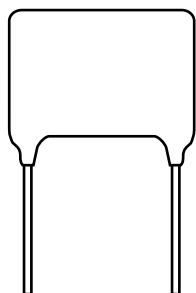




DC Film Capacitors MKT Radial Lacquered Type



FEATURES

- Available taped and loose in box
- Material categorization:
for definitions of compliance please see www.vishay.com/doc?99912



RoHS
COMPLIANT

APPLICATIONS

Blocking and coupling, bypass and energy reservoir

| QUICK REFERENCE DATA | |
|---|--|
| Capacitance range (E12 series) | 0.001 μ F to 1.0 μ F |
| Capacitance tolerance | $\pm 10\%$, $\pm 5\%$ |
| Climatic testing class according to IEC 60068-1 | 55/105/56 |
| Maximum application temperature | 105 °C |
| Reference standards | IEC 60384-2 |
| Dielectric | Polyester film |
| Electrodes | Metallized |
| Construction | Mono construction |
| Encapsulation | Flame retardant epoxy material (UL-class 94 V-0) |
| Leads | Tinned wire |
| Marking | C-value; tolerance; rated voltage; code for manufacturer; manufacturer's type; manufacturer's logo |
| Rated (DC) voltage | 100 V, 250 V, 400 V, 630 V |
| Rated (AC) voltage | 63 V, 160 V, 220 V, 250 V |
| Rated temperature | 85 °C |

Note

- For more detailed data and test requirements, contact dc-film@vishay.com

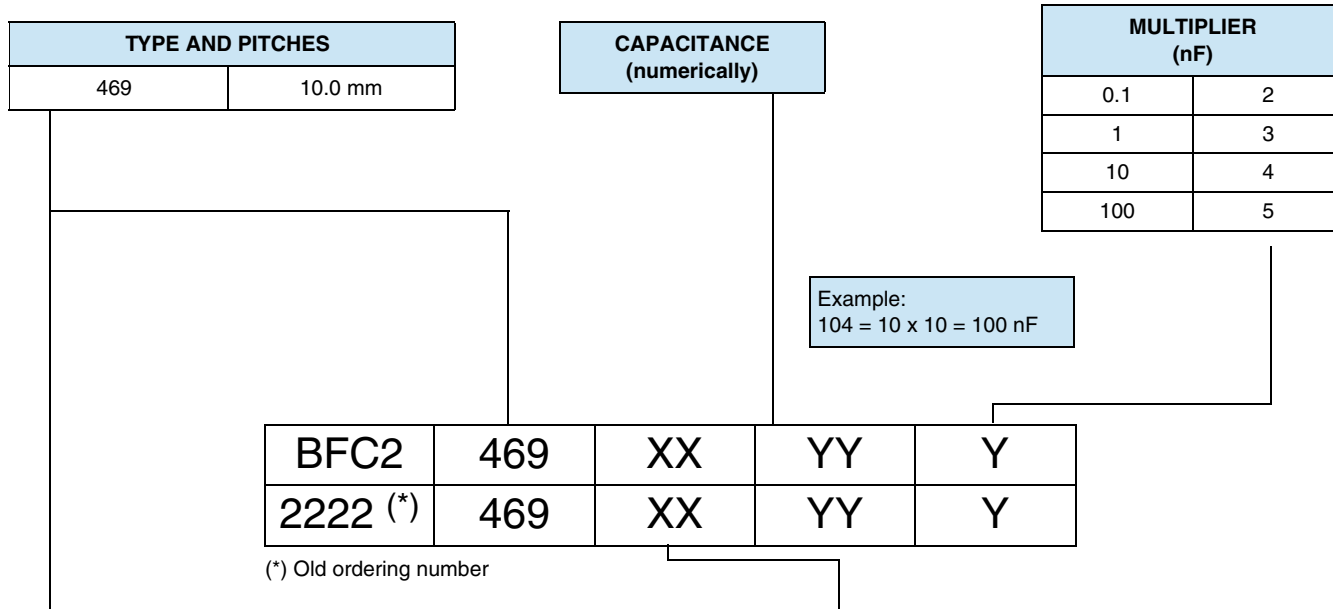
| DIMENSIONS |
|--|
| <p style="text-align: center;">Straight Leads</p> |

Note

- (1) Hole \varnothing 1.0 for $d_t = 0.6$ mm



COMPOSITION OF CATALOG NUMBER



| TYPE | PACKAGING | LEAD CONFIGURATION | PREFERRED TYPES | | | | |
|------|-------------------|---|-----------------|-------|-------|-------|-------|
| | | | C-TOL. | 100 V | 250 V | 400 V | 630 V |
| 469 | Loose in box | Lead length 4.0 mm + 1.0 mm/- 0.5 mm | ± 10 % | 25 | 45 | 55 | 65 |
| | | | ± 5 % | 26 | 46 | 56 | 66 |
| | | Lead length 22.0 mm ± 4.0 mm | ± 10 % | 21 | 41 | 51 | 61 |
| | | | ± 5 % | 22 | 42 | 52 | 62 |
| | Taped on reel (1) | H = 18.5 mm; P ₀ = 12.7 mm Reel diameter = 500 mm | ± 10 % | 28 | 48 | 58 | 68 |
| | | | ± 5 % | 29 | 49 | 59 | 69 |

Note

(1) For detailed tape specifications refer to packaging information: www.vishay.com/doc?28139

| SPECIFIC REFERENCE DATA | | | | |
|---|-------------------------|--------------------------|--------------------------|---------------------|
| DESCRIPTION | VALUE | | | |
| | at 1 kHz | at 10 kHz | at 100 kHz | |
| Tangent of loss angle: | | | | |
| C ≤ 0.1 μF | ≤ 75 x 10 ⁻⁴ | ≤ 120 x 10 ⁻⁴ | ≤ 200 x 10 ⁻⁴ | |
| 0.1 μF < C ≤ 0.47 μF | ≤ 75 x 10 ⁻⁴ | ≤ 120 x 10 ⁻⁴ | ≤ 225 x 10 ⁻⁴ | |
| 0.47 μF < C ≤ 1.0 μF | ≤ 75 x 10 ⁻⁴ | ≤ 120 x 10 ⁻⁴ | - | |
| Rated voltage pulse slope (dU/dt) _R at I _{max.} = 12.5 mA | 100 V _{DC} | 250 V _{DC} | 400 V _{DC} | 630 V _{DC} |
| | 30 V/μs | 120 V/μs | 170 V/μs | 120 V/μs |
| R between leads, for C ≤ 0.33 μF at 100 V; 1 min at 500 V; 1 min | > 15 000 MΩ | > 30 000 MΩ | > 30 000 MΩ | > 30 000 MΩ |
| RC between leads, for C > 0.33 μF at 100 V; 1 min at 500 V; 1 min | > 5000 s | > 10 000 s | > 10 000 s | > 10 000 s |
| R between interconnecting leads and casing, at 100 V; 1 min at 500 V; 1 min | > 30 000 MΩ | > 30 000 MΩ | > 30 000 MΩ | > 30 000 MΩ |
| Withstanding (DC) voltage (cut off current 10 mA) (1); rise time ≤ 1000 V/s | 160 V; 1 min | 400 V; 1 min | 640 V; 1 min | 1008 V; 1 min |
| Withstanding (DC) voltage between leads and case | 200 V; 1 min | 500 V; 1 min | 840 V; 1 min | 1260 V; 1 min |
| Maximum application temperature | 105 °C | | | |

Note

(1) See "Voltage Proof Test for Metallized Film Capacitors": www.vishay.com/doc?28169



| ELECTRICAL DATA AND ORDERING INFORMATION | | | | | | | | | | | |
|--|---------------------------------|---|--|---|---------------------------------|---|---------------------------------|---|---------------------------------|--|----------------|
| U_{RDC} (V) | CAP. (µF) | DIMENSIONS W_{max.} x h_{max.} x l_{max.} (mm) | MASS (g) ⁽¹⁾ | CATALOG NUMBER BFC2 469 XXYYY AND PACKAGING | | | | | | | C-VALUE |
| | | | | LOOSE IN BOX | | | | REEL | | | |
| | | | | l_t = 4.0 mm + 1.0 mm / - 0.5 mm | | l_t = 22.0 mm ± 4.0 mm | | H = 18.5 mm; P₀ = 12.7 mm | | | |
| | | | | C-TOL. = ± 10 % | C-TOL. = ± 5 % | C-TOL. = ± 10 % | C-TOL. = ± 5 % | C-TOL. = ± 10 % | C-TOL. = ± 5 % | | |
| | | XX (SPQ) | XX (SPQ) | XX (SPQ) | XX (SPQ) | XX (SPQ) | XX (SPQ) | XX (SPQ) | XX (SPQ) | ..YYY | |
| Pitch = 10.0 mm ± 0.4 mm; d_t = 0.60 mm ± 0.06 mm (U_{RAC} = 63 V) | | | | | | | | | | | |
| 100 | 0.056 0.068 0.082 0.10 | 4.0 x 11.0 x 12.5 | 0.35 | 25... (2000) | 26... (2000) | 21... (1500) | 22... (1500) | 28... (1500) | 29... (1500) | 563 683 823 104 | |
| | 0.12 | 4.3 x 11.3 x 12.5 | 0.38 | 25... (2000) | 26... (2000) | 21... (1500) | 22... (1500) | 28... (1500) | 29... (1500) | 124 | |
| | 0.15 | 3.9 x 10.9 x 12.5 | 0.34 | 25... (2000) | 26... (2000) | 21... (1500) | 22... (1500) | 28... (1500) | 29... (1500) | 154 | |
| | 0.18 | 4.2 x 11.2 x 12.5 | 0.37 | 25... (2000) | 26... (2000) | 21... (1500) | 22... (1500) | 28... (1500) | 29... (1500) | 184 | |
| | 0.22 | 4.5 x 11.5 x 12.5 | 0.40 | 25... (2000) | 26... (2000) | 21... (1500) | 22... (1500) | 28... (1300) | 29... (1300) | 224 | |
| | 0.27 | 4.2 x 11.2 x 12.5 | 0.37 | 25... (2000) | 26... (2000) | 21... (1500) | 22... (1500) | 28... (1500) | 29... (1500) | 274 | |
| | 0.33 | 4.6 x 11.6 x 12.5 | 0.41 | 25... (2000) | 26... (2000) | 21... (1500) | 22... (1500) | 28... (1300) | 29... (1300) | 334 | |
| | 0.39 | 4.0 x 11.0 x 12.5 | 0.35 | 25... (2000) | 26... (2000) | 21... (1500) | 22... (1500) | 28... (1500) | 29... (1500) | 394 | |
| | 0.47 | 4.2 x 11.2 x 12.5 | 0.37 | 25... (2000) | 26... (2000) | 21... (1500) | 22... (1500) | 28... (1500) | 29... (1500) | 474 | |
| | 0.56 | 4.6 x 11.6 x 12.5 | 0.41 | 25... (2000) | 26... (2000) | 21... (1500) | 22... (1500) | 28... (1300) | 29... (1300) | 564 | |
| | 0.68 | 5.0 x 12.0 x 12.5 | 0.44 | 25... (1500) | 26... (1500) | 21... (1250) | 22... (1250) | 28... (1200) | 29... (1200) | 684 | |
| | 0.82 | 5.5 x 12.5 x 12.5 | 0.47 | 25... (1500) | 26... (1500) | 21... (1000) | 22... (1000) | 28... (1100) | 29... (1100) | 824 | |
| 1.0 | 6.0 x 13.0 x 12.5 | 0.55 | 25... (1250) | 26... (1250) | 21... (1000) | 22... (1000) | 28... (1000) | 29... (1000) | 105 | | |
| Pitch = 10.0 mm ± 0.4 mm; d_t = 0.60 mm ± 0.06 mm (U_{RAC} = 160 V) | | | | | | | | | | | |
| 250 | 0.027 | 4.2 x 11.2 x 12.5 | 0.37 | 45... (2000) | 46... (2000) | 41... (1500) | 42... (1500) | 48... (1500) | 49... (1500) | 273 | |
| | 0.033 | 4.6 x 11.6 x 12.5 | 0.41 | 45... (2000) | 46... (2000) | 41... (1500) | 42... (1500) | 48... (1300) | 49... (1300) | 333 | |
| | 0.039 | 4.0 x 11.0 x 12.5 | 0.35 | 45... (2000) | 46... (2000) | 41... (1500) | 42... (1500) | 48... (1500) | 49... (1500) | 393 | |
| | 0.047 | 4.1 x 11.1 x 12.5 | 0.36 | 45... (2000) | 46... (2000) | 41... (1500) | 42... (1500) | 48... (1500) | 49... (1500) | 473 | |
| | 0.056 | 4.0 x 11.0 x 12.5 | 0.35 | 45... (2000) | 46... (2000) | 41... (1500) | 42... (1500) | 48... (1500) | 49... (1500) | 563 | |
| | 0.068 | 4.1 x 11.1 x 12.5 | 0.36 | 45... (2000) | 46... (2000) | 41... (1500) | 42... (1500) | 48... (1500) | 49... (1500) | 683 | |
| | 0.082 | 4.4 x 11.4 x 12.5 | 0.39 | 45... (2000) | 46... (2000) | 41... (1500) | 42... (1500) | 48... (1500) | 49... (1500) | 823 | |
| | 0.10 | 4.0 x 11.0 x 12.5 | 0.35 | 45... (2000) | 46... (2000) | 41... (1500) | 42... (1500) | 48... (1500) | 49... (1500) | 104 | |
| | 0.12 | 4.3 x 11.3 x 12.5 | 0.38 | 45... (2000) | 46... (2000) | 41... (1500) | 42... (1500) | 48... (1500) | 49... (1500) | 124 | |
| | 0.15 | 4.8 x 11.8 x 12.5 | 0.42 | 45... (2000) | 46... (2000) | 41... (1250) | 42... (1250) | 48... (1300) | 49... (1300) | 154 | |
| | 0.18 | 5.2 x 12.2 x 12.5 | 0.45 | 45... (1500) | 46... (1500) | 41... (1000) | 42... (1000) | 48... (1200) | 49... (1200) | 184 | |
| | 0.22 | 5.8 x 12.8 x 12.5 | 0.50 | 45... (1500) | 46... (1500) | 41... (1000) | 42... (1000) | 48... (1100) | 49... (1100) | 224 | |



| ELECTRICAL DATA AND ORDERING INFORMATION | | | | | | | | | | | |
|---|--------------------------------------|---|----------------------------|--|-------------------|-----------------------------------|-------------------|--|-------------------|--------------------------|---------|
| U _{RDC} (V) | CAP. (μF) | DIMENSIONS w _{max.} x h _{max.} x l _{max.} (mm) | MASS (g) ⁽¹⁾ | CATALOG NUMBER BFC2 469 XYYYY AND PACKAGING | | | | | | | C-VALUE |
| | | | | LOOSE IN BOX | | | | REEL | | | |
| | | | | l _t = 4.0 mm + 1.0 mm / - 0.5 mm | | l _t = 22.0 mm ± 4.0 mm | | H = 18.5 mm; P ₀ = 12.7 mm | | | |
| | | | | C-TOL. = ± 10 % | C-TOL. = ± 5 % | C-TOL. = ± 10 % | C-TOL. = ± 5 % | C-TOL. = ± 10 % | C-TOL. = ± 5 % | | |
| XX (SPQ) | XX (SPQ) | XX (SPQ) | XX (SPQ) | XX (SPQ) | XX (SPQ) | XX (SPQ) | XX (SPQ) | ..YYY | | | |
| Pitch = 10.0 mm ± 0.4 mm; d _t = 0.60 mm ± 0.06 mm (U _{RAC} = 220 V) | | | | | | | | | | | |
| 400 | 0.0010 0.0012 0.0015 0.0018 | 4.5 x 11.5 x 12.5 | 0.40 | 55... (2000) | 56... (2000) | 51... (1500) | 52... (1500) | 58... (1300) | 59... (1300) | 102 122 152 182 | |
| | 0.0022 | 4.0 x 11.0 x 12.5 | 0.35 | 55... (2000) | 56... (2000) | 51... (1500) | 52... (1500) | 58... (1500) | 59... (1500) | 222 | |
| | 0.0027 | 4.3 x 11.3 x 12.5 | 0.38 | 55... (2000) | 56... (2000) | 51... (1500) | 52... (1500) | 58... (1500) | 59... (1500) | 272 | |
| | 0.0033 | 4.6 x 11.6 x 12.5 | 0.41 | 55... (2000) | 56... (2000) | 51... (1500) | 52... (1500) | 58... (1300) | 59... (1300) | 332 | |
| | 0.0039 | 4.0 x 11.0 x 12.5 | 0.35 | 55... (2000) | 56... (2000) | 51... (1500) | 52... (1500) | 58... (1500) | 59... (1500) | 392 | |
| | 0.0047 | 4.1 x 11.1 x 12.5 | 0.36 | 55... (2000) | 56... (2000) | 51... (1500) | 52... (1500) | 58... (1500) | 59... (1500) | 472 | |
| | 0.0056 | 4.6 x 11.6 x 12.5 | 0.41 | 55... (2000) | 56... (2000) | 51... (1500) | 52... (1500) | 58... (1300) | 59... (1300) | 562 | |
| | 0.0068 | 4.2 x 11.2 x 12.5 | 0.37 | 55... (2000) | 56... (2000) | 51... (1500) | 52... (1500) | 58... (1500) | 59... (1500) | 682 | |
| | 0.0082 | 4.6 x 11.6 x 12.5 | 0.41 | 55... (2000) | 56... (2000) | 51... (1500) | 52... (1500) | 58... (1300) | 59... (1300) | 822 | |
| | 0.010 | 4.1 x 11.1 x 12.5 | 0.36 | 55... (2000) | 56... (2000) | 51... (1500) | 52... (1500) | 58... (1500) | 59... (1500) | 103 | |
| | 0.012 | 4.5 x 11.5 x 12.5 | 0.40 | 55... (2000) | 56... (2000) | 51... (1500) | 52... (1500) | 58... (1300) | 59... (1300) | 123 | |
| | 0.015 | 4.1 x 11.1 x 12.5 | 0.36 | 55... (2000) | 56... (2000) | 51... (1500) | 52... (1500) | 58... (1500) | 59... (1500) | 153 | |
| | 0.018 | 4.5 x 11.5 x 12.5 | 0.40 | 55... (2000) | 56... (2000) | 51... (1500) | 52... (1500) | 58... (1300) | 59... (1300) | 183 | |
| | 0.022 | 4.0 x 11.0 x 12.5 | 0.35 | 55... (2000) | 56... (2000) | 51... (1500) | 52... (1500) | 58... (1500) | 59... (1500) | 223 | |
| | 0.027 | 4.2 x 11.2 x 12.5 | 0.37 | 55... (2000) | 56... (2000) | 51... (1500) | 52... (1500) | 58... (1500) | 59... (1500) | 273 | |
| | 0.033 | 4.6 x 11.6 x 12.5 | 0.41 | 55... (2000) | 56... (2000) | 51... (1500) | 52... (1500) | 58... (1300) | 59... (1300) | 333 | |
| | 0.039 | 5.0 x 12.0 x 12.5 | 0.44 | 55... (1500) | 56... (1500) | 51... (1250) | 52... (1250) | 58... (1200) | 59... (1200) | 393 | |
| | 0.047 | 4.1 x 11.1 x 12.5 | 0.36 | 55... (2000) | 56... (2000) | 51... (1500) | 52... (1500) | 58... (1500) | 59... (1500) | 473 | |
| 0.056 | 4.4 x 11.4 x 12.5 | 0.39 | 55... (2000) | 56... (2000) | 51... (1500) | 52... (1500) | 58... (1500) | 59... (1500) | 563 | | |
| 0.068 | 4.8 x 11.8 x 12.5 | 0.42 | 55... (2000) | 56... (2000) | 51... (1250) | 52... (1250) | 58... (1300) | 59... (1300) | 683 | | |
| 0.082 | 5.4 x 12.4 x 12.5 | 0.46 | 55... (1500) | 56... (1500) | 51... (1000) | 52... (1000) | 58... (1200) | 59... (1200) | 823 | | |
| 0.10 | 5.7 x 12.7 x 12.5 | 0.48 | 55... (1500) | 56... (1500) | 51... (1000) | 52... (1000) | 58... (1100) | 59... (1100) | 104 | | |



| ELECTRICAL DATA AND ORDERING INFORMATION | | | | | | | | | | | |
|---|--------------|---|----------------------------|--|-------------------|-----------------------------------|-------------------|--|-------------------|---------|---------|
| U _{RDC} (V) | CAP. (μF) | DIMENSIONS w _{max.} x h _{max.} x l _{max.} (mm) | MASS (g) ⁽¹⁾ | CATALOG NUMBER BFC2 469 XXYYY AND PACKAGING | | | | | | | C-VALUE |
| | | | | LOOSE IN BOX | | | | REEL | | C-VALUE | |
| | | | | l _t = 4.0 mm + 1.0 mm / - 0.5 mm | | l _t = 22.0 mm ± 4.0 mm | | H = 18.5 mm; P ₀ = 12.7 mm | | | |
| | | | | C-TOL. = ± 10 % | C-TOL. = ± 5 % | C-TOL. = ± 10 % | C-TOL. = ± 5 % | C-TOL. = ± 10 % | C-TOL. = ± 5 % | | |
| XX (SPQ) | XX (SPQ) | XX (SPQ) | XX (SPQ) | XX (SPQ) | XX (SPQ) | ..YYY | | | | | |
| Pitch = 10.0 mm ± 0.4 mm; d _t = 0.60 mm ± 0.06 mm (U _{RAC} = 250 V) | | | | | | | | | | | |
| 630 | 0.010 | 4.1 x 11.1 x 12.5 | 0.36 | 65... (2000) | 66... (2000) | 61... (1500) | 62... (1500) | 68... (1500) | 69... (1500) | 103 | |
| | 0.012 | 4.5 x 11.5 x 12.5 | 0.40 | 65... (2000) | 66... (2000) | 61... (1500) | 62... (1500) | 68... (1300) | 69... (1300) | 123 | |
| | 0.015 | 4.9 x 11.9 x 12.5 | 0.43 | 65... (2000) | 66... (2000) | 61... (1250) | 62... (1250) | 68... (1200) | 69... (1200) | 153 | |
| | 0.018 | 5.4 x 12.4 x 12.5 | 0.46 | 65... (1500) | 66... (1500) | 61... (1000) | 62... (1000) | 68... (1100) | 69... (1100) | 183 | |
| | 0.022 | 4.8 x 11.8 x 12.5 | 0.42 | 65... (2000) | 66... (2000) | 61... (1250) | 62... (1250) | 68... (1300) | 69... (1300) | 223 | |
| | 0.027 | 5.3 x 12.3 x 12.5 | 0.46 | 65... (2000) | 66... (2000) | 61... (1000) | 62... (1000) | 68... (1200) | 69... (1200) | 273 | |
| | 0.033 | 5.9 x 12.9 x 12.5 | 0.52 | 65... (1500) | 66... (1500) | 61... (1000) | 62... (1000) | 68... (1100) | 69... (1100) | 333 | |

Notes

- SPQ = Standard Packing Quantity
- ⁽¹⁾ Net weight for short lead product only

MOUNTING**Normal Use**

The capacitors are designed for mounting on printed-circuit boards. The capacitors packed in bandoleers are designed for mounting in printed-circuit boards by means of automatic insertion machines.

For detailed tape specifications refer to packaging information: www.vishay.com/doc?28139

Specific Method of Mounting to Withstand Vibration and Shock

In order to withstand vibration and shock tests, it must be ensured that the underside and the kinks are in good contact with the printed-circuit board.

- For pitches ≤ 15 mm capacitors shall be mechanically fixed by the leads
- For larger pitches the capacitors shall be mounted in the same way and the body clamped

Storage Temperature

T_{stg} = -25 °C to +35 °C with RH maximum 75 % without condensation

SOLDERING

For general soldering conditions and wave soldering profile, we refer to the application note:

“Soldering Guidelines for Film Capacitors”: www.vishay.com/doc?28171

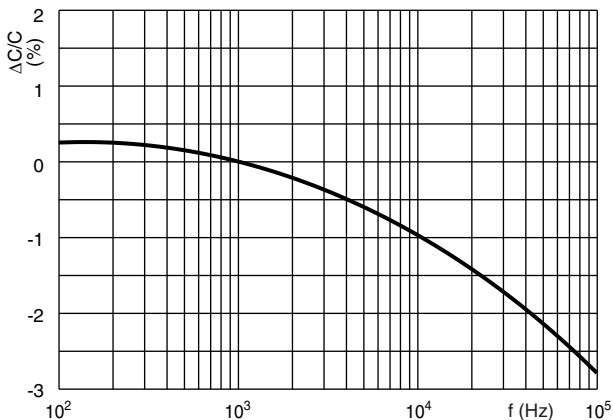
Ratings and Characteristics Reference Conditions

Unless otherwise specified, all electrical values apply to an ambient free air temperature of 23 °C ± 1 °C, an atmospheric pressure of 86 kPa to 106 kPa and a relative humidity of 50 % ± 2 %.

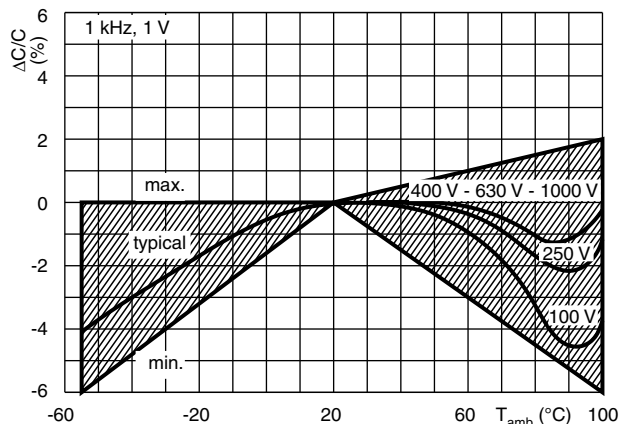
For reference testing, a conditioning period shall be applied over 96 h ± 4 h by heating the products in a circulating air oven at the rated temperature and a relative humidity not exceeding 20 %.



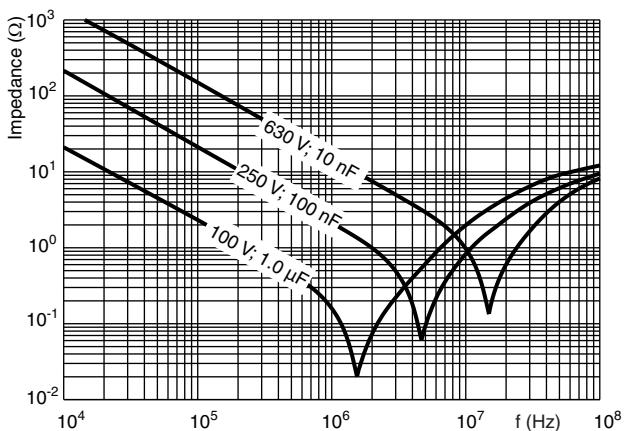
CHARACTERISTICS



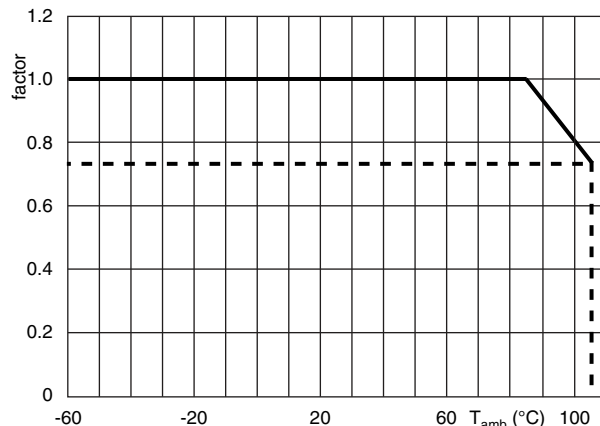
Capacitance as a function of frequency (typical curve)



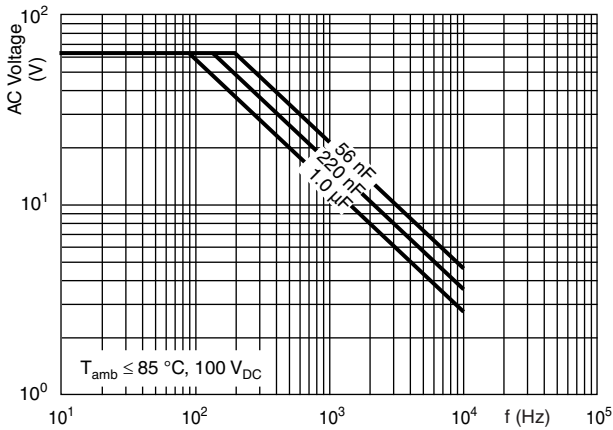
Capacitance as a function of ambient temperature (typical curve)



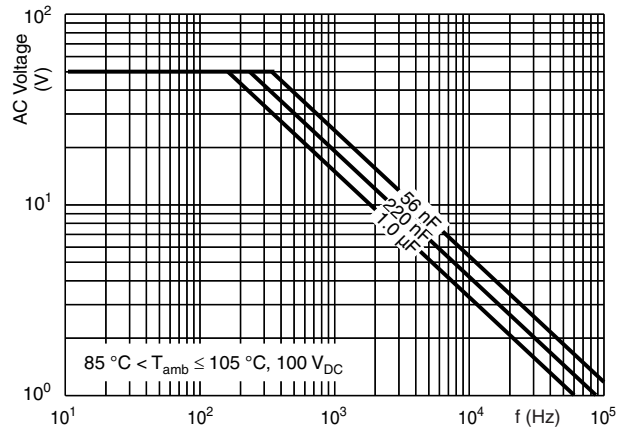
Impedance as a function of frequency (typical curve)



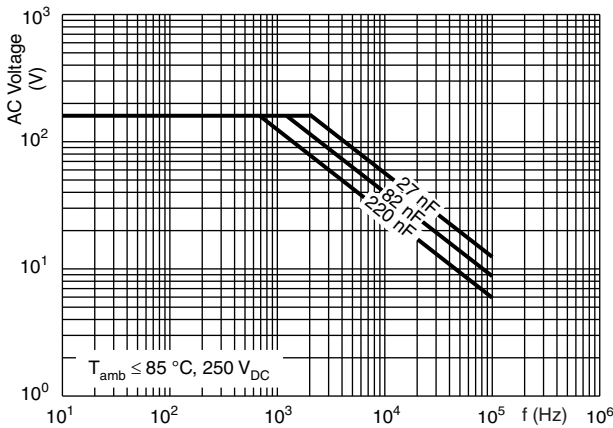
Max. DC and AC voltage as a function of temperature



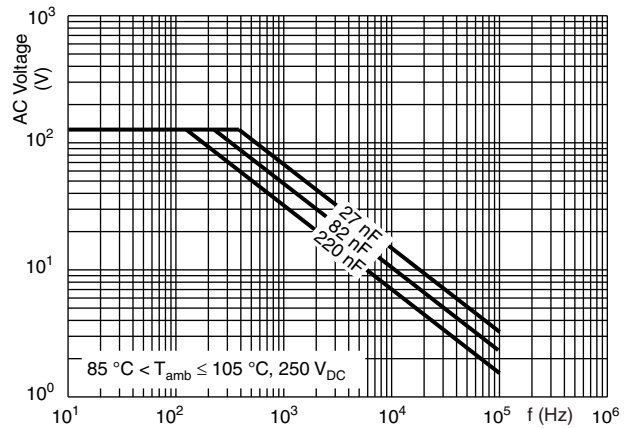
Max. RMS voltage as a function of frequency



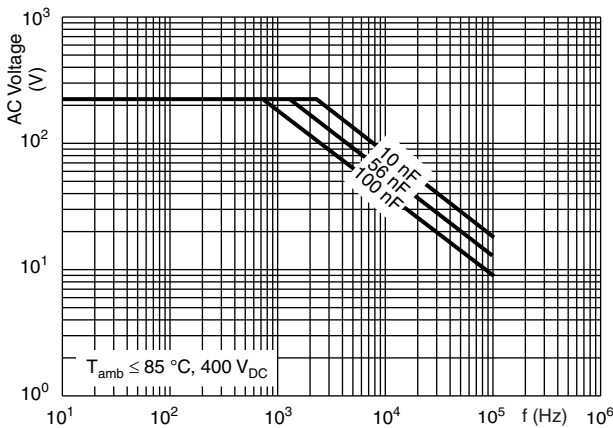
Max. RMS voltage as a function of frequency



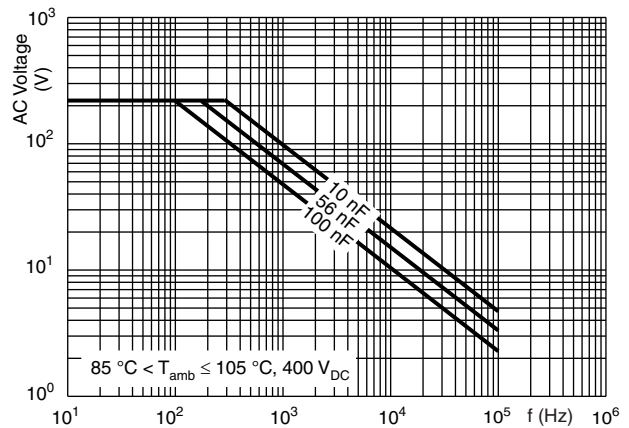
Max. RMS voltage as a function of frequency



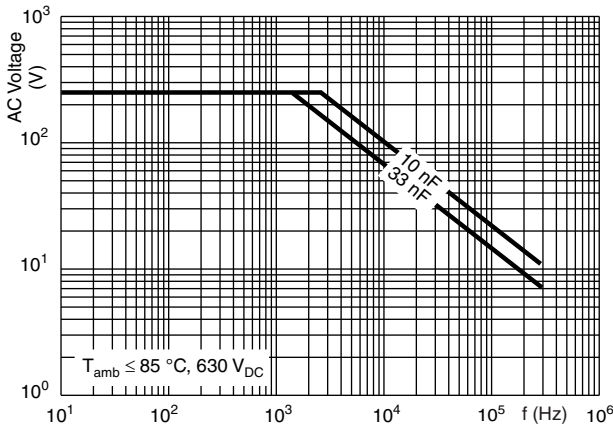
Max. RMS voltage as a function of frequency



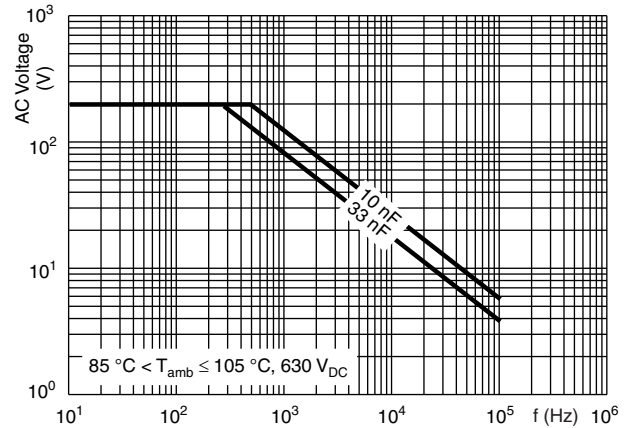
Max. RMS voltage as a function of frequency



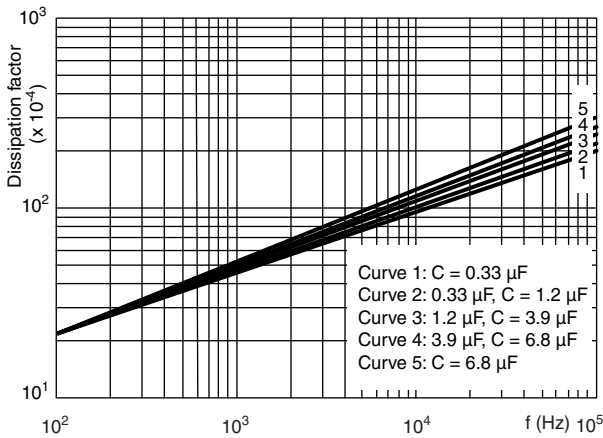
Max. RMS voltage as a function of frequency



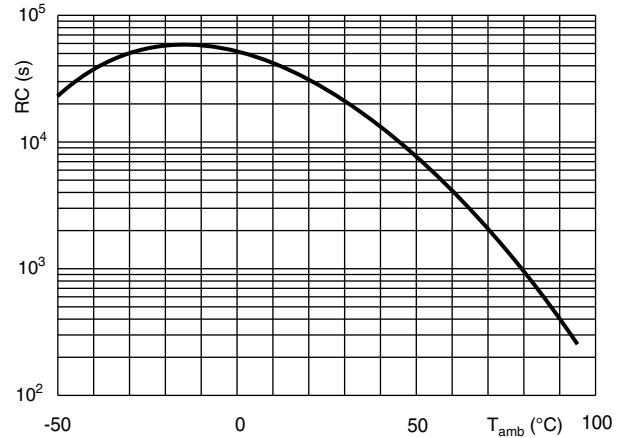
Max. RMS voltage as a function of frequency



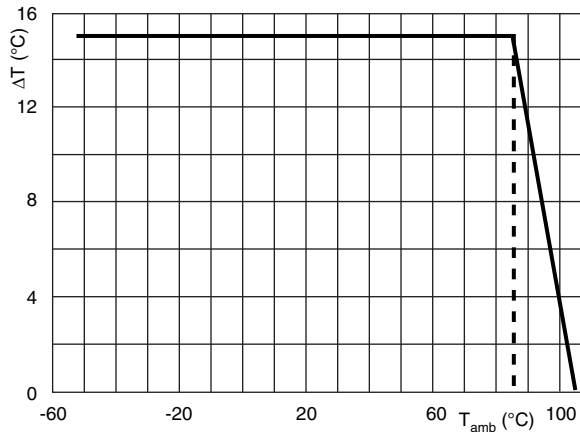
RMS voltage as a function of frequency



Tangent of loss angle as a function of frequency (typical curve)



Insulation resistance as a function of the ambient temperature (typical curve)



Maximum allowed component temperature rise (ΔT) as a function of the ambient temperature (T_{amb})


HEAT CONDUCTIVITY (G) AS A FUNCTION OF (ORIGINAL) PITCH AND CAPACITOR BODY THICKNESS IN mW/°C

| W _{max.} (mm) | HEAT CONDUCTIVITY (mW/°C) | | | |
|---------------------------|---------------------------|---------------|---------------|---------------|
| | PITCH 10 mm | PITCH 15.5 mm | PITCH 22.5 mm | PITCH 27.5 mm |
| 4.0 | 4.0 | 5.0 | - | - |
| 4.5 | 4.5 | 6.0 | - | - |
| 5.0 | 5.0 | 6.0 | 12.0 | 13.0 |
| 5.5 | 6.0 | 6.5 | 13.0 | 15.0 |
| 6.0 | 6.0 | 6.5 | 13.0 | 15.0 |
| 6.5 | 6.5 | 8.0 | 15.0 | 17.0 |
| 7.0 | - | 8.0 | 15.0 | 17.0 |
| 7.5 | - | 9.0 | 17.0 | 18.0 |
| 8.0 | - | 9.0 | 17.0 | 20.0 |
| 8.5 | - | 11.0 | 18.0 | 20.0 |
| 9.0 | - | 11.0 | 18.0 | 22.0 |
| 9.5 | - | 12.0 | 20.0 | 22.0 |
| 10.0 | - | 12.0 | 20.0 | 23.0 |
| 10.5 | - | - | 22.0 | 25.0 |
| 11.0 | - | - | - | 25.0 |
| 11.5 | - | - | - | 27.0 |
| 12.0 | - | - | - | 27.0 |
| 12.5 | - | - | - | 30.0 |
| 13.0 | - | - | - | 30.0 |
| 13.5 | - | - | - | 30.0 |
| 14.0 | - | - | - | 30.0 |
| 14.5 | - | - | - | 33.0 |
| 15.0 | - | - | - | 33.0 |
| 15.5 | - | - | - | 37.0 |
| 16.0 | - | - | - | 37.0 |

POWER DISSIPATION AND MAXIMUM COMPONENT TEMPERATURE RISE

The power dissipation must be limited in order not to exceed the maximum allowed component temperature rise as a function of the free ambient temperature.

The power dissipation can be calculated according type detail specification “HQN-384-01/101: Technical Information Film Capacitors”.

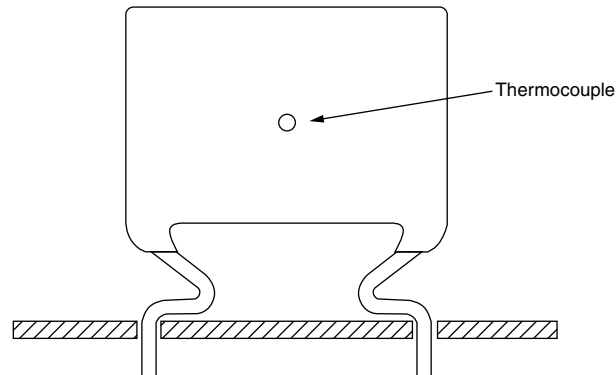
The component temperature rise (ΔT) can be measured (see section “Measuring the component temperature” for more details) or calculated by $\Delta T = P/G$:

- ΔT = component temperature rise (°C)
- P = power dissipation of the component (mW)
- G = heat conductivity of the component (mW/°C)



MEASURING THE COMPONENT TEMPERATURE

A thermocouple must be attached to the capacitor body as in:



The temperature is measured in unloaded (T_{amb}) and maximum loaded condition (T_C).

The temperature rise is given by $\Delta T = T_C - T_{amb}$.

To avoid radiation or convection, the capacitor should be tested in a wind-free box.

APPLICATION NOTE AND LIMITING CONDITIONS

These capacitors are not suitable for mains applications as across-the-line capacitors without additional protection, as described hereunder. These mains applications are strictly regulated in safety standards and therefore electromagnetic interference suppression capacitors conforming the standards must be used.

For capacitors connected in parallel, normally the proof voltage and possibly the rated voltage must be reduced. For information depending of the capacitance value and the number of parallel connections contact: dc-film@vishay.com

To select the capacitor for a certain application, the following conditions must be checked:

1. The peak voltage (U_P) shall not be greater than the rated DC voltage (U_{RDC})
2. The peak-to-peak voltage (U_{P-P}) shall not be greater than $2\sqrt{2} \times U_{RAC}$ to avoid the ionization inception level
3. The voltage pulse slope (dU/dt) shall not exceed the rated voltage pulse slope in an RC-circuit at rated voltage and without ringing. If the pulse voltage is lower than the rated DC voltage, the rated voltage pulse slope may be multiplied by U_{RDC} and divided by the applied voltage.

For all other pulses following equation must be fulfilled:

$$2 \times \int_0^T \left(\frac{dU}{dt} \right)^2 \times dt < U_{RDC} \times \left(\frac{dU}{dt} \right)_{rated}$$

T is the pulse duration.

The rated voltage pulse slope is valid for ambient temperatures up to 85 °C. For higher temperatures a derating factor of 3 % per K shall be applied.

4. The maximum component surface temperature rise must be lower than the limits (see graph "Max. allowed component temperature rise").
5. Since in circuits used at voltages over 280 V peak-to-peak the risk for an intrinsically active flammability after a capacitor breakdown (short circuit) increases, it is recommended that the power to the component is limited to 100 times the values mentioned in the table: "Heat Conductivity"
6. When using these capacitors as across-the-line capacitor in the input filter for mains applications or as series connected with an impedance to the mains the applicant must guarantee that the following conditions are fulfilled in any case (spikes and surge voltages from the mains included).



| VOLTAGE CONDITIONS FOR 6 ABOVE | | |
|--|---|---|
| ALLOWED VOLTAGES | $T_{amb} \leq 85\text{ }^{\circ}\text{C}$ | $85\text{ }^{\circ}\text{C} < T_{amb} \leq 105\text{ }^{\circ}\text{C}$ |
| Maximum continuous RMS voltage | U_{RAC} | $0.8 \times U_{RAC}$ |
| Maximum temperature RMS-overvoltage (< 24 h) | $1.25 \times U_{RAC}$ | U_{RAC} |
| Maximum peak voltage (V_{O-P}) (< 2 s) | $1.6 \times U_{RAC}$ | $1.3 \times U_{RAC}$ |

Example

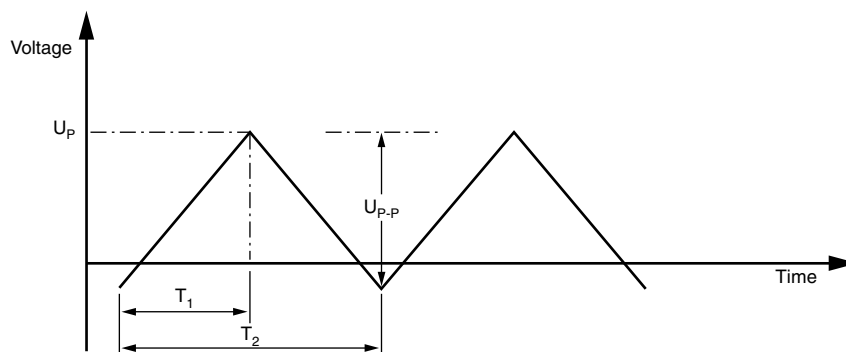
$C = 330\text{ nF} - 100\text{ V}$ used for the voltage signal shown in next drawing.

$U_{P-P} = 80\text{ V}$; $U_P = 70\text{ V}$; $T_1 = 0.5\text{ ms}$; $T_2 = 1\text{ ms}$

The ambient temperature is $35\text{ }^{\circ}\text{C}$

Checking conditions:

1. The peak voltage $U_P = 70\text{ V}$ is lower than 100 V_{DC}
2. The peak-to-peak voltage 80 V is lower than $2\sqrt{2} \times 63\text{ V}_{AC} = 178\text{ V}_{P-P}$
3. The voltage pulse slope (dU/dt) = $80\text{ V}/500\text{ }\mu\text{s} = 0.16\text{ V}/\mu\text{s}$
This is lower than $20\text{ V}/\mu\text{s}$ (see specific reference data for each version)
4. The dissipated power is 60 mW as calculated with fourier terms
The temperature rise for $W_{max.} = 8.5\text{ mm}$ and pitch = 15 mm will be $60\text{ mW}/11\text{ mW}/^{\circ}\text{C} = 5.5\text{ }^{\circ}\text{C}$
This is lower than $15\text{ }^{\circ}\text{C}$ temperature rise at $35\text{ }^{\circ}\text{C}$, according figure "Max. allowed component temperature rise"
5. Not applicable
6. Not applicable

Voltage Signal

**INSPECTION REQUIREMENTS****General Notes**

Sub-clause numbers of tests and performance requirements refer to the “Sectional Specification, Publication IEC 60384-2 and Specific Reference Data”.

| GROUP C INSPECTION REQUIREMENTS | | |
|---|---|--|
| SUB-CLAUSE NUMBER AND TEST | CONDITIONS | PERFORMANCE REQUIREMENTS |
| SUB-GROUP C1A PART OF SAMPLE OF SUB-GROUP C1 | | |
| 4.1 Dimensions (detail) | | As specified in chapters “General Data” of this specification |
| 4.3.1 Initial measurements | Capacitance Tangent of loss angle: for C ≤ 470 nF at 100 kHz or for C > 470 nF at 10 kHz | |
| 4.3 Robustness of terminations | Tensile: load 10 N; 10 s Bending: load 5 N; 4 x 90° | No visible damage |
| 4.4 Resistance to soldering heat | Method: 1A Solder bath: 280 °C ± 5 °C Duration: 10 s | |
| 4.14 Component solvent resistance | Isopropylalcohol at room temperature Method: 2 Immersion time: 5 min ± 0.5 min Recovery time: min. 1 h, max. 2 h | |
| 4.4.2 Final measurements | Visual examination | No visible damage Legible marking |
| | Capacitance | $ \Delta C/C \leq 2\%$ of the value measured initially |
| | Tangent of loss angle | Increase of tan δ ≤ 0.005 for: C ≤ 100 nF or ≤ 0.010 for: 100 nF < C ≤ 220 nF or ≤ 0.015 for: 220 nF < C ≤ 470 nF and ≤ 0.003 for: C > 470 nF Compared to values measured in 4.3.1 |
| SUB-GROUP C1B PART OF SAMPLE OF SUB-GROUP C1 | | |
| 4.6.1 Initial measurements | Capacitance Tangent of loss angle: for C ≤ 470 nF at 100 kHz or for C > 470 nF at 10 kHz | No visible damage |
| 4.6 Rapid change of temperature | θA = -55 °C θB = +100 °C 5 cycles Duration t = 30 min | |
| 4.7 Vibration | Visual examination Mounting: see section “Mounting” of this specification Procedure B4 Frequency range: 10 Hz to 55 Hz Amplitude: 0.75 mm or Acceleration 98 m/s ² (whichever is less severe) Total duration 6 h | No visible damage |
| 4.7.2 Final inspection | Visual examination | No visible damage |



| GROUP C INSPECTION REQUIREMENTS | | |
|--|--|--|
| SUB-CLAUSE NUMBER AND TEST | CONDITIONS | PERFORMANCE REQUIREMENTS |
| 4.9 Shock | Mounting: see section "Mounting" of this specification Pulse shape: half sine Acceleration: 490 m/s ² Duration of pulse: 11 ms | |
| 4.9.3 Final measurements | Visual examination Capacitance Tangent of loss angle Insulation resistance | No visible damage $ \Delta C/C \leq 3\%$ of the value measured in 4.6.1 Increase of $\tan \delta$ ≤ 0.005 for: $C \leq 100$ nF or ≤ 0.010 for: 100 nF < $C \leq 220$ nF or ≤ 0.015 for: 220 nF < $C \leq 470$ nF and ≤ 0.003 for: $C > 470$ nF Compared to values measured in 4.6.1 As specified in section "Insulation Resistance" of this specification |
| SUB-GROUP C1 COMBINED SAMPLE OF SPECIMENS OF SUB-GROUPS C1A AND C1B | | |
| 4.10 Climatic sequence | | |
| 4.10.2 Dry heat | Temperature: +105 °C Duration: 16 h | |
| 4.10.3 Damp heat cyclic Test Db, first cycle | | |
| 4.10.4 Cold | Temperature: -55 °C Duration: 2 h | |
| 4.10.6 Damp heat cyclic Test Db, remaining cycles | | |
| 4.10.6.2 Final measurements | Voltage proof = U_{RDC} for 1 min within 15 min after removal from test chamber Visual examination Capacitance Tangent of loss angle Insulation resistance | No breakdown or flash-over No visible damage Legible marking $ \Delta C/C \leq 5\%$ of the value measured in 4.4.2 or 4.9.3 Increase of $\tan \delta$ ≤ 0.007 for: $C \leq 100$ nF or ≤ 0.010 for: 100 nF < $C \leq 220$ nF or ≤ 0.015 for: 220 nF < $C \leq 470$ nF and ≤ 0.005 for: $C > 470$ nF Compared to values measured in 4.3.1 or 4.6.1 $\geq 50\%$ of values specified in section "Insulation Resistance" of this specification |



| GROUP C INSPECTION REQUIREMENTS | | |
|---------------------------------|---|---|
| SUB-CLAUSE NUMBER AND TEST | CONDITIONS | PERFORMANCE REQUIREMENTS |
| SUB-GROUP C2 | | |
| 4.11 Damp heat steady state | 56 days, 40 °C, 90 % to 95 % RH | |
| 4.11.1 Initial measurements | Capacitance Tangent of loss angle at 1 kHz | |
| 4.11.3 Final measurements | Voltage proof = U_{RDC} for 1 min within 15 min after removal from test chamber | No breakdown or flash-over |
| | Visual examination | No visible damage Legible marking |
| | Capacitance | $ \Delta C/C \leq 5\%$ of the value measured in 4.11.1. |
| | Tangent of loss angle | Increase of $\tan \delta \leq 0.005$ Compared to values measured in 4.11.1 |
| | Insulation resistance | $\geq 50\%$ of values specified in section "Insulation Resistance" of this specification |
| SUB-GROUP C3 | | |
| 4.12 Endurance | Duration: 2000 h $1.25 \times U_{RDC}$ at 85 °C $1.0 \times U_{RDC}$ at 105 °C | |
| 4.12.1 Initial measurements | Capacitance Tangent of loss angle: for $C \leq 470$ nF at 100 kHz or for $C > 470$ nF at 10 kHz | |
| 4.12.5 Final measurements | Visual examination | No visible damage Legible marking |
| | Capacitance | $ \Delta C/C \leq 5\%$ compared to values measured in 4.12.1 |
| | Tangent of loss angle | Increase of $\tan \delta$ ≤ 0.005 for: $C \leq 100$ nF or ≤ 0.010 for: 100 nF $< C \leq 220$ nF or ≤ 0.015 for: 220 nF $< C \leq 470$ nF and ≤ 0.003 for: $C > 470$ nF Compared to values measured in 4.12.1 |
| | Insulation resistance | $\geq 50\%$ of values specified in section "Insulation Resistance" of this specification |
| SUB-GROUP C4 | | |
| 4.13 Charge and discharge | 10 000 cycles Charged to U_{RDC} Discharge resistance: $R = \frac{U_R}{C \times 2.5 \times (dU/dt)_R}$ | |
| 4.13.1 Initial measurements | Capacitance Tangent of loss angle: for $C \leq 470$ nF at 100 kHz or for $C > 470$ nF at 10 kHz | |
| 4.13.3 Final measurements | Capacitance | $ \Delta C/C \leq 3\%$ compared to values measured in 4.13.1 |
| | Tangent of loss angle | Increase of $\tan \delta$ ≤ 0.005 for: $C \leq 100$ nF or ≤ 0.010 for: 100 nF $< C \leq 220$ nF or ≤ 0.015 for: 220 nF $< C \leq 470$ nF and ≤ 0.003 for: $C > 470$ nF Compared to values measured in 4.13.1 |
| | Insulation resistance | $\geq 50\%$ of values specified in section "Insulation Resistance" of this specification |



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