x 30 | 700 | 38 | 0.09 | 0.30 | 0.16 | - | 13217471E3 | 13227471E3 | - | 13247471E3 |
| | 680 | 18 x 30 | 900 | 54 | 0.09 | 0.21 | 0.10 | - | 13217681E3 | - | - | 13247681E3 |
| | 1000 | 18 x 38 | 1200 | 80 | 0.09 | 0.14 | 0.08 | - | 13217102E3 | - | - | 13247102E3 |
| | 1500 | 21 x 38 | 1500 | 120 | 0.10 | 0.10 | 0.06 | - | 13217152E3 | - | - | 13247152E3 |
| 2200 | 21 x 38 | 1900 | 180 | 0.10 | 0.07 | 0.05 | - | 13217222E3 | - | - | 13247222E3 | |
| 63 | 4.7 | 6.5 x 18 | 38 | 4.6 | 0.07 | 24 | 12 | 5.0 | - | 13228478E3 | 13238478E3 | - |
| | 10 | 6.5 x 18 | 64 | 5.3 | 0.07 | 11 | 5.5 | 3.3 | - | 13228109E3 | 13238109E3 | - |
| | 22 | 8 x 18 | 100 | 6.8 | 0.07 | 5.1 | 2.5 | 2.1 | - | 13228229E3 | 13238229E3 | - |
| | 47 | 10 x 18 | 170 | 9.9 | 0.07 | 2.4 | 1.2 | 1.2 | - | 13228479E3 | 13238479E3 | - |
| | 68 | 10 x 25 | 210 | 12.6 | 0.07 | 1.6 | 0.81 | 0.60 | - | 13290513E3 | 13290514E3 | - |
| | 68 | 10 x 30 | 210 | 8.6 | 0.07 | 1.6 | 0.80 | 0.60 | 13218689E3 | 13228689E3 | - | - |
| | 100 | 10 x 30 | 300 | 12.6 | 0.07 | 1.1 | 0.60 | 0.40 | 13218101E3 | 13228101E3 | - | - |
| | 150 | 15 x 30 | 350 | 19 | 0.07 | 0.74 | 0.37 | - | 13218151E3 | 13228151E3 | - | 13248151E3 |
| | 220 | 15 x 30 | 520 | 28 | 0.07 | 0.50 | 0.25 | - | 13218221E3 | 13228221E3 | - | 13248221E3 |
| | 330 | 18 x 30 | 600 | 42 | 0.07 | 0.34 | 0.15 | - | 13218331E3 | - | - | 13248331E3 |
| | 470 | 18 x 38 | 970 | 59 | 0.07 | 0.24 | 0.12 | - | 13218471E3 | - | - | 13248471E3 |
| | 680 | 21 x 38 | 1000 | 86 | 0.07 | 0.16 | 0.08 | - | 13218681E3 | - | - | 13248681E3 |
| 1000 | 21 x 38 | 1600 | 130 | 0.07 | 0.11 | 0.06 | - | 13218102E3 | - | - | 13248102E3 | |



| ELECTRICAL DATA AND ORDERING INFORMATION | | | | | | | | | | | | |
|--|----------------------------------|---|---|----------------------------------|-----------------|----------------------|--------------------|---------------------|-------------------------|-----------------------------|----------------------------|-----------------------------|
| U _R (V) | C _R 100 Hz (μF) | NOMINAL CASE SIZE Ø D x L (mm) | I _R 100 Hz 85 °C (mA) | I _{L5} 5 min (μA) | tan δ 100 Hz | ESR 100 Hz (Ω) | Z 10 kHz (Ω) | Z 100 kHz (Ω) | ORDERING CODE MAL2..... | | | |
| | | | | | | | | | IN BOX FORM AA | TAPED ON REEL FORM BR | TAPED IN BOX FORM BA | MOUNTING RING FORM MR |
| 100 | 1.0 | 6.5 x 18 | 20 | 4.0 | 0.06 | 95 | 45 | 6.0 | - | 13229108E3 | 13239108E3 | - |
| | 4.7 | 6.5 x 18 | 48 | 4.9 | 0.06 | 20 | 9.6 | 4.0 | - | 13229478E3 | 13239478E3 | - |
| | 47 | 10 x 25 | 220 | 13.4 | 0.06 | 2.0 | 1.0 | 0.90 | - | 13290505E3 | 13290506E3 | - |
| | 47 | 10 x 30 | 220 | 9.4 | 0.06 | 2.0 | 1.0 | 0.90 | 13219479E3 | 13229479E3 | - | - |
| | 68 | 12.5 x 30 | 250 | 13.5 | 0.06 | 1.4 | 0.80 | - | 13219689E3 | 13229689E3 | - | - |
| | 100 | 15 x 30 | 380 | 20 | 0.06 | 0.95 | 0.50 | - | 13219101E3 | 13229101E3 | - | 13249101E3 |
| | 150 | 18 x 30 | 400 | 30 | 0.06 | 0.64 | 0.35 | - | 13219151E3 | - | - | 13249151E3 |
| | 220 | 18 x 38 | 660 | 44 | 0.06 | 0.43 | 0.20 | - | 13219221E3 | - | - | 13249221E3 |
| | 330 | 18 x 38 | 700 | 66 | 0.06 | 0.29 | 0.15 | - | 13219331E3 | - | - | 13249331E3 |
| | 470 | 21 x 38 | 1200 | 94 | 0.06 | 0.20 | 0.10 | - | 13219471E3 | - | - | 13249471E3 |
| 160 | 22 | 10 x 25 | 120 | 20 | 0.10 | 7.2 | 5.5 | 2.5 | - | 13390502E3 | 13390503E3 | - |

| ADDITIONAL ELECTRICAL DATA | | | |
|--|--|--|---------------|
| PARAMETER | CONDITIONS | VALUE | |
| | | AXIAL | MOUNTING RING |
| Voltage | | | |
| Surge voltage | U _R = 10 V to 160 V | U _s ≤ 1.15 x U _R | |
| Reverse voltage | | U _{rev} ≤ 1 V | |
| Current | | | |
| Leakage current | After 1 min: | | |
| | case Ø D x L = 6.5 mm x 18 mm to 10 mm x 25 mm: | | |
| | U _R = 10 V to 100 V | I _{L1} ≤ 0.01 C _R x U _R + 3 μA | |
| | U _R = 160 V | I _{L1} ≤ 50 μA | |
| | case Ø D x L = 10 mm x 30 mm to 21 mm x 38 mm: | | |
| | U _R = 10 V to 100 V | I _{L1} ≤ 0.006 C _R x U _R + 3 μA | |
| | After 5 min: | | |
| | case Ø D x L = 6.5 mm x 18 mm to 10 mm x 25 mm: | | |
| | U _R = 10 V to 100 V | I _{L5} ≤ 0.002 C _R x U _R + 4 μA | |
| | U _R = 160 V | I _{L5} ≤ 20 μA | |
| case Ø D x L = 10 mm x 30 mm to 21 mm x 38 mm: | | | |
| U _R = 10 V to 100 V | I _{L5} ≤ 0.002 C _R x U _R + 4 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 at 10 kHz

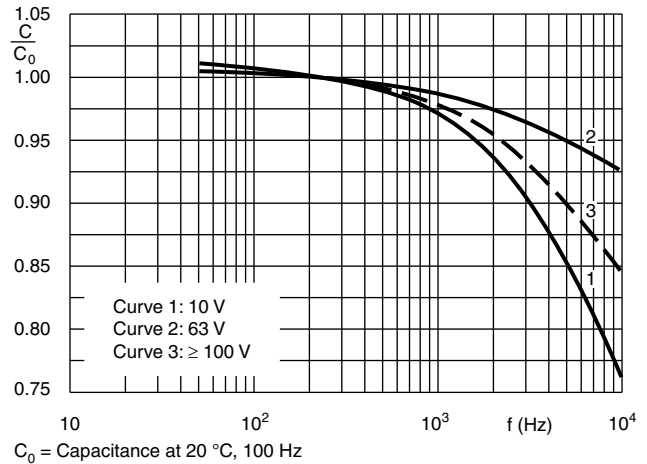


Fig. 6 - Typical multiplier of capacitance as a function of frequency

DISSIPATION FACTOR (tan δ)

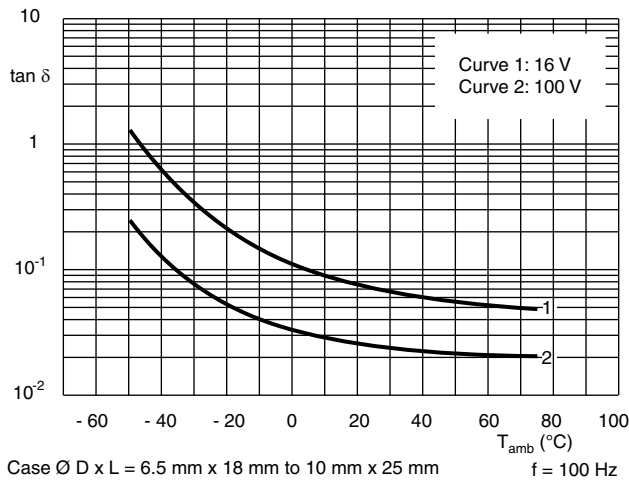


Fig. 7 - Typical tan δ as a function of ambient temperature

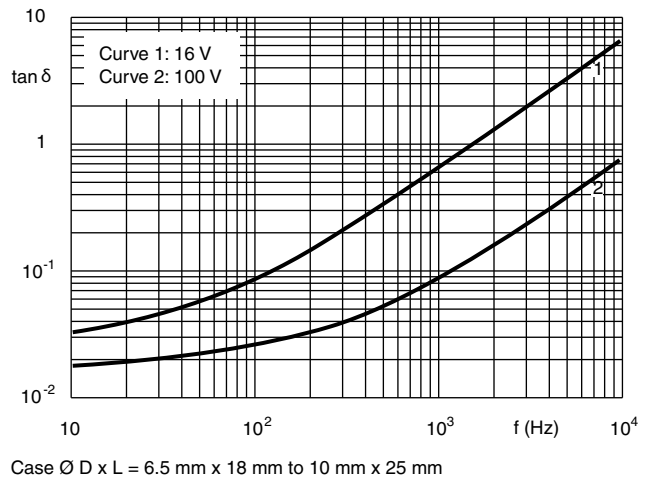


Fig. 8 - Typical tan δ as a function of frequency

IMPEDANCE (Z)

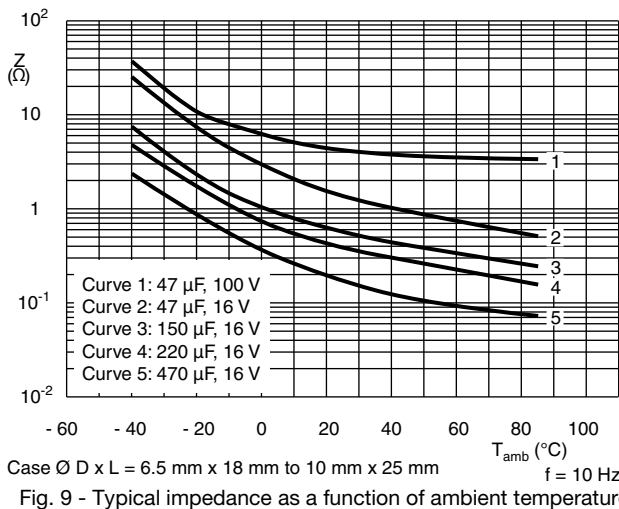


Fig. 9 - Typical impedance as a function of ambient temperature

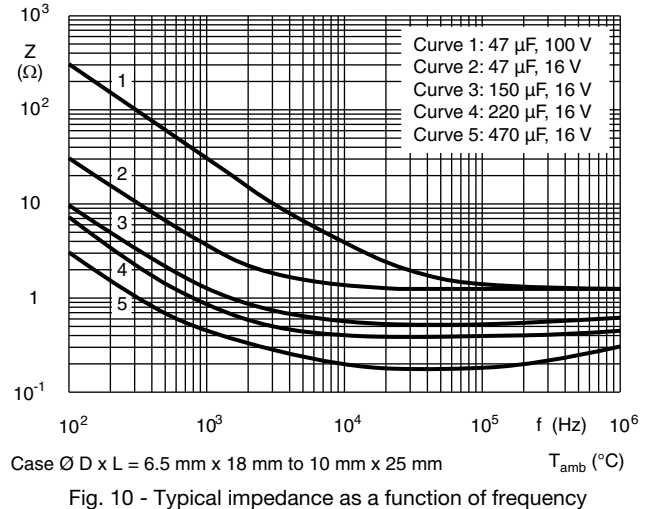


Fig. 10 - Typical impedance as a function of frequency



RIPPLE CURRENT AND USEFUL LIFE

Table 4

| ENDURANCE TEST DURATION AND USEFUL LIFE | | |
|---|------------------------------|--------------------------------|
| NOMINAL CASE SIZE Ø D x L (mm) | ENDURANCE AT 85 °C (h) | USEFUL LIFE AT 85 °C (h) |
| 6.5 x 18 | 6000 | 10 000 |
| 8 x 18 | 6000 | 10 000 |
| 10 x 18 | 6000 | 10 000 |
| 10 x 25 | 6000 | 10 000 |
| 10 x 30 | 8000 | 15 000 |
| 12.5 x 30 | 8000 | 15 000 |
| 15 x 30 | 8000 | 15 000 |
| 18 x 30 | 8000 | 15 000 |
| 18 x 38 | 8000 | 15 000 |
| 21 x 38 | 8000 | 15 000 |

Note

- Multiplier of useful life code: CCC205

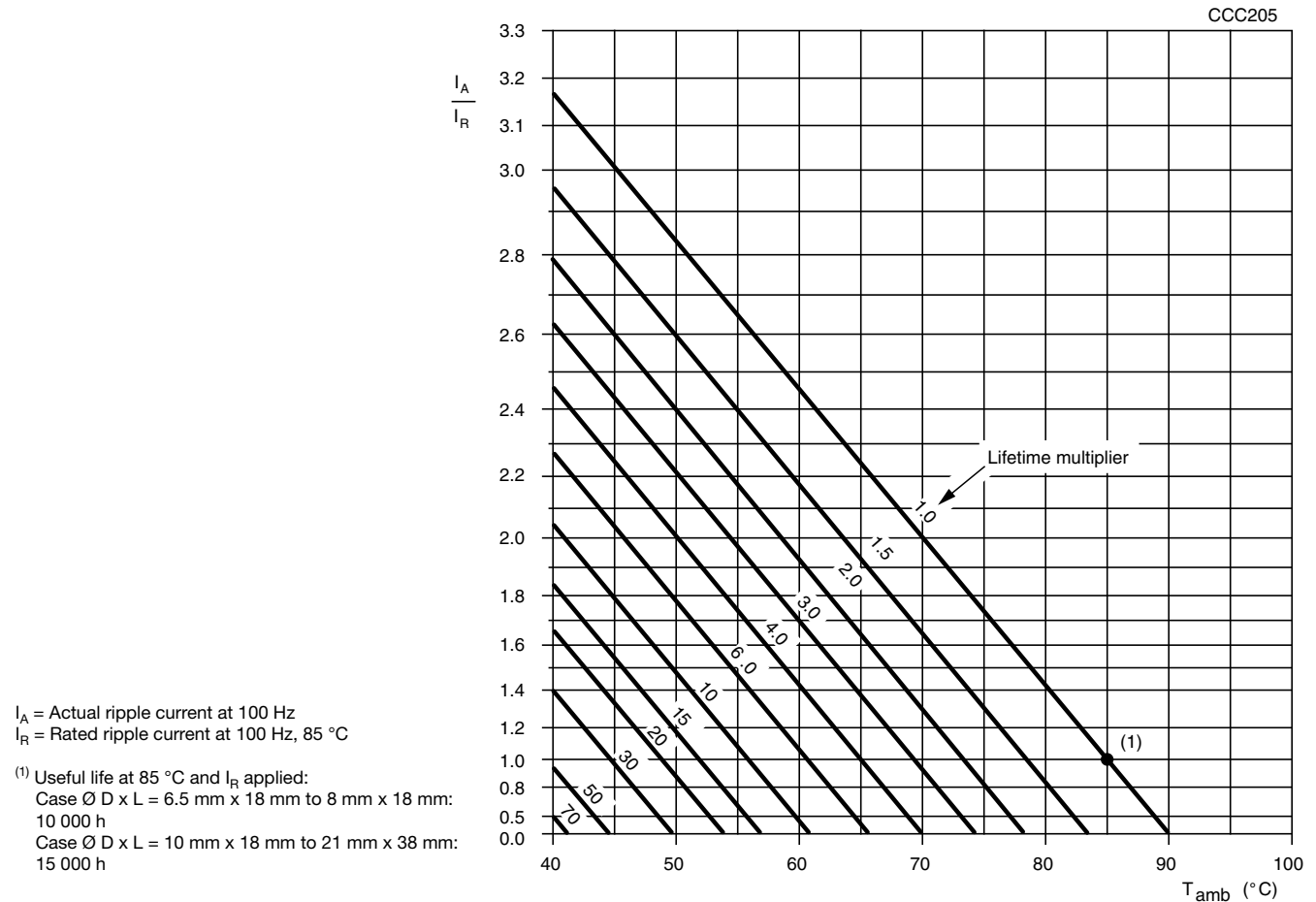


Fig. 11 - Multiplier of useful life as a function of ambient temperature and ripple current load



Table 5

| MULTIPLIER OF RIPPLE CURRENT (I_R) AS A FUNCTION OF FREQUENCY | | | | | | |
|---|----------------|------|------|------|------|----------------|
| U_R (V) | FREQUENCY (Hz) | | | | | |
| | 50 | 100 | 300 | 1000 | 3000 | $\geq 10\ 000$ |
| I_R MULTIPLIER | | | | | | |
| 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 | 0.90 | 1.00 | 1.12 | 1.20 | 1.25 | 1.30 |
| 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 |
| 160 | 0.85 | 1.00 | 1.20 | 1.30 | 1.35 | 1.40 |
| 250 | 0.85 | 1.00 | 1.20 | 1.30 | 1.35 | 1.40 |

Table 6

| TEST PROCEDURES AND REQUIREMENTS | | | |
|--|---|--|--|
| TEST | | PROCEDURE (quick reference) | REQUIREMENTS |
| NAME OF TEST | REFERENCE | | |
| Endurance | IEC 60384-4/ EN 130300 subclause 4.13 | $T_{amb} = 85\ ^\circ\text{C}$; U_R applied; Case $\varnothing D \times L = 6.5\ \text{mm} \times 18\ \text{mm}$ to $8\ \text{mm} \times 18\ \text{mm}$: 6000 h; Case $\varnothing D \times L = 10\ \text{mm} \times 18\ \text{mm}$ to $21\ \text{mm} \times 38\ \text{mm}$: 8000 h | $U_R = 10\ \text{V}$ to $160\ \text{V}$; $\Delta C/C: \pm 15\ \%$ $\tan \delta \leq 1.3 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ |
| Useful life | CECC 30301 subclause 1.8.1 | $T_{amb} = 85\ ^\circ\text{C}$; U_R and I_R applied; Case $\varnothing D \times L = 6.5\ \text{mm} \times 18\ \text{mm}$ to $8\ \text{mm} \times 18\ \text{mm}$: 10 000 h; Case $\varnothing D \times L = 10\ \text{mm} \times 18\ \text{mm}$ to $21\ \text{mm} \times 38\ \text{mm}$: 15 000 h | $U_R = 10\ \text{V}$ to $160\ \text{V}$; $\Delta C/C: \pm 45\ \%$ $\tan \delta \leq 3 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit total failure percentage: $\leq 1\ \%$ |
| Shelf life (storage at high temperature) | IEC 60384-4/ EN 130300 subclause 4.17 | $T_{amb} = 85\ ^\circ\text{C}$; no voltage applied; 500 h; After test: U_R to be applied for 30 min, 24 h to 48 h before measurement | $\Delta C/C$, $\tan \delta$, Z : for requirements see "Endurance test" above $I_{L5} \leq 2 \times \text{spec. limit}$ |



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