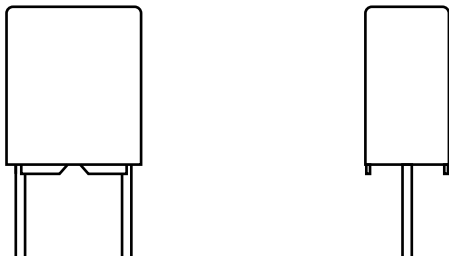




## Interference Suppression Film Capacitors MKT Radial Potted Type



### FEATURES

- 15 mm to 37.5 mm lead pitch
- Supplied loose in box, taped on reel
- Material categorization:  
for definitions of compliance please see  
[www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)




**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**

### APPLICATIONS

High stability grade for continuous across the line X2 applications.

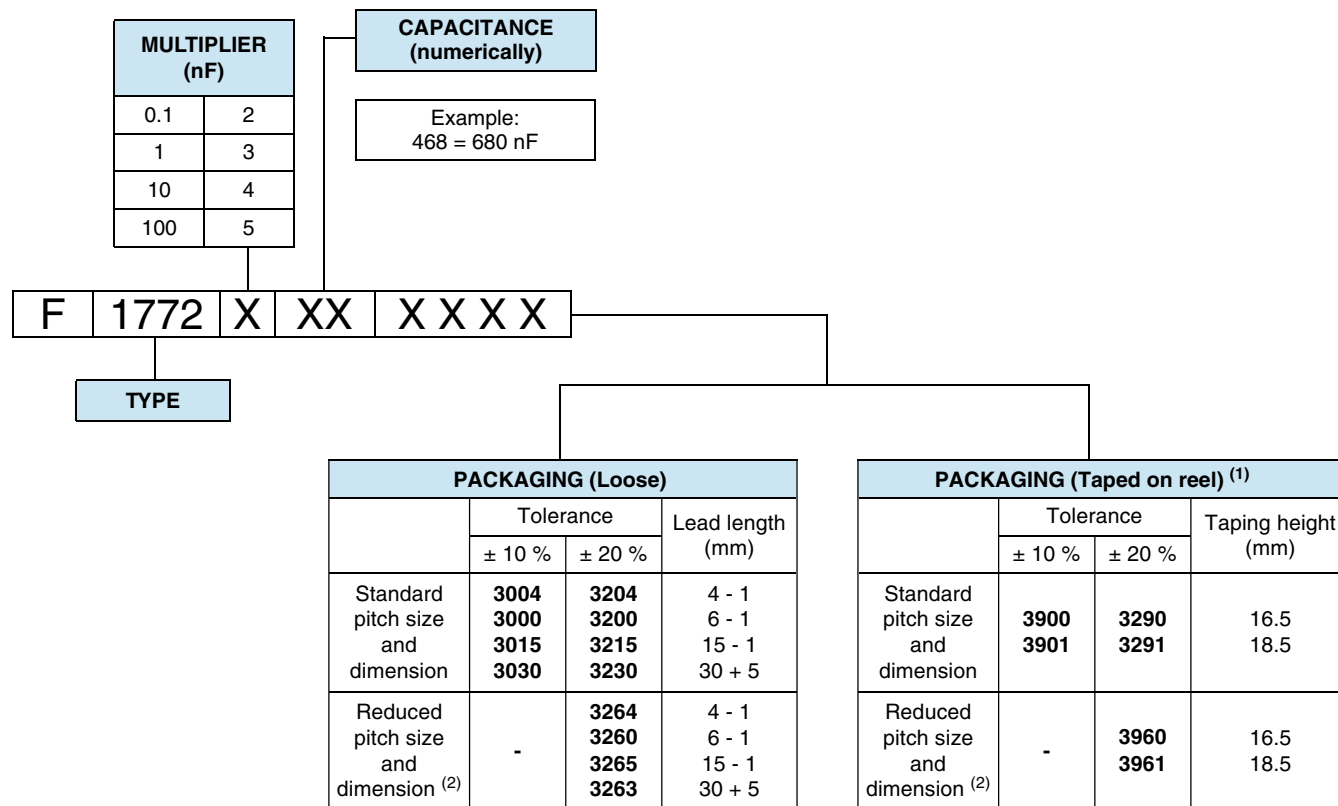
See also application note: [www.vishay.com/doc?28153](http://www.vishay.com/doc?28153)

QUICK REFERENCE DATA	
Capacitance range (E12 series)	E12 series 0.01 $\mu\text{F}$ to 2.2 $\mu\text{F}$ preferred values acc. to E6
Capacitance tolerance	$\pm 10\%$ , $\pm 20\%$
Rated AC voltage	300 V <sub>AC</sub> ; 50 Hz to 60 Hz
Permissible DC voltage	800 V <sub>DC</sub> at 85 °C 630 V <sub>DC</sub> at 110 °C
Climatic testing class acc. to IEC 60068-1	40/100/56/C
Maximum application temperature	100 °C
Reference standards	IEC 60384-14 ed-3 and EN 60384-14 IEC 60065 pass. flamm. class C CSA-E384-14 UL 60384-14
Dielectric	Polyester film
Electrodes	Metallized
Construction	Series construction 
Encapsulation	Plastic case, epoxy resin sealed, flame retardant UL-class 94 V-0
Leads	Tinned wire
Marking	C-value; tolerance; rated voltage; sub-class; manufacturer's type; code for dielectric material; manufacturer location; manufacturer's logo; year and week; safety approvals

### Note

- For more detailed data and test requirements, contact [rfi@vishay.com](mailto:rfi@vishay.com)

DIMENSIONS in millimeters

**COMPOSITION OF CATALOG NUMBER**

Example: F17724153**215** means 0.15  $\mu$ F,  $\pm$  20 %; standard pitch 22.5 mm; lead length 15 mm - 1 mm;  
 F17724153**265** means 0.15  $\mu$ F,  $\pm$  20 %; reduced pitch 15.0 mm; lead length 15 mm - 1 mm

**Notes**

- For detailed tape specifications refer to packaging information [www.vishay.com/doc?28139](http://www.vishay.com/doc?28139)
- <sup>(1)</sup> Taped on reel pitch  $\geq$  27.5 mm is not available
- <sup>(2)</sup> Same capacitance values  $\geq$  0.15  $\mu$ F at 20 % are available in two different pitch sizes and dimensions

<b>SPECIFIC REFERENCE DATA</b>	
DESCRIPTION	VALUE
Rated AC voltage ( $U_{RAC}$ )	300 V
Permissible DC voltage ( $U_{RDC}$ )	630 V
Tangent of loss angle	$\leq 100 \times 10^{-4}$ at 1 kHz
Rated voltage pulse slope at $(dU/dt)_R$ 435 V <sub>DC</sub>	100 V/ $\mu$ s
R between leads, for $C \leq 0.33 \mu$ F at 100 V; 1 min	$> 15\,000 \text{ M}\Omega$
RC between leads, $C > 0.33 \mu$ F at 100 V; 1 min	$> 5000 \text{ s}$
R between leads and case; 100 V; 1 min	$> 30\,000 \text{ M}\Omega$
Withstanding (DC) voltage (cut off current 10 mA) <sup>(1)</sup> ; rise time $\leq 1000 \text{ V/s}$	2150 V; for 1 min
Withstanding (AC) voltage between leads and case	2500 V; for 2 s at 25 °C
Maximum application temperature	100 °C

**Note**

- See "Voltage Proof Test for Metalized Film Capacitors": [www.vishay.com/doc?28169](http://www.vishay.com/doc?28169)



ELECTRICAL DATA AND ORDERING INFORMATION						
$U_{RAC}$ (V)	CAP. ( $\mu$ F)	PITCH (mm)	DIMENSIONS w x h x l MAX. (mm)	MASS <sup>(3)</sup> (g)	SPQ (pieces) SHORT LEAD	ORDERING CODE BULK LEAD LENGTH 6 mm - 1 mm <sup>(1)(2)</sup>
300	<b><math>d_t = 0.60 \text{ mm} \pm 0.06 \text{ mm}</math>; C-TOL. = <math>\pm 10 \%</math></b>					
	0.010	15	5.0 x 11.0 x 17.5	1.4	750	F17723103000
	0.012	15	5.0 x 11.0 x 17.5	1.4	750	F17723123000
	0.015	15	5.0 x 11.0 x 17.5	1.4	750	F17723153000
	0.018	15	5.0 x 11.0 x 17.5	1.4	750	F17723183000
	0.022	15	5.0 x 11.0 x 17.5	1.4	750	F17723223000
	0.027	15	5.0 x 11.0 x 17.5	1.4	750	F17723273000
	0.033	15	5.0 x 11.0 x 17.5	1.4	750	F17723333000
	0.039	15	6.0 x 12.0 x 17.5	2.0	500	F17723393000
	0.047	15	6.0 x 12.0 x 17.5	2.0	500	F17723473000
	0.056	15	6.0 x 12.0 x 17.5	2.0	500	F17723563000
	<b><math>d_t = 0.80 \text{ mm} \pm 0.08 \text{ mm}</math>; C-TOL. = <math>\pm 10 \%</math></b>					
	0.068	15	7.0 x 13.5 x 17.5	2.4	450	F17723683000
	0.082	15	8.5 x 15.0 x 17.5	2.7	300	F17723823000
	0.10	15	8.5 x 15.0 x 17.5	2.7	325	F17724103000
	0.12	15	8.5 x 15.0 x 17.5	2.7	300	F17724123000
	0.15	22.5	7.0 x 16.5 x 26.0	4.1	235	F17724153000
	0.18	22.5	7.0 x 16.5 x 26.0	4.1	235	F17724183000
	0.22	22.5	8.5 x 18.0 x 26.0	4.6	200	F17724223000
	0.33	27.5	11.0 x 20.3 x 31.3	6.7	170	F17724333000
	0.39	27.5	11.0 x 21.0 x 31.0	9.1	125	F17724393000
	0.47	27.5	11.0 x 21.0 x 31.0	9.1	125	F17724473000
	0.56	27.5	11.0 x 21.0 x 31.0	9.1	125	F17724563000
	0.68	27.5	13.0 x 23.0 x 31.0	12.9	110	F17724683000
	0.82	27.5	13.0 x 23.0 x 31.0	12.9	110	F17724823000
	1.0	27.5	15.0 x 25.0 x 31.5	15.0	100	F17725103000
	1.5	37.5	15.5 x 28.5 x 41.5	24.0	70	F17725153000
	1.8	37.5	15.5 x 28.5 x 41.5	24.0	70	F17725183000
	2.2	37.5	18.0 x 32.5 x 41.5	31.6	60	F17725223000
	<b><math>d_t = 0.60 \text{ mm} \pm 0.06 \text{ mm}</math>; C-TOL. = <math>\pm 20 \%</math></b>					
	0.010	15	5.0 x 11.0 x 17.5	1.4	750	F17723103200
	0.015	15	5.0 x 11.0 x 17.5	1.4	750	F17723153200
	0.022	15	5.0 x 11.0 x 17.5	1.4	750	F17723223200
0.033	15	5.0 x 11.0 x 17.5	1.4	750	F17723333200	
0.047	15	5.0 x 11.0 x 17.5	1.4	750	F17723473200	
0.068	15	6.0 x 12.0 x 17.5	2.0	600	F17723683200	
0.10	15	6.0 x 12.0 x 17.5	2.0	600	F17724103200	



ELECTRICAL DATA AND ORDERING INFORMATION						
U <sub>RAC</sub> (V)	CAP. (μF)	PITCH (mm)	DIMENSIONS w x h x l MAX. (mm)	MASS <sup>(3)</sup> (g)	SPQ (pieces) SHORT LEAD	ORDERING CODE BULK LEAD LENGTH <sup>(1)(2)</sup> 6 mm - 1 mm
<b>d<sub>t</sub> = 0.80 mm ± 0.08 mm; C-TOL. = ± 20 %</b>						
300	0.15	15	8.5 x 15.0 x 17.5	2.7	325	F17724153260
	0.15	22.5	6.0 x 15.5 x 26.0	3.3	260	F17724153200
	0.22	15	10.0 x 16.5 x 17.5	4.5	300	F17724223260
	0.22	22.5	7.0 x 16.5 x 26.0	4.1	235	F17724223200
	0.33	22.5	8.5 x 18.0 x 26.0	5.3	190	F1772433200
	0.47	22.5	10.0 x 19.5 x 26.0	6.7	170	F17724473260
	0.47	27.5	9.0 x 19.0 x 31.5	6.8	160	F17724473200
	0.68	22.5	12.0 x 22.0 x 26.0	13.4	110	F17724683260
	0.68	27.5	11.0 x 21.0 x 31.0	12.9	125	F17724683200
	1.0	22.5	15.5 x 26.5 x 26.5	13.5	110	F17725103260
	1.0	27.5	15.0 x 25.0 x 31.5	15.0	100	F17725103200
	1.5	27.5	18.0 x 28.0 x 31.5	19.0	85	F17725153260
	1.5	37.5	14.5 x 24.5 x 41.5	18.9	80	F17725153200
2.2	37.5	15.5 x 28.5 x 41.5	24.0	70	F17725223200	

**Notes**

- SPQ = Standard Packing Quantity
- For detailed tape specifications refer to packaging information: [www.vishay.com/doc?28139](http://www.vishay.com/doc?28139)
- (1) For further packaging see table "Composition of Catalog Number"
- (2) Further information about packaging quantities with different lead length and/or taped versions, see document "Packing Quantities" [www.vishay.com/doc?27608](http://www.vishay.com/doc?27608)
- (3) Weight for short lead product only

APPROVALS			
SAFETY APPROVALS X2	VOLTAGE	VALUE	FILE NUMBERS
EN 60384-14 (ENEC) (= IEC 60384-14 ed 3)	310 V <sub>AC</sub>	0.01 μF to 2.2 μF X2	40005079
UL 60384-14	310 V <sub>AC</sub>	0.01 μF to 2.2 μF X2	E354331
CSA-E 384-14	310 V <sub>AC</sub>	0.01 μF to 2.2 μF X2	E354331
CB test-certificate	310 V <sub>AC</sub>	0.01 μF to 2.2 μF X2	DE 1-40110/A1
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](http://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 stand-off pips are in good contact with the printed-circuit board:

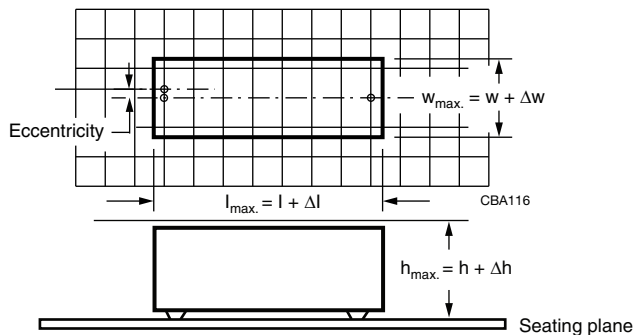
- For pitches  $\leq 15$  mm capacitors shall be mechanically fixed by the leads
- For larger pitches the capacitors shall be mounted in the same way and the body clamped

**Space Requirements on Printed Circuit Board**

The maximum space for length ( $l_{max.}$ ), width ( $w_{max.}$ ) and height ( $h_{max.}$ ) of film capacitors to take in account on the printed circuit board is shown in the drawings.

- For products with pitch  $\leq 15$  mm,  $\Delta w = \Delta l = 0.3$  mm;  $\Delta h = 0.1$  mm
- For products with  $15$  mm  $<$  pitch  $\leq 27.5$  mm,  $\Delta w = \Delta l = 0.5$  mm;  $\Delta h = 0.1$  mm
- For products with pitch = 37.5 mm,  $\Delta w = \Delta l = 0.7$  mm;  $\Delta h = 0.5$  mm

Eccentricity defined as in drawing. The maximum eccentricity is smaller than or equal to the lead diameter of the product concerned.

**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](http://www.vishay.com/doc?28171)

**Storage Temperature**

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

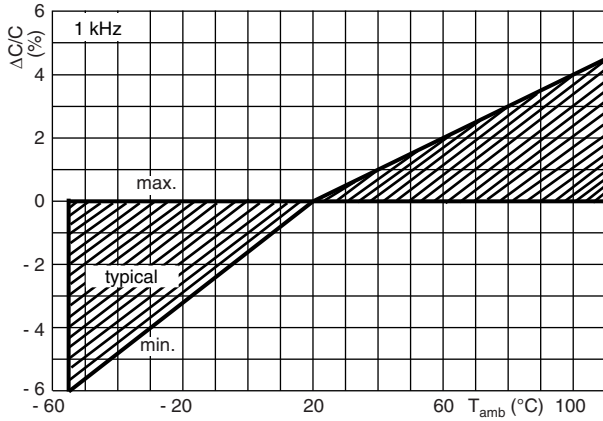
**Ratings and Characteristics Reference Conditions**

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

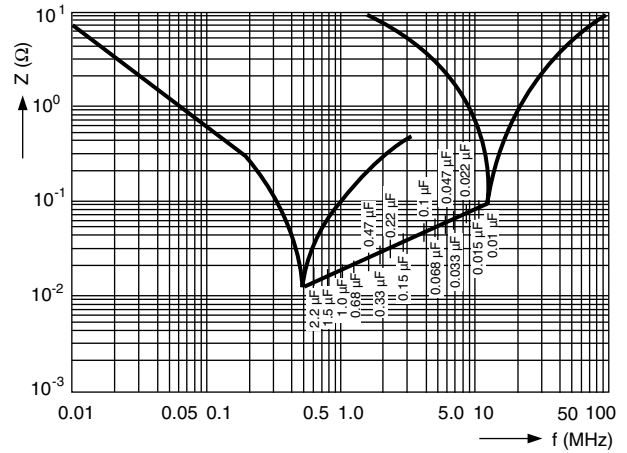
For reference testing, a conditioning period shall be applied over  $96$  h  $\pm 4$  h by heating the products in a circulating air oven at the rated temperature and a relative humidity not exceeding 20 %.



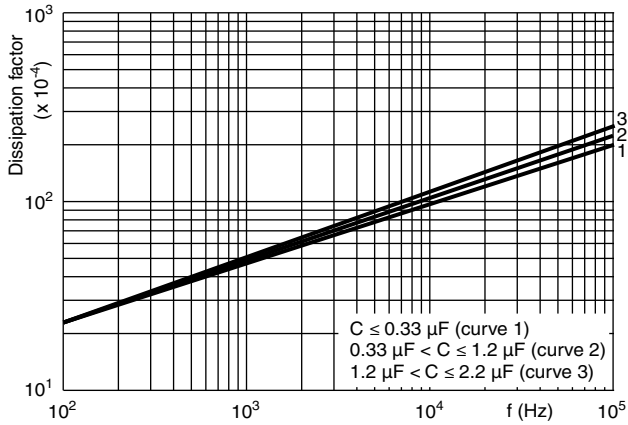
**CHARACTERISTICS**



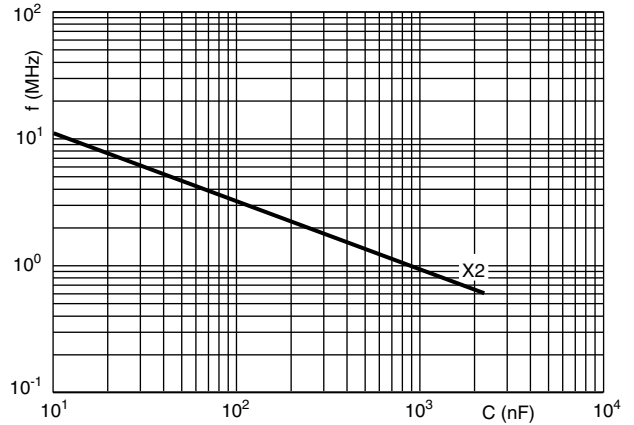
Capacitance as a function of ambient temperature (typical curve)



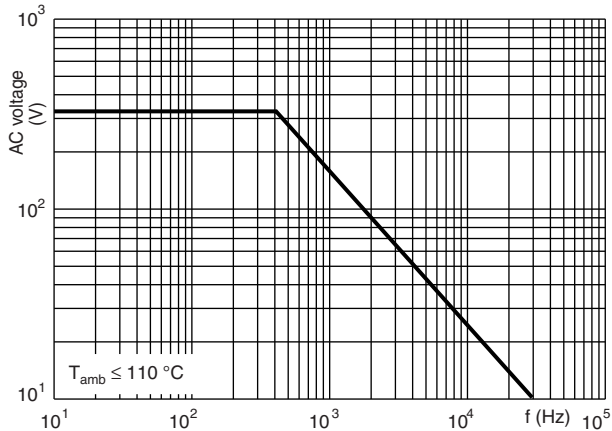
Impedance as a function of frequency (typical curve)



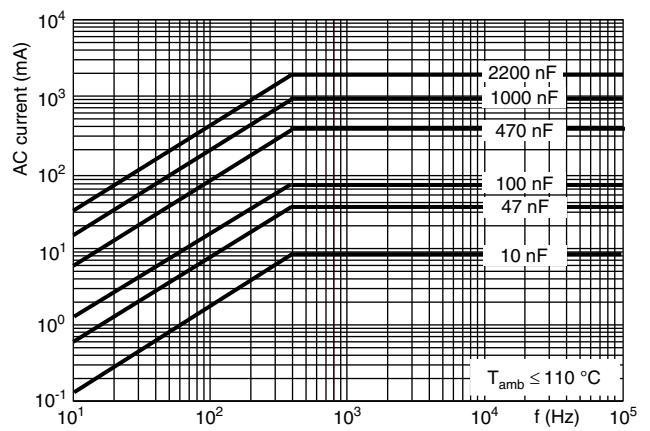
Tangent of loss angle as a function of frequency (typical curve)



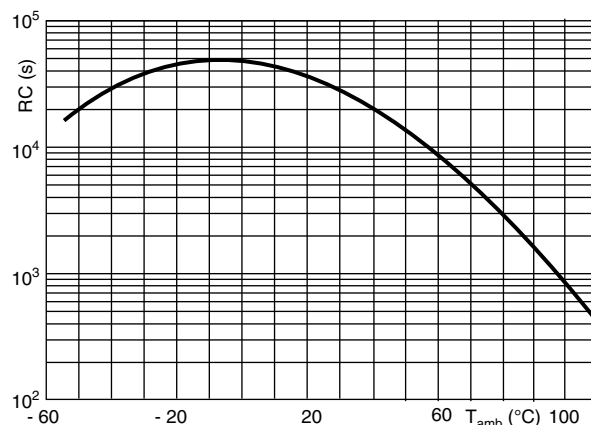
Resonant frequency as a function of capacitance (typical curve)



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 300 V<sub>AC</sub>.
- 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](http://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 435 V<sub>DC</sub> 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 3 and Specific Reference Data”.

GROUP C INSPECTION REQUIREMENTS		
SUB-CLAUSE NUMBER AND TEST	CONDITIONS	PERFORMANCE REQUIREMENTS
<b>SUB-GROUP C1A PART OF SAMPLE OF SUB-GROUP C1</b>		
4.1 Dimensions (detail)		As specified in chapter “General Data” of this specification
Initial measurements	Capacitance Tangent of loss angle: For C ≤ 1 μF at 10 kHz 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
<b>SUB-GROUP C1A PART OF SAMPLE OF SUB-GROUP C1</b>		
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 $\tan \delta$ $\leq 0.008$ for: $C \leq 1 \mu\text{F}$ or $\leq 0.005$ for: $C > 1 \mu\text{F}$ Compared to values measured initially  As specified in section "Insulation Resistance" of this specification
<b>SUB-GROUP C1B PART OF SAMPLE OF SUB-GROUP C1</b>		
Initial measurements	Capacitance Tangent of loss angle: For $C \leq 1 \mu\text{F}$ at 10 kHz For $C > 1 \mu\text{F}$ 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	$\theta A = -40\text{ }^\circ\text{C}$ $\theta B = +100\text{ }^\circ\text{C}$ 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 $98\text{ m/s}^2$ (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: $490\text{ m/s}^2$ 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 $\tan \delta$ $\leq 0.008$ for: $C \leq 1 \mu\text{F}$ or $\leq 0.005$ for: $C > 1 \mu\text{F}$ Compared to values measured initially  As specified in section "Specific Reference" of this specification



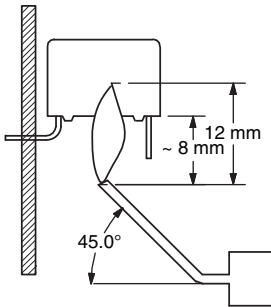


<b>GROUP C INSPECTION REQUIREMENTS</b>		
<b>SUB-CLAUSE NUMBER AND TEST</b>	<b>CONDITIONS</b>	<b>PERFORMANCE REQUIREMENTS</b>
<b>SUB-GROUP C1 COMBINED SAMPLE OF SPECIMENS OF SUB-GROUPS C1A AND C1B</b>		
4.11 Climatic sequence	Capacitance	
4.11.1 Initial measurements	Measured in 4.4.2 and 4.9.2 Tangent of loss angle Measured initially in C1A and C1B	
4.11.2 Dry heat	Temperature: 100 °C Duration: 16 h	
4.11.3 Damp heat cyclic Test Db, first cycle		
4.11.4 Cold	Temperature: - 40 °C Duration: 2 h	
4.11.5 Damp heat cyclic Test Db, remaining cycles		
4.11.6 Final measurements	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 $\tan \delta$ $\leq 0.008$ for: $C \leq 1 \mu\text{F}$ or $\leq 0.005$ for: $C > 1 \mu\text{F}$ Compared to values measured in 4.11.1
	Voltage proof 1350 V <sub>DC</sub> 1 min between terminations	No permanent breakdown or flash-over
	Insulation resistance	$\geq 50\%$ of values specified in section "Insulation Resistance" of this specification
<b>SUB-GROUP C2</b>		
4.12 Damp heat steady state	56 days, 40 °C, 90 % to 95 % RH No load	
4.12.1 Initial measurements	Capacitance Tangent of loss angle: 1 kHz	
4.12.3 Final measurements	Visual examination	No visible damage Legible marking
	Capacitance	$ \Delta C/C  \leq 5\%$ of the value measured in 4.12.1
	Tangent of loss angle	Increase of $\tan \delta$ $\leq 0.008$ for: $C \leq 1 \mu\text{F}$ or $\leq 0.005$ for: $C > 1 \mu\text{F}$ Compared to values measured in 4.12.1
	Voltage proof 1350 V <sub>DC</sub> ; 1 min between terminations	No permanent breakdown or flash-over
	Insulation resistance	$\geq 50\%$ of values specified in section "Insulation Resistance" of this specification



<b>GROUP C INSPECTION REQUIREMENTS</b>		
<b>SUB-CLAUSE NUMBER AND TEST</b>	<b>CONDITIONS</b>	<b>PERFORMANCE REQUIREMENTS</b>
<b>SUB-GROUP C3</b>		
4.13.1 Initial measurements	Capacitance Tangent of loss angle: For C ≤ 1 μF at 10 kHz 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 <sub>RAC</sub> at 100 °C 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  Capacitance  Tangent of loss angle  Voltage proof 1350 V <sub>DC</sub> ; 1 min between terminations 2500 V <sub>AC</sub> ; 2 s at 25 °C between terminations and case  Insulation resistance	No visible damage Legible marking   ΔC/C  ≤ 5 % compared to values measured in 4.13.1  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  No permanent breakdown or flash-over  ≥ 50 % of values specified in section "Insulation Resistance" of this specification
<b>SUB-GROUP C4</b>		
4.15 Charge and discharge	10 000 cycles Charged to 435 V <sub>DC</sub> Discharge resistance: $R = \frac{435 V_{DC}}{1.5 \times C(dU/dt)}$	
4.15.1 Initial measurements	Capacitance Tangent of loss angle: For C ≤ 1 μF at 10 kHz For C > 1 μF at 1 kHz	
4.13.3 Final measurements	Capacitance  Tangent of loss angle  Insulation resistance	ΔC/C  ≤ 10 % compared to values measured in 4.15.1  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  ≥ 50 % of values specified in section "Insulation Resistance" of this specification



GROUP C INSPECTION REQUIREMENTS		
SUB-CLAUSE NUMBER AND TEST	CONDITIONS	PERFORMANCE REQUIREMENTS
<b>SUB-GROUP C5</b>		
4.16 Radio frequency characteristic	Resonance frequency	$\geq 0.9$ times the value as specified in section "Resonant Frequency" of this specification.
<b>SUB-GROUP C6</b>		
4.17 Passive flammability Class C	Bore of gas jet: $\varnothing 0.5$ mm Fuel: Butane Test duration for actual volume $V$ in $\text{mm}^3$ : $V \leq 250$ : 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.
<b>SUB-GROUP C7</b>		
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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