

Interference Suppression Film Capacitor - Class X2 Axial MKT 253 V_{AC} - Continuous Across the Line



FEATURES

- Axial mounting
- Low building height
- Material categorization:
for definitions of compliance please see www.vishay.com/doc?99912



RoHS
COMPLIANT
HALOGEN
FREE
GREEN
(5-2008)

APPLICATIONS

High stability grade for continuous across the line X2 applications.

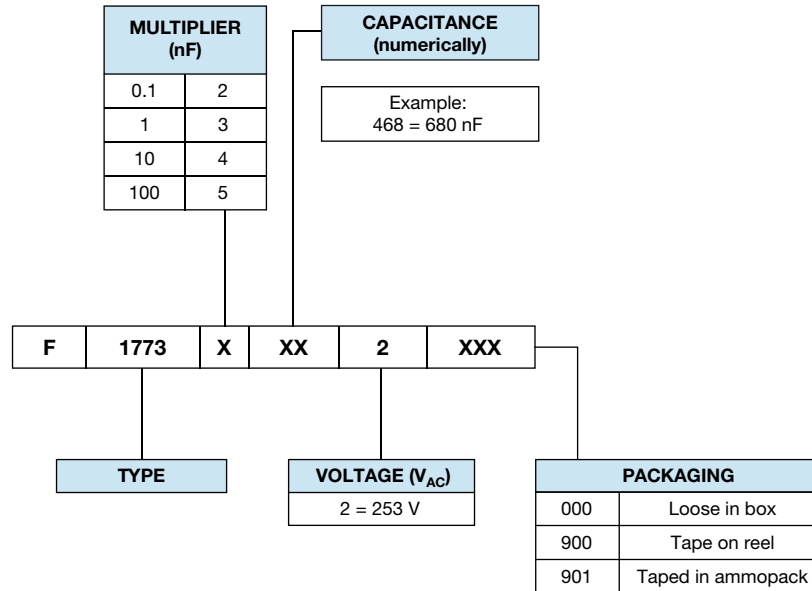
See also application note: www.vishay.com/doc?28153

| QUICK REFERENCE DATA | |
|---|--|
| Capacitance range (E12 series) | 0.01 μ F to 2.2 μ F (preferred values according to E6) |
| Capacitance tolerance | 0.01 μ F to \leq 0.1 μ F: \pm 20 % 0.12 μ F to \leq 2.2 μ F: \pm 10 % |
| Rated AC voltage | 253 V _{AC} ; 50 Hz to 60 Hz |
| Permissible DC voltage | 630 V _{DC} |
| Climatic testing class (according to IEC 60068-1) | C \leq 1.0 μ F = 40 / 100 / 21 / C C > 1.0 μ F = 40 / 085 / 21 / C |
| Maximum application temperature | 100 °C |
| Leads | Tinned wire |
| Reference standards | IEC 60384-14 ed-4 (2013) and EN 60384-14, UL 60384-14, CSA E384-14 |
| Dielectric | Polyester film |
| Electrodes | Metallized |
| Construction | Series construction |
| Encapsulation | Plastic, epoxy resin sealed, flame retardant UL-class 94 V-0 |
| Marking | C-value; tolerance; rated voltage; sub-class; manufacturer's type; code for dielectric material; manufacturer location, year and week; manufacturer's logo or name; safety approvals |

Note

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

| DIMENSIONS in millimeters | |
|-------------------------------|---------------|
| | |
| LEAD DIAMETER d_t | D |
| 0.7 \pm 0.07 | \leq 7 |
| 0.8 \pm 0.08 | > 7 to < 16.5 |
| 1.0 \pm 0.1 | \geq 16.5 |

COMPOSITION OF CATALOG NUMBER

Note

- For detailed tape specifications refer to "Packaging information" www.vishay.com/doc?28139 or end of catalog





| SPECIFIC REFERENCE DATA | |
|---|-----------------------------------|
| DESCRIPTION | VALUE |
| Rated AC voltage (U _{RAC}) | 253 V |
| Permissible DC voltage (U _{RDC}) | 630 V |
| Tangent of loss angle | ≤ 100 x 10 ⁻⁴ at 1 kHz |
| Rated voltage pulse slope (dU/dt) _R at 350 V _{DC} | |
| L 19 mm | 200 V/μs |
| L 26.5 mm | 150 V/μs |
| L 31.5 mm | 100 V/μs |
| L 41.5 mm | 100 V/μs |
| R between leads, for C ≤ 0.33 μF at 100 V; 1 min | > 15 000 MΩ |
| RC between leads, for C > 0.33 μF at 100 V; 1 min | > 5000 s |
| R between leads and case; 100 V; 1 min | > 30 000 MΩ |
| Withstanding (AC) voltage between leads and cover | 2000 V; -1 min |
| Withstanding (DC) voltage (cut off current 10 mA); rise time 100 V/s | 1200 V; 1 min |
| Maximum application temperature | 100 °C |



| ELECTRICAL DATA AND ORDERING CODE | | | | | | | |
|-----------------------------------|--|---------------|-------------|-----------------------|----------|-----------------------------|------------------------------|
| U _{RAC} (V) | CAP. (μF) | TOLERANCE (%) | PITCH (mm) | DIMENSIONS D x L (mm) | MASS (g) | SPQ ⁽¹⁾ (pieces) | ORDERING CODE ⁽²⁾ |
| 253 | d_t = 0.70 mm ± 0.07 mm | | | | | | |
| | 0.010 | ± 20 | 22.5 | 6.0 x 19.0 | 0.9 | 1500 | F17733102000 |
| | 0.012 | ± 20 | 22.5 | 6.0 x 19.0 | 0.9 | 1500 | F17733122000 |
| | 0.015 | ± 20 | 22.5 | 6.0 x 19.0 | 0.9 | 1500 | F17733152000 |
| | 0.018 | ± 20 | 22.5 | 6.0 x 19.0 | 0.9 | 1500 | F17733182000 |
| | 0.022 | ± 20 | 22.5 | 6.0 x 19.0 | 0.9 | 1500 | F17733222000 |
| | 0.027 | ± 20 | 22.5 | 6.0 x 19.0 | 0.9 | 1500 | F17733272000 |
| | 0.033 | ± 20 | 22.5 | 6.0 x 19.0 | 0.9 | 1500 | F17733332000 |
| | 0.039 | ± 20 | 22.5 | 6.5 x 19.0 | 1.0 | 1500 | F17733392000 |
| | 0.047 | ± 20 | 22.5 | 7.0 x 19.0 | 1.1 | 1500 | F17733472000 |
| | d_t = 0.80 mm ± 0.08 mm | | | | | | |
| | 0.056 | ± 20 | 22.5 | 8.0 x 19.0 | 1.6 | 1500 | F17733562000 |
| | 0.068 | ± 20 | 22.5 | 8.0 x 19.0 | 1.6 | 1500 | F17733682000 |
| | 0.082 | ± 20 | 22.5 | 9.0 x 19.0 | 1.8 | 1500 | F17733822000 |
| | 0.10 | ± 20 | 22.5 | 9.5 x 19.0 | 2.0 | 1000 | F17734102000 |
| | 0.12 | ± 10 | 22.5 | 10.5 x 19.0 | 2.2 | 1000 | F17734122000 |
| | 0.15 | ± 10 | 30.0 | 8.5 x 26.5 | 2.2 | 1000 | F17734152000 |
| | 0.18 | ± 10 | 30.0 | 9.5 x 26.5 | 2.6 | 1000 | F17734182000 |
| | 0.22 | ± 10 | 30.0 | 10.0 x 26.5 | 2.8 | 1000 | F17734222000 |
| | 0.27 | ± 10 | 30.0 | 11.0 x 26.5 | 3.3 | 750 | F17734272000 |
| | 0.33 | ± 10 | 30.0 | 12.0 x 26.5 | 3.8 | 750 | F17734332000 |
| | 0.39 | ± 10 | 30.0 | 13.0 x 26.5 | 4.7 | 750 | F17734392000 |
| | 0.47 | ± 10 | 30.0 | 14.0 x 26.5 | 5.5 | 1250 | F17734472000 |
| | 0.56 | ± 10 | 35.0 | 14.0 x 31.5 | 6.2 | 1000 | F17734562000 |
| | 0.68 | ± 10 | 35.0 | 15.0 x 31.5 | 6.7 | 1000 | F17734682000 |
| | d_t = 1.0 mm ± 0.1 mm | | | | | | |
| | 0.82 | ± 10 | 35.0 | 16.5 x 31.5 | 8.3 | 750 | F17734822000 |
| | 1.0 | ± 10 | 35.0 | 18.0 x 31.5 | 9.5 | 750 | F17735102000 |
| 1.2 | ± 10 | 35.0 | 19.5 x 31.5 | 11.0 | 500 | F17735122000 | |
| 1.5 | ± 10 | 45.0 | 18.0 x 41.5 | 13.5 | 500 | F17735152000 | |
| 1.8 | ± 10 | 45.0 | 19.5 x 41.5 | 15.7 | 450 | F17735182000 | |
| 2.2 | ± 10 | 45.0 | 21.5 x 41.5 | 17.8 | 400 | F17735222000 | |

Notes

- For detailed tape specifications refer to packaging information: www.vishay.com/doc?28139 or end of catalog
- (1) SPQ = Standard Packing Quantity
- (2) These capacitors can be delivered on continuous tape and reel; the ordering code is F1773...2900 taped on reel, F1773...2901 taped ammpack

| APPROVALS | | | | |
|--|---------------------|----------------------|---------------------|--|
| SAFETY APPROVALS X2 | VOLTAGE | VALUE | FILE NUMBERS | LINK |
| EN 60384-14 (ENEC) (= IEC 60384-14 ed-4 (2013)) | 253 V _{AC} | 0.01 µF to 2.2 µF X2 | 40005089 | www.vishay.com/doc?28222 |
| UL 60384-14 | 253 V _{AC} | 0.01 µF to 2.2 µF X2 | E354331 | www.vishay.com/doc?28223 |
| CSA E384-14 | 253 V _{AC} | 0.01 µF to 2.2 µF X2 | 1913342 | www.vishay.com/doc?28224 |
| CB Test-Certificate | 253 V _{AC} | 0.01 µF to 2.2 µF X2 | DE 1-7470 | www.vishay.com/doc?28221 |
| The ENEC-approval together with the CB-Certificate replace all national marks of the following countries (they have already signed the ENEC-Agreement): Austria; Belgium; Czech Republic; Denmark; Finland; France; Germany; Greece; Hungary; Ireland; Italy; Luxembourg; Netherlands; Norway; Portugal; Slovenian; Spain; Sweden; Switzerland and United Kingdom. | | | | |
|     | | | | |

MOUNTING

Normal Use

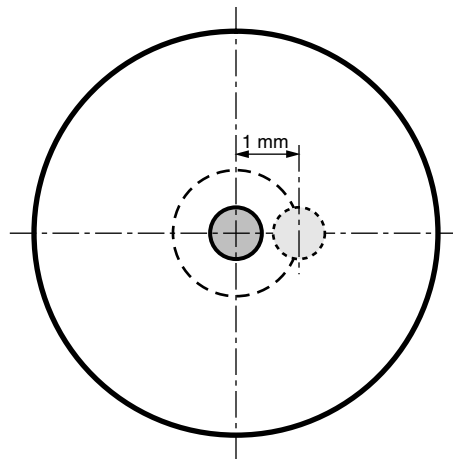
The capacitors are designed for mounting on printed-circuit boards. The capacitors packed in bandoliers are designed for mounting in printed-circuit boards by means of automatic insertion machines.

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

Specific Method of Mounting to Withstand Vibration and Shock

In order to withstand vibration and shock tests, it must be ensured that capacitor body is in good contact with the printed-circuit board:

- For $L \leq 19$ 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
- The maximum diameter and length of the capacitors are specified in the dimensions table
- Eccentricity as shown in the drawing below:



SOLDERING CONDITIONS

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

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

Storage Temperature

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

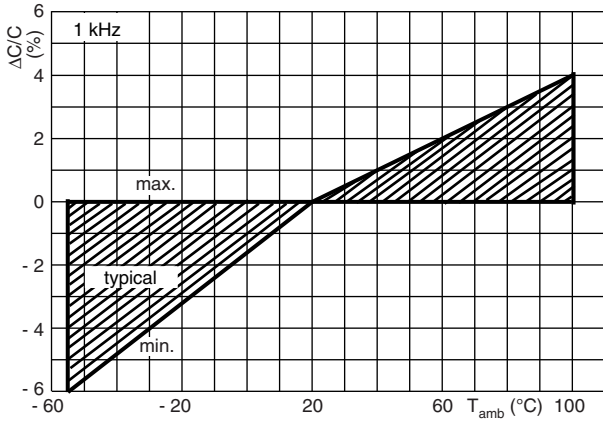
Ratings and Characteristics Reference Conditions

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

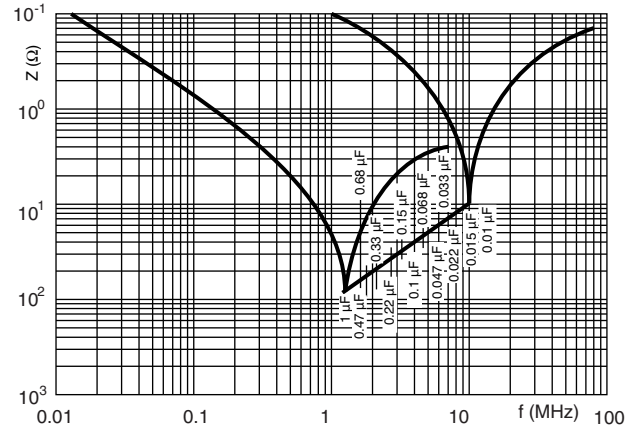
For reference testing, a conditioning period shall be applied over 96 h ± 4 h by heating the products in a circulating air oven at the rated temperature and a relative humidity not exceeding 20 %.



CHARACTERISTICS

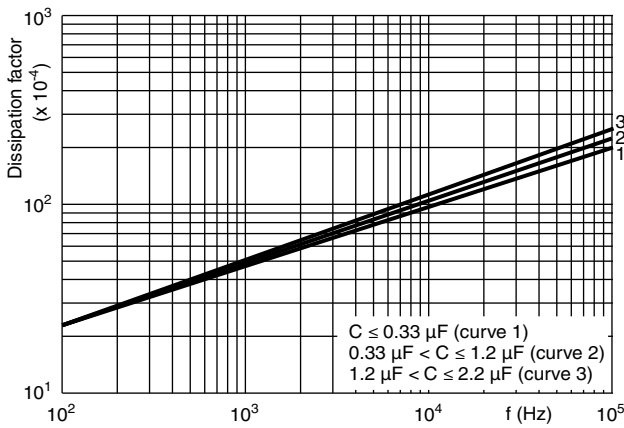


Capacitance as a function of ambient temperature (typical curve)



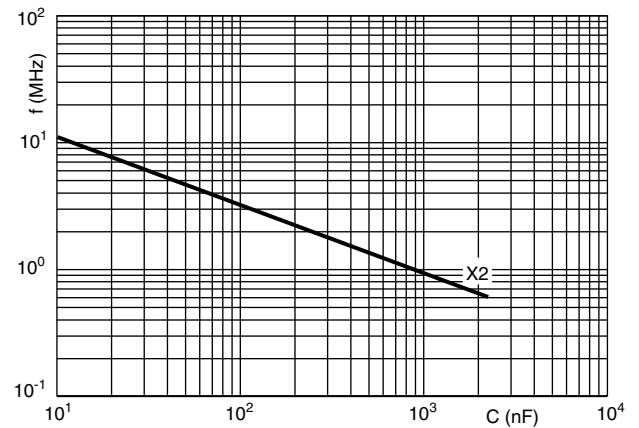
Impedance (Z) as a function of frequency (f) at $T_a = 20^\circ\text{C}$ (average) Measurement with length 6 mm

Impedance as a function of frequency (typical curve)

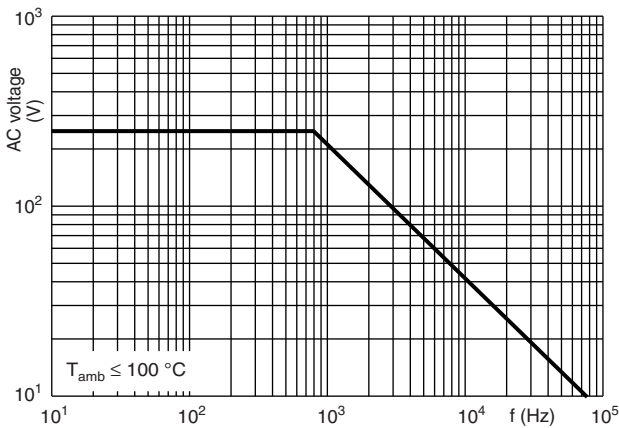


$C \leq 0.33 \mu\text{F}$ (curve 1)
 $0.33 \mu\text{F} < C \leq 1.2 \mu\text{F}$ (curve 2)
 $1.2 \mu\text{F} < C \leq 2.2 \mu\text{F}$ (curve 3)

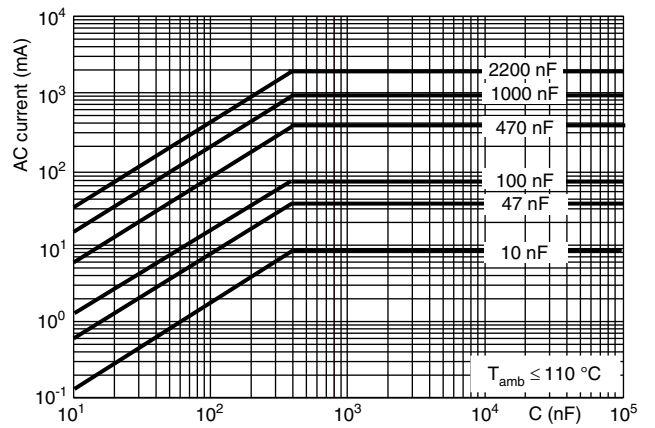
Tangent of loss angle as a function of frequency (typical curve)



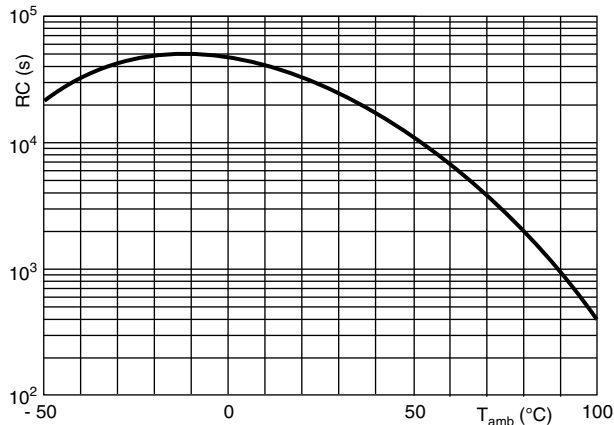
Resonant frequency as a function of capacitance (typical curve)



Max. RMS voltage as a function of frequency



Max. RMS current as a function of frequency



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

APPLICATION NOTES AND LIMITING CONDITIONS

- For X2 electromagnetic interference suppression where a higher stability grade is needed for **continuous across the line applications** (50 Hz / 60 Hz) with a maximum mains voltage of 253 V_{AC}.
- These capacitors are not intended for continuous pulse application. For these situations capacitors of the AC and pulse programs must be used.
- For series impedance applications we refer to application note: www.vishay.com/doc?28153
- The maximum ambient temperature must not exceed 100 °C.
- Rated voltage pulse slope:
if the pulse voltage is lower than the rated voltage, the values of the specific reference data can be multiplied by 350 V_{DC} and divided by the applied voltage.

INSPECTION REQUIREMENTS

General Notes

Sub-clause numbers of tests and performance requirements refer to the “Sectional Specification, Publication IEC 60384-14 ed-4 (2013) 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 |
| Initial measurements | Capacitance Tangent of loss angle: for C ≤ 1 μF at 10 kHz or for C > 1 μF at 1 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 | No pre-drying Method: 1A Solder bath: 280 °C ± 5 °C Duration: 10 s | |



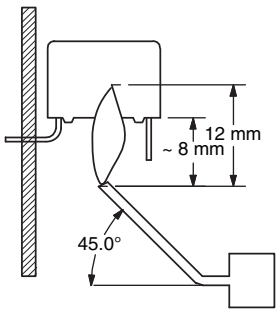
| GROUP C INSPECTION REQUIREMENTS | | |
|---|--|--|
| SUB-CLAUSE NUMBER AND TEST | CONDITIONS | PERFORMANCE REQUIREMENTS |
| SUB-GROUP C1A PART OF SAMPLE OF SUB-GROUP C1 | | |
| 4.19 Component solvent resistance | Isopropylalcohol at room temperature Method: 2 Immersion time: 5 min ± 0.5 min Recovery time: min. 1 h, max. 2 h | |
| 4.4.2 Final measurements | Visual examination Capacitance Tangent of loss angle Insulation resistance | No visible damage Legible marking $ \Delta C/C \leq 5\%$ of the value measured initially Increase of $\tan \delta$: ≤ 0.008 for: $C \leq 1 \mu F$ or ≤ 0.005 for: $C > 1 \mu F$ Compared to values measured initially As specified in section "Insulation Resistance" of this specification |
| SUB-GROUP C1B PART OF SAMPLE OF SUB-GROUP C1 | | |
| Initial measurements | Capacitance Tangent of loss angle: for $C \leq 1 \mu F$ at 10 kHz or for $C > 1 \mu F$ at 1 kHz | |
| 4.20 Solvent resistance of the marking | Isopropylalcohol at room temperature Method: 1 Rubbing material: cotton wool Immersion time: 5 min ± 0.5 min | No visible damage Legible marking |
| 4.6 Rapid change of temperature | $\theta A = -40\text{ }^\circ C$ $\theta B = +100\text{ }^\circ C$ 5 cycles Duration $t = 30$ min | |
| 4.6.1 Inspection | Visual examination | No visible damage |
| 4.7 Vibration | 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 | |
| 4.7.2 Final inspection | Visual examination | No visible damage |
| 4.9 Shock | Mounting: see section "Mounting" for more information Pulse shape: half sine Acceleration: 490 m/s ² Duration of pulse: 11 ms | |
| 4.9.2 Final measurements | Visual examination Capacitance Tangent of loss angle Insulation resistance | No visible damage $ \Delta C/C \leq 5\%$ of the value measured initially Increase of $\tan \delta$: ≤ 0.008 for: $C \leq 1 \mu F$ or ≤ 0.005 for: $C > 1 \mu F$ Compared to values measured initially As specified in section "Insulation Resistance" of this specification |



| GROUP C INSPECTION REQUIREMENTS | | |
|---|--|--|
| SUB-CLAUSE NUMBER AND TEST | CONDITIONS | PERFORMANCE REQUIREMENTS |
| SUB-GROUP C1 COMBINED SAMPLE OF SPECIMENS OF SUB-GROUPS C1A AND C1B | | |
| 4.11 Climatic sequence 4.11.1 Initial measurements 4.11.2 Dry heat 4.11.3 Damp heat cyclic Test Db First cycle 4.11.4 Cold 4.11.5 Damp heat cyclic Test Db remaining cycles 4.11.6 Final measurements | Capacitance: measured in 4.4.2 and 4.9.2 Tangent of loss angle: measured initially in C1A and C1B Temperature: 100 °C Duration: 16 h Temperature: -40 °C Duration: 2 h Visual examination Capacitance Tangent of loss angle Voltage proof 1200 V _{DC} ; 1 min between terminations Insulation resistance | No visible damage Legible marking $ \Delta C/C \leq 5\%$ of the value measured in 4.11.1. Increase of tan δ : ≤ 0.008 for: $C \leq 1 \mu\text{F}$ or ≤ 0.005 for: $C > 1 \mu\text{F}$ Compared to values measured in 4.11.1. No permanent breakdown or flash-over $\geq 50\%$ of values specified in section "Insulation Resistance" of this specification |
| SUB-GROUP C2 | | |
| 4.12 Damp heat steady state 4.12.1 Initial measurements 4.12.3 Final measurements | 21 days; 40 °C; 90 % to 95 % RH no load Capacitance Tangent of loss angle: for $C \leq 1 \mu\text{F}$ at 10 kHz or for $C > 1 \mu\text{F}$ at 1 kHz Visual examination Capacitance Tangent of loss angle Voltage proof 1200 V _{DC} ; 1 min between terminations Insulation resistance | No visible damage Legible marking $ \Delta C/C \leq 5\%$ of the value measured in 4.12.1. Increase of tan δ : ≤ 0.008 for: $C \leq 1 \mu\text{F}$ or ≤ 0.005 for: $C > 1 \mu\text{F}$ Compared to values measured in 4.12.1. No permanent breakdown or flash-over $\geq 50\%$ of values specified in section "Insulation Resistance" of this specification |



| GROUP C INSPECTION REQUIREMENTS | | |
|---------------------------------|--|---|
| SUB-CLAUSE NUMBER AND TEST | CONDITIONS | PERFORMANCE REQUIREMENTS |
| SUB-GROUP C3 | | |
| 4.13.1 Initial measurements | Capacitance Tangent of loss angle: for C ≤ 1 μF at 10 kHz or for C > 1 μF at 1 kHz | |
| 4.13 Impulse voltage | 3 successive impulses, full wave, peak voltage: X2: 2.5 kV for C ≤ 1 μF X2: 2.5 kV/√C for C > 1 μF Max. 24 pulses | No self healing breakdowns or flash-over |
| 4.14 Endurance | Duration: 1000 h 1.25 x U _{RAC} at 100 °C for C ≤ 1 μF 1.25 x U _{RAC} at 85 °C for C > 1 μF Once in every hour the voltage is increased to 1000 V _{RMS} for 0.1 s via resistor of 47 Ω ± 5 % | |
| 4.14.7 Final measurements | Visual examination | No visible damage Legible marking |
| | Capacitance | ΔC/C ≤ 10 % compared to values measured in 4.13.1. |
| | Tangent of loss angle | Increase of tan δ: ≤ 0.008 for: C ≤ 1 μF or ≤ 0.005 for: C > 1 μF Compared to values measured in 4.13.1. |
| | Voltage proof 1200 V _{DC} ; 1 min between terminations 2000 V _{AC} ; 1 min between terminations and case | No permanent breakdown or flash-over |
| | Insulation resistance | ≥ 50 % of values specified in section "Insulation Resistance" of this specification |
| SUB-GROUP C4 | | |
| 4.15 Charge and discharge | 10 000 cycles Charged to 350 V _{DC} Discharge resistance: $R = \frac{350 V_{DC}}{2 \times C (dU/dt)}$ | |
| 4.15.1 Initial measurements | Capacitance Tangent of loss angle: for C ≤ 1 μF at 10 kHz or for C > 1 μF at 1 kHz | |
| 4.15.3 Final measurements | Capacitance | ΔC/C ≤ 10 % compared to values measured in 4.15.1. |
| | Tangent of loss angle | Increase of tan δ: ≤ 0.008 for: C ≤ 1 μF or ≤ 0.005 for: C > 1 μF Compared to values measured in 4.15.1. |
| | Insulation resistance | ≥ 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 C5 | | |
| 4.16 Radio frequency characteristic | Resonance frequency | ≥ 0.9 times the value as specified in section "Resonant Frequency" of this specification |
| SUB-GROUP C6 | | |
| 4.17 Passive flammability Class C | Bore of gas jet: $\varnothing 0.5$ mm Fuel: butane Test duration for actual volume V in mm^3 : $V \leq 250$: 5 s $250 < V \leq 500$: 10 s $500 < V \leq 1750$: 20 s $V > 1750$: 30 s One flame application | After removing test flame from capacitor, the capacitor must not continue to burn for more than 30 s. No burning particle must drop from the sample. |
|  | | |
| SUB-GROUP C7 | | |
| 4.18 Active flammability | 20 cycles of 2.5 kV discharges on the test capacitor connected to U_{RAC} | The cheese cloth around the capacitors shall not burn with a flame. No electrical measurements are required. |



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