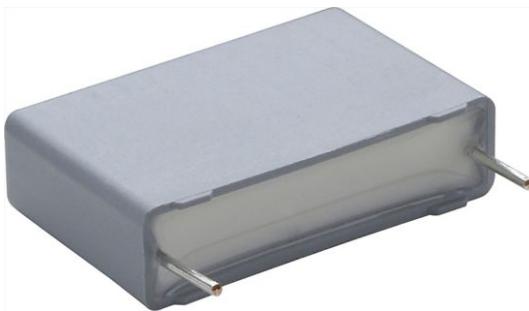


Interference Suppression Film Capacitors

MKP Radial Potted Type



FEATURES

- 15 mm to 27.5 mm lead pitch.
- Supplied in box, taped on ammopack or reel
- Material categorization:
for definitions of compliance please see www.vishay.com/doc?99912



APPLICATIONS

X1 class

For X1 electromagnetic interference suppression in across the line applications (50 Hz/60 Hz) with a maximum mains voltage of 275 V_{AC}.

For application limitations please refer to section "Application Notes".

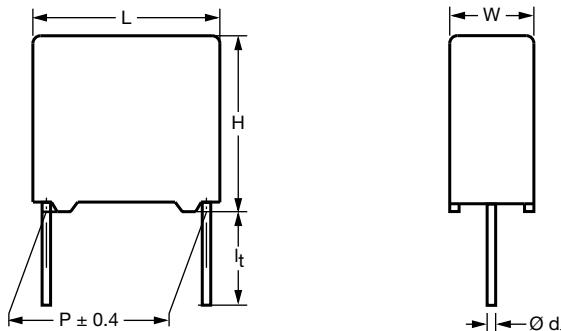
QUICK REFERENCE DATA

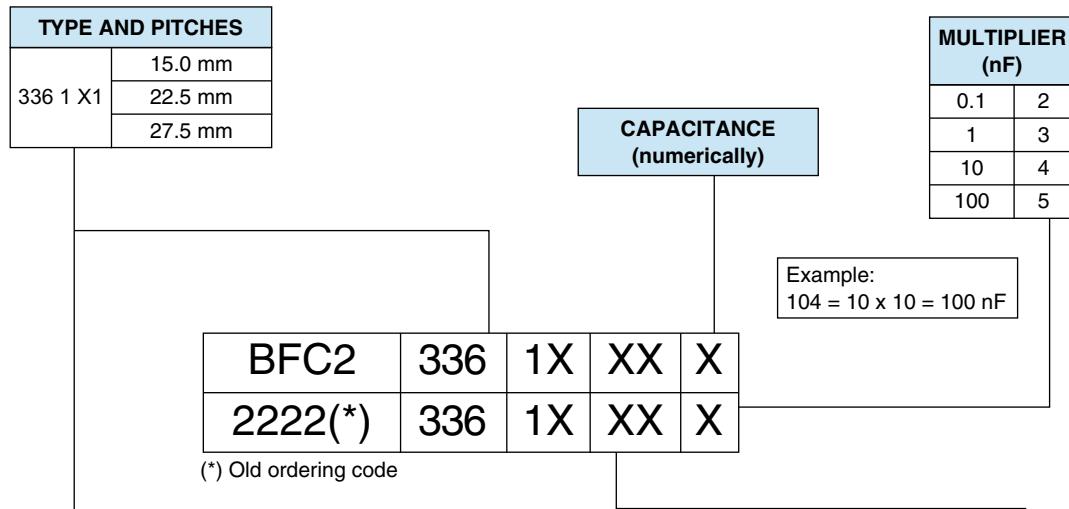
Capacitance range (E12 series)	0.01 μ F to 1 μ F (preferred values according to E6)
Capacitance tolerance	$\pm 20\%$; $\pm 10\%$; $\pm 5\%$
Rated AC voltage	275 V _{AC} ; 50 Hz to 60 Hz
Permissible DC voltage	630 V _{DC}
Climatic testing class (according to EN 60068-1)	55/105/56/B
Maximum application temperature	105 °C
Rated temperature	105 °C
Leads	Tinned wire
Reference standards	IEC 60384-14 ed-4 (2013) and EN 132400 IEC 60065, pass. flamm. class B UL 60384-14 CSA E384-14
Dielectric	Polypropylene film
Electrodes	Metallized film
Construction	Mono construction
Encapsulation	Plastic case, 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 rifi@vishay.com

DIMENSIONS in millimeters



COMPOSITION OF CATALOG NUMBER

TYPE	PACKAGING	LEAD CONFIGURATION		C-TOL.	PREFERRED TYPES
336 1 X1	Loose in box	Lead length 3.5 mm \pm 0.3 mm		\pm 20 %	BFC2 336 10...
		Lead length 25.0 mm \pm 2.0 mm			BFC2 336 16...
					ON REQUEST
336 1 X1	Loose in box	Lead length 3.5 mm \pm 0.3 mm		\pm 10 %	BFC2 336 11...
		Lead length 25.0 mm \pm 2.0 mm			BFC2 336 17...
	Taped on reel	H = 18.5 mm; P ₀ = 12.7 mm; reel diameter 500 mm		\pm 20 %	BFC2 336 13...
					BFC2 336 14...

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

SPECIFIC REFERENCE DATA	
DESCRIPTION	VALUE
Tangent of loss angle: C \leq 100 nF	at 10 kHz
100 nF $<$ C \leq 470 nF	$\leq 10 \times 10^{-4}$
C $>$ 470 nF	$\leq 20 \times 10^{-4}$ $\leq 70 \times 10^{-4}$
Rated voltage pulse slope (dU/dt) _R at 385 V _{DC} : P = 15 mm	250 V/μs
P = 22.5 mm	150 V/μs
P = 27.5 mm	100 V/μs
R between leads, for C \leq 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 (DC) voltage (cut off current 10 mA) ⁽¹⁾ ; rise time \leq 1000 V/s	3400 V; 1 min
Withstanding (AC) voltage between leads and case	2050 V; 1 min

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

ELECTRICAL DATA AND ORDERING INFORMATION							
U _{RAC} (V)	CAP. (μ F)	DIMENSIONS W x H x L (mm)	MASS (g) ⁽¹⁾	CATALOG NUMBER BFC2 336 1 AND PACKAGING			
				LOOSE IN BOX			REEL 500 mm ⁽¹⁾⁽²⁾
				I _t = 3.5 mm \pm 0.3 mm		I _t = 25.0 mm \pm 2.0 mm	H = 18.5 mm; P ₀ = 12.7 mm
				LAST 5 DIGITS OF CATALOG NUMBER	SPQ	LAST 5 DIGITS OF CATALOG NUMBER	SPQ
PITCH = 15.0 mm \pm 0.4 mm; d_t = 0.6 mm \pm 0.06 mm; U_{RAC} = 275 V; C-TOL. = \pm 20 %							
0.010	5.0 x 11.0 x 17.5	1	19001	1000	19007	1000	19002
0.015			10153		16153		13153
0.022			10223		16223		13223
0.033			10333		16333		13333
PITCH = 15.0 mm \pm 0.4 mm; d_t = 0.8 mm \pm 0.08 mm; U_{RAC} = 275 V; C-TOL. = \pm 20 %							
0.047	7.0 x 13.5 x 17.5	1.8	10473	1000	16473	500	13473
0.068	8.5 x 15.0 x 17.5	2.4	10683		16683		13683
0.100	10.0 x 16.5 x 17.5	3	10104		16104		13104
PITCH = 22.5 mm \pm 0.4 mm; d_t = 0.8 mm \pm 0.08 mm; U_{RAC} = 275 V; C-TOL. = \pm 20 %							
0.10	7.0 x 16.5 x 26.0	2.9	19003	200	19008	500	19004
0.15	8.5 x 18.0 x 26.0	3.8	10154		16154		13154
0.22	10.0 x 19.5 x 26.0	6.8	10224		16224		13224
PITCH = 27.5 mm \pm 0.4 mm; d_t = 0.8 mm \pm 0.08 mm; U_{RAC} = 275 V; C-TOL. = \pm 20 %							
0.22	11.0 x 21.0 x 31.0	7.4	19005	100	19009	125	
0.33	13.0 x 23.0 x 31.0	9.2	10334		16334		
0.47	15.0 x 25.0 x 31.0	12.3	10474		16474		
0.68	18.0 x 28.0 x 31.0	16.1	10684		16684		
1.00	21.0 x 31.0 x 31.0	20.3	10105		16105		75
PITCH = 15.0 mm \pm 0.4 mm; d_t = 0.6 mm \pm 0.06 mm; U_{RAC} = 275 V; C-TOL. = \pm 10 %							
0.010	5.0 x 11.0 x 17.5	1	11103	1000	17103	1000	14103
0.012			11123		17123		14123
0.015			11153		17153		14153
0.018			11183		17183		14183
0.022			11223		17223		14223
0.027			11273		17273		14273
PITCH = 15.0 mm \pm 0.4 mm; d_t = 0.8 mm \pm 0.08 mm; U_{RAC} = 275 V; C-TOL. = \pm 10 %							
0.033	7.0 x 13.5 x 17.5	1.8	11333	1000	17333	500	14333
0.039			11393		17393		14393
0.047			11473		17473		14473
0.056			11563		17563		14563
0.068			11683		17683		14683
0.082			11823		17823		14823
PITCH = 22.5 mm \pm 0.4 mm; d_t = 0.8 mm \pm 0.08 mm; U_{RAC} = 275 V; C-TOL. = \pm 10 %							
0.10	7.0 x 16.5 x 26.0	2.9	11104	200	17104	500	14104
0.12	8.5 x 18.0 x 26.0	3.8	11124		17124		14124
0.15			11154		17154		14154
0.18			11184		17184		14184
PITCH = 27.5 mm \pm 0.4 mm; d_t = 0.8 mm \pm 0.08 mm; U_{RAC} = 275 V; C-TOL. = \pm 10 %							
0.22	11.0 x 21.0 x 31.0	7.4	11224	100	17224	125	
0.27			11274		17274		
0.33			11334		17334		
0.39			11394		17394		
0.47			11474		17474		
0.56			11564		17564		
0.68			11684		17684		
0.82			11824		17824		75

Notes

- SPQ = Standard Packing Quantity

(1) Reel diameter = 356 mm is available on request

(2) H = In tape height; P₀ = Sprocket hole distance; for detailed specifications refer to Packaging Information.

(3) Weight for short lead product only

APPROVALS				
SAFETY APPROVALS X1	VOLTAGE	VALUE	FILE NUMBERS	LINKS
EN 60384-14 (ENECL (= IEC 60384-14 ed-4 (2013))	275 V _{AC}	10 nF to 1 μ F	FI 2016036	www.vishay.com/doc?28197
UL 60384-14	275 V _{AC}	10 nF to 1 μ F	E354331	www.vishay.com/doc?28188
CSA E384-14	275 V _{AC}	10 nF to 1 μ F	E354331	www.vishay.com/doc?28188
CB-Test-Certificate	275 V _{AC}	10 nF to 1 μ F	FI 9217	www.vishay.com/doc?28198
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; 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".

Specific Method of Mounting to Withstand Vibration and Shock

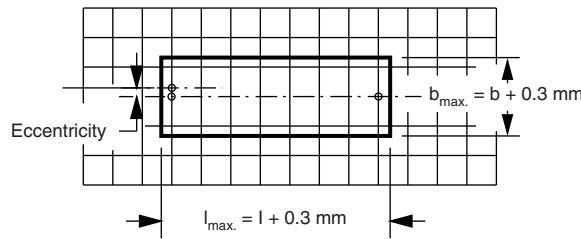
In order to withstand vibration and shock tests, it must be ensured that the stand-off pips are in good contact with the printed-circuit board:

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

Space Requirements on Printed Circuit Board

The maximum length and width of film capacitors is shown in Figure:

- Eccentricity as in figure. The maximum eccentricity is smaller than or equal to the lead diameter of the product concerned
- Product height with seating plane as given by "IEC 60717" as reference: $h_{\max.} \leq h + 0.3$ mm



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

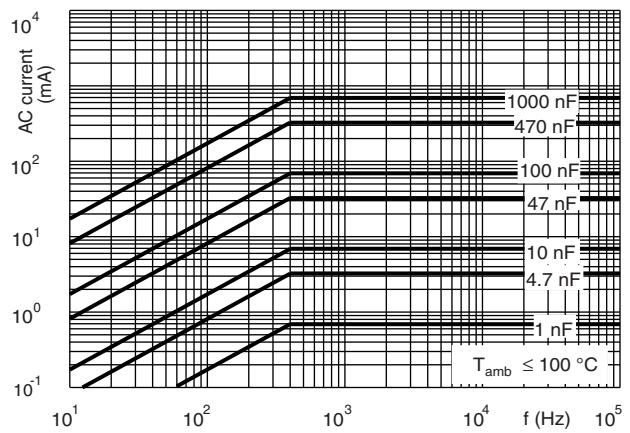
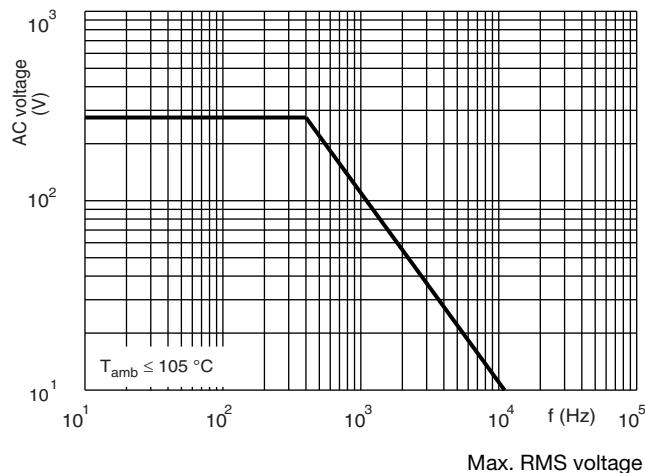
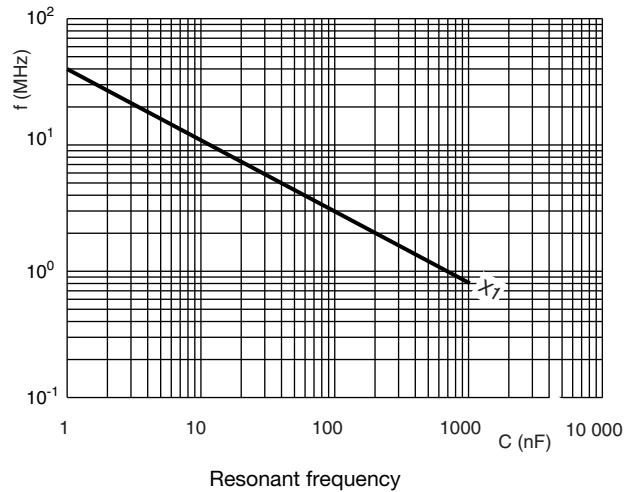
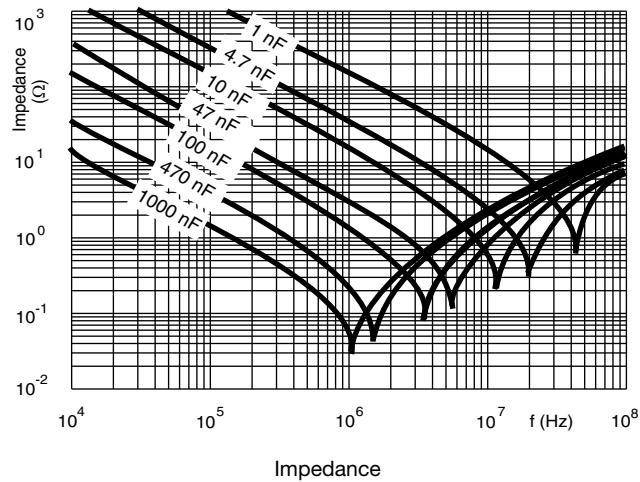
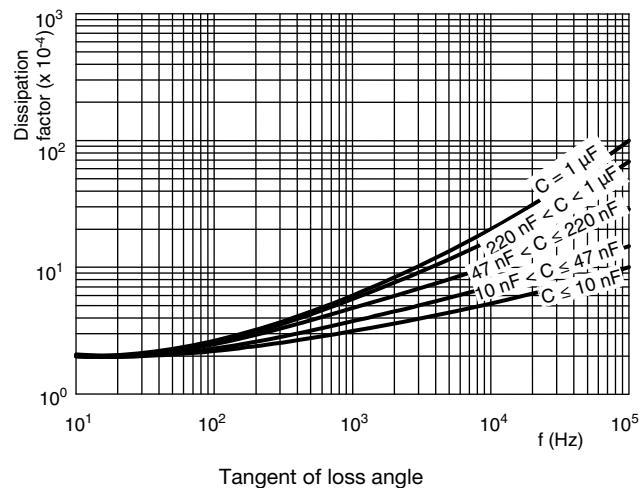
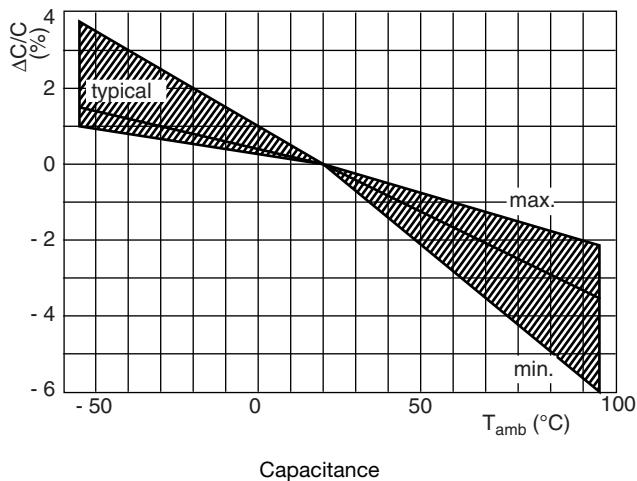
$T_{\text{stg}} = -25^{\circ}\text{C}$ to $+35^{\circ}\text{C}$ with RH maximum 75 % without condensation

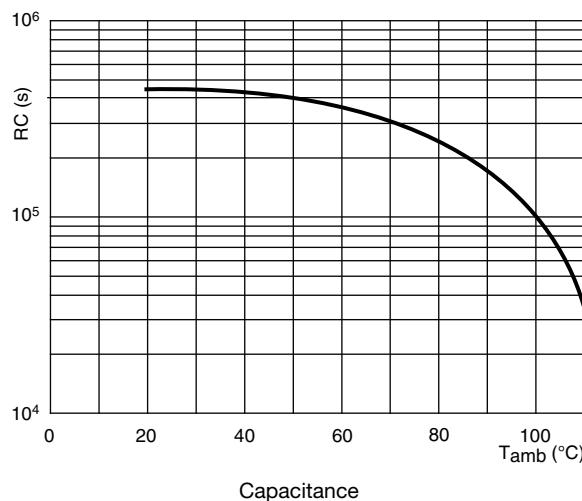
Ratings and Characteristics Reference Conditions

Unless otherwise specified, all electrical values apply to an ambient temperature of $23^{\circ}\text{C} \pm 1^{\circ}\text{C}$, 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 $96\text{ h} \pm 4\text{ h}$ by heating the products in a circulating air oven at the rated temperature and a relative humidity not exceeding 20 %.

CHARACTERISTICS





APPLICATION NOTES

- For X2 electromagnetic interference suppression in standard across the line applications (50 Hz/60 Hz) with a maximum mains voltage of 310 VAC.
- For series impedance applications we refer to application note www.vishay.com/doc?28153
- 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
- These capacitors are not intended for continuous pulse application. For these situations capacitors of the AC and pulse programs must be used.
- The maximum ambient temperature must not exceed 110 °C. (125 °C for less than 1000 h) for $C \leq 470 \text{ nF}$ and 110 °C for $C > 470 \text{ nF}$.
- 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_{DC} and divided by the applied voltage.

INSPECTION REQUIREMENTS

General Notes

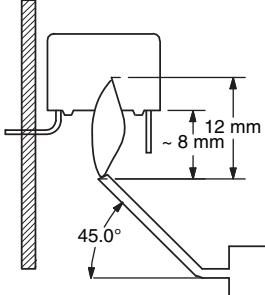
Sub-clause numbers of tests and performance requirements refer to the "Sectional Specification, Publication IEC 60384-14 ed-4 (2013) and Specific Reference Data."

GROUP C INSPECTION REQUIREMENTS			
SUB-CLAUSE NUMBER AND TEST	D OR ND	CONDITIONS	PERFORMANCE REQUIREMENTS
SUB-GROUP C1A PART OF SAMPLE OF SUB-GROUP C1	D		
4.1 Dimensions (detail)			As specified in chapters "General Data" of this specification
Initial measurements		Capacitance Tangent of loss angle: For $C \leq 470 \text{ nF}$ at 100 kHz For $C > 470 \text{ nF}$ at 10 kHz	
4.3 Robustness of terminations		Tensile: load 10 N; 10 s Bending: load 5 N; 4 x 90°	No visible damage

GROUP C INSPECTION REQUIREMENTS			
SUB-CLAUSE NUMBER AND TEST	D OR ND	CONDITIONS	PERFORMANCE REQUIREMENTS
SUB-GROUP C1A PART OF SAMPLE OF SUB-GROUP C1	D		
4.4 Resistance to soldering heat		No pre-drying Method: 1A Solder bath: 260 °C Duration: 10 s	
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 $\tan \delta: \leq 0.008$ Compared to values measured initially As specified in section "Insulation Resistance" of this specification
SUB-GROUP C1B PART OF SAMPLE OF SUB-GROUP C1	D		
Initial measurements		Capacitance Tangent of loss angle: For $C \leq 470 \text{ nF}$ at 100 kHz For $C > 470 \text{ nF}$ at 10 kHz	No visible damage Legible marking
4.20 Solvent resistance of the marking: see section "General Notes"; item 5		Isopropylalcohol at room temperature Method: 1 Rubbing material: cotton wool Immersion time: 5 min ± 0.5 min	No visible damage
4.6 Rapid change of temperature		$0A = -55^\circ\text{C}$ $0B = +105^\circ\text{C}$ 5 cycles	
SUB-GROUP C1B PART OF SAMPLE OF SUB-GROUP C1	D		
4.6.1 Inspection		Duration $t = 30 \text{ min}$	
4.7 Vibration (see note 3.1)		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	D OR ND	CONDITIONS	PERFORMANCE REQUIREMENTS
SUB-GROUP C1B PART OF SAMPLE OF SUB-GROUP C1	D		
4.9 Shock (see note 3)		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 $\tan \delta: \leq 0.008$ Compared to values measured initially As specified in section "Insulation Resistance" of this specification
SUB-GROUP C1 COMBINED SAMPLE OF SPECIMENS OF SUB-GROUPS C1A AND C1B	D		
4.11 Climatic sequence			
4.11.1 Initial measurements		Capacitance 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: 105 °C Duration: 16 h	
4.11.3 Damp heat cyclic Test Db First cycle			
4.11.4 Cold		Temperature: - 55 °C Duration: 2 h	
4.11.5 Damp heat cyclic Test Db remaining cycles			
SUB-GROUP C1 COMBINED SAMPLE OF SPECIMENS OF SUB-GROUPS C1A AND C1B	D		
4.11.6 Final measurements		Visual examination Capacitance Tangent of loss angle Voltage proof 1200 V _{DC} ; 1 min between term Insulation resistance	No visible damage Legible marking $ \Delta C/C \leq 5\%$ of the value measured in 4.11.1 Increase of $\tan \delta: \leq 0.008$ 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

GROUP C INSPECTION REQUIREMENTS			
SUB-CLAUSE NUMBER AND TEST	D OR ND	CONDITIONS	PERFORMANCE REQUIREMENTS
SUB-GROUP C2	D		
4.12 Damp heat steady state		56 days, 40 °C, 90 % to 95 % RH, no load capacitance	
4.12.1 Initial measurements		Tangent of loss angle at 10 kHz	
4.12.3 Final measurements		Visual examination Capacitance Tangent of loss angle Voltage proof 1200 V _{DC} ; 1 min between term Insulation resistance	No visible damage Legible marking $ \Delta C/C \leq 5 \%$ of the value measured in 4.12.1. Increase of $\tan \delta: \leq 0.008$ 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
SUB GROUP C3	D		
4.13.1 Initial measurements		Capacitance Tangent of loss angle: For $C \leq 470 \text{ nF}$ at 100 kHz For $C > 470 \text{ nF}$ at 10 kHz	
4.13 Impulse voltage		3 successive impulses, full wave, peak voltage: X1: 4 kV Max. 24 pulses	No selfhealing breakdowns or flashover
4.14 Endurance		Duration: 1000 h 1.25 U _{RAC} at 105 °C Once in every hour the voltage is increased to 1000 V _{RMS} for 0.1 s via resistor of $47 \Omega \pm 5 \%$	
SUB GROUP C3	D		
4.14.7 Final measurements		Visual examination Capacitance Tangent of loss angle Voltage proof 1200 V _{DC} ; 1 min between terminations 2050 V _{DC} ; 1 min between terminations and case Insulation resistance	No visible damage Legible marking $ \Delta C/C \leq 10 \%$ compared to values measured in 4.13.1. Increase of $\tan \delta: \leq 0.008$ Compared to values measured in 4.13.1. 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	D OR ND	CONDITIONS	PERFORMANCE REQUIREMENTS
SUB-GROUP C 4	D		
4.15 Charge and discharge		10 000 cycles (50 c/s) charge to U_R half sinewave Duration: 5 ms Discharge resistance: $R = \frac{385 \text{ V}_{\text{DC}}}{1.5 \times C(dU/dt)}$ $R_{\text{min.}} = 2.2$ Capacitance Tangent of loss angle For $C \leq 470 \text{ nF}$ at 100 kHz For $C > 470 \text{ nF}$ at 10 kHz	
4.15.1 Initial measurements			
4.15.3 Final measurements		Capacitance Tangent of loss angle Insulation resistance	$ \Delta C/C \leq 10 \%$ compared to values measured in 4.15.1. Increase of $\tan \delta: \leq 0.008$ Compared to values measured in 4.15.1 $\geq 50 \%$ of values specified in section "Insulation Resistance" of this specification
SUB-GROUP C 5	D		
4.16 Radio frequency characteristic		Resonance frequency	As specified in section "Resonant Frequency" of this specification. $\pm 10 \%$
SUB-GROUP C 6	D		
4.17 Passive flammability Class B		Bore of gas jet: $\varnothing 0.5 \text{ mm}$ Fuel: Butane Test duration for actual volume V in mm^3 : $V \leq 250: 10 \text{ s}$ $250 < V \leq 500: 20 \text{ s}$ $500 < V \leq 1750: 30 \text{ s}$ $V > 1750: 60 \text{ s}$ One flame application	After removing test flame from capacitor, the capacitor must not continue to burn for more than 10 s. No burning particle must drop from the sample.
			
SUB-GROUP C 7	D		
4.18 Active flammability		20 x 4 kV discharges on the test capacitor connected to U_R	The cheese cloth around the capacitors shall not burn with a flame. No electrical measurements are required.

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