VISHAY

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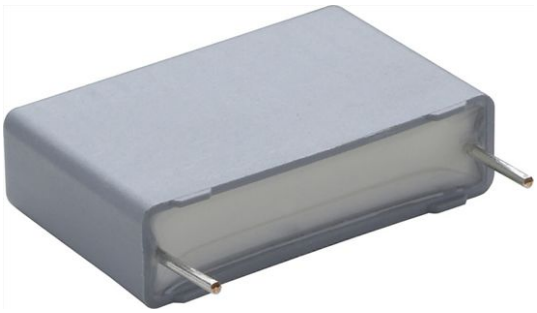
MKP336 1 X1

Vishay BCcomponents

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

Pb-free

RoHS COMPLIANT

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}.

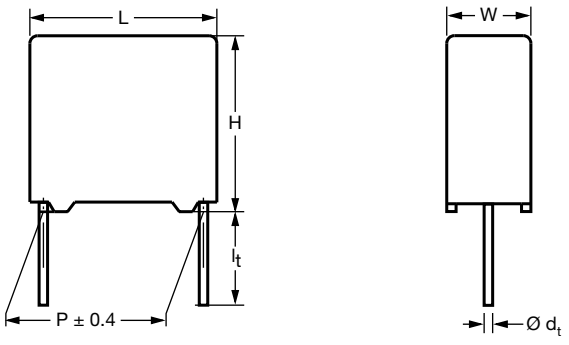
For application limitations please refer to section “Application Notes”.

QUICK REFERENCE DATA	
Capacitance range (E12 series)	0.01 µF to 1 µF (preferred values according to E6)
Capacitance tolerance	± 20 %; ± 10 %; ± 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 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 rfi@vishay.com

DIMENSIONS in millimeters



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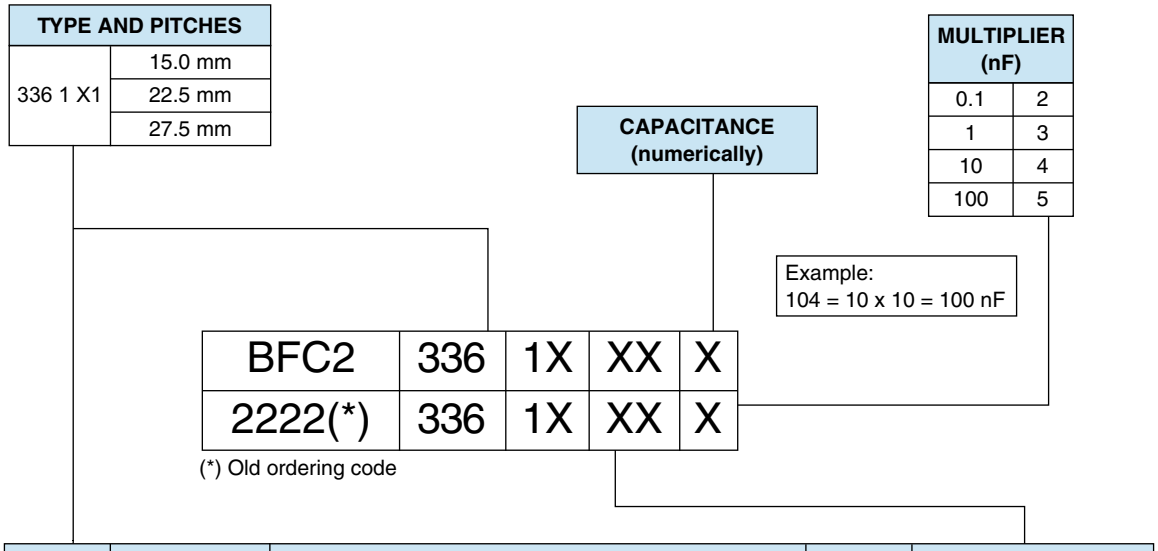
COMPOSITION OF CATALOG NUMBER



TYPE	PACKAGING	LEAD CONFIGURATION	C-TOL.	PREFERRED TYPES
336 1 X1	Loose in box	Lead length 3.5 mm ± 0.3 mm	± 20 %	BFC2 336 10...
		Lead length 25.0 mm ± 2.0 mm		BFC2 336 16...
				ON REQUEST
336 1 X1	Loose in box	Lead length 3.5 mm ± 0.3 mm	± 10 %	BFC2 336 11...
		Lead length 25.0 mm ± 2.0 mm		BFC2 336 17...
	Taped on reel	H = 18.5 mm; P_0 = 12.7 mm; reel diameter 500 mm	± 20 %	BFC2 336 13...
			± 10 %	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:	at 10 kHz
C ≤ 100 nF	≤ 10 x 10^{-4}
100 nF < C ≤ 470 nF	≤ 20 x 10^{-4}
C > 470 nF	≤ 70 x 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 ≤ 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 ≤ 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

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ELECTRICAL DATA AND ORDERING INFORMATION

U_{RAC} (V)	CAP. (µF)	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)	
				l_t = 3.5 mm ± 0.3 mm		l_t = 25.0 mm ± 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	LAST 5 DIGITS OF CATALOG NUMBER	SPQ
275	PITCH = 15.0 mm ± 0.4 mm; d_t = 0.6 mm ± 0.06 mm; U_{RAC} = 275 V; C-TOL. = ± 20 %								
	0.010	5.0 x 11.0 x 17.5	1	19001	1000	19007	1000	19002	1100
	0.015			10153		16153		13153	
	0.022			10223		16223		13223	
	0.033	6.0 x 12.0 x 17.5	1.4	10333		16333		13333	900
	PITCH = 15.0 mm ± 0.4 mm; d_t = 0.8 mm ± 0.08 mm; U_{RAC} = 275 V; C-TOL. = ± 20 %								
	0.047	7.0 x 13.5 x 17.5	1.8	10473	1000	16473	500	13473	800
	0.068	8.5 x 15.0 x 17.5	2.4	10683		16683		13683	650
	0.100	10.0 x 16.5 x 17.5	3	10104	500	16104		13104	600
	PITCH = 22.5 mm ± 0.4 mm; d_t = 0.8 mm ± 0.08 mm; U_{RAC} = 275 V; C-TOL. = ± 20 %								
	0.10	7.0 x 16.5 x 26.0	2.9	19003	200	19008	500	19004	550
	0.15	8.5 x 18.0 x 26.0	3.8	10154		16154		13154	450
	0.22	10.0 x 19.5 x 26.0	6.8	10224		16224		13224	400
	PITCH = 27.5 mm ± 0.4 mm; d_t = 0.8 mm ± 0.08 mm; U_{RAC} = 275 V; C-TOL. = ± 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	50	16105	75		
	PITCH = 15.0 mm ± 0.4 mm; d_t = 0.6 mm ± 0.06 mm; U_{RAC} = 275 V; C-TOL. = ± 10 %								
	0.010	5.0 x 11.0 x 17.5	1	11103	1000	17103	1000	14103	1100
	0.012			11123		17123		14123	
	0.015			11153		17153		14153	
	0.018			11183		17183		14183	
	0.022	6.0 x 12.0 x 17.5	1.4	11223		17223		14223	900
	0.027			11273		17273		14273	
	PITCH = 15.0 mm ± 0.4 mm; d_t = 0.8 mm ± 0.08 mm; U_{RAC} = 275 V; C-TOL. = ± 10 %								
	0.033	7.0 x 13.5 x 17.5	1.8	11333	1000	17333	500	14333	800
	0.039			11393		17393		14393	
	0.047	8.5 x 15.0 x 17.5	2.4	11473		17473		14473	650
	0.056			11563		17563		14563	
	0.068	10.0 x 16.5 x 17.5	3	11683	500	17683		14683	600
	0.082			11823		17823		14823	
	PITCH = 22.5 mm ± 0.4 mm; d_t = 0.8 mm ± 0.08 mm; U_{RAC} = 275 V; C-TOL. = ± 10 %								
	0.10	7.0 x 16.5 x 26.0	2.9	11104	200	17104	500	14104	550
	0.12	8.5 x 18.0 x 26.0	3.8	11124		17124	250	14124	450
	0.15			11154		17154		14154	
	0.18	10.0 x 19.5 x 26.0	6.8	11184		17184	500	14184	400
	PITCH = 27.5 mm ± 0.4 mm; d_t = 0.8 mm ± 0.08 mm; U_{RAC} = 275 V; C-TOL. = ± 10 %								
	0.22	11.0 x 21.0 x 31.0	7.4	11224	100	17224	125		
	0.27			11274		17274			
	0.33	13.0 x 23.0 x 31.0	9.2	11334		17334			
	0.39	15.0 x 25.0 x 31.0	12.3	11394		17394			
	0.47			11474		17474			
	0.56	18.0 x 28.0 x 31.0	16.1	11564		17564			
	0.68			11684		17684			
	0.82	21.0 x 31.0 x 31.0	20.3	11824	50	17824	75		

Notes

- SPQ = Standard Packing Quantity

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

(2) H = In tape height; P_0 = Sprocket hole distance; for detailed specifications refer to Packaging Information.

(3) Weight for short lead product only

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APPROVALS			
SAFETY APPROVALS X1	**VOLTAGE**	**VALUE**	**FILE NUMBERS**
EN 60384-14 (ENEC) (= IEC 60384-14)	275 V_{AC}	10 nF to 1 µF	FI 2013012
UL 60384-14	275 V_{AC}	10 nF to 1 µF	E354331
CSA E384-14	275 V_{AC}	10 nF to 1 µF	E354331
CB-Test-Certificate	275 V_{AC}	10 nF to 1 µF	FI 5254 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; 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

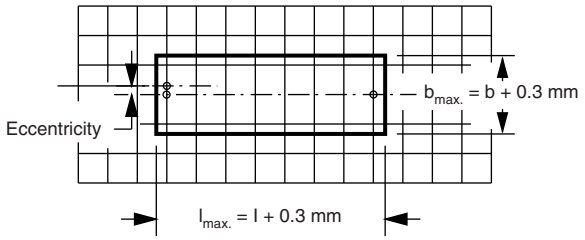
In order to withstand vibration and shock tests, it must be ensured that the stand-off pips are in good contact with the printed-circuit board:

- 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



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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

- 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 %.

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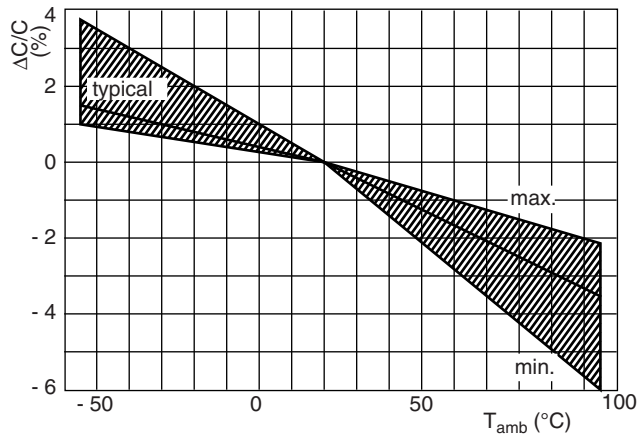
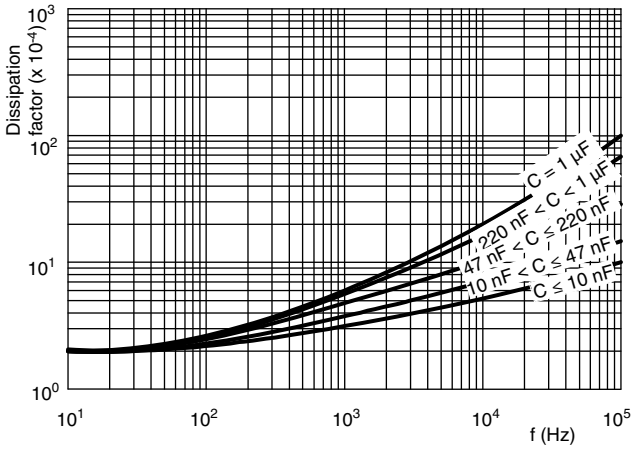
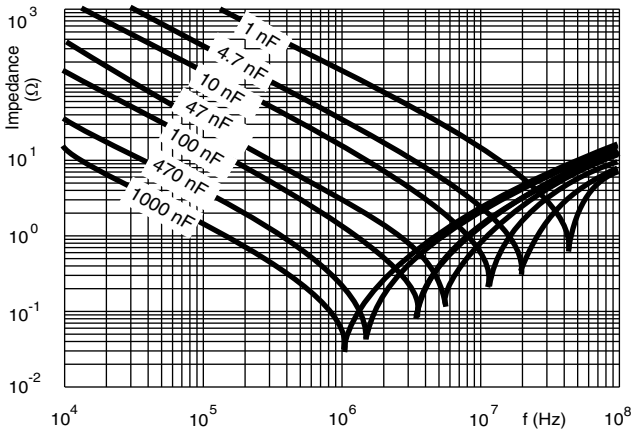
CHARACTERISTICS



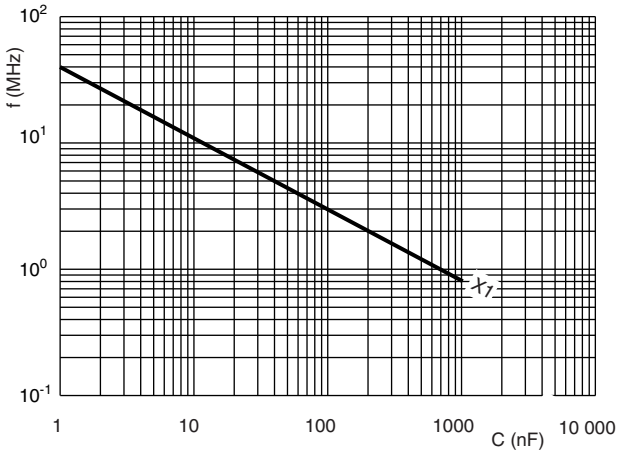
Capacitance



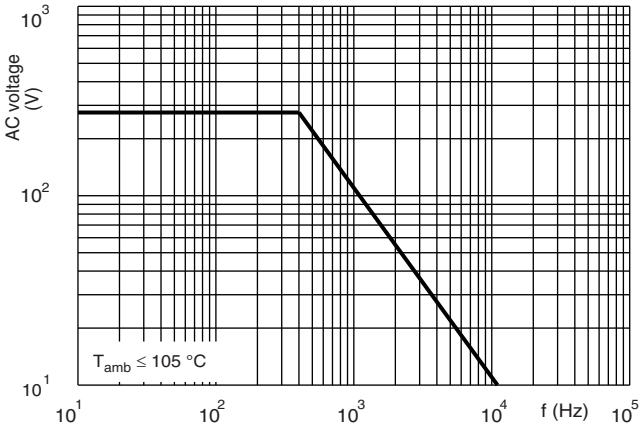
Tangent of loss angle

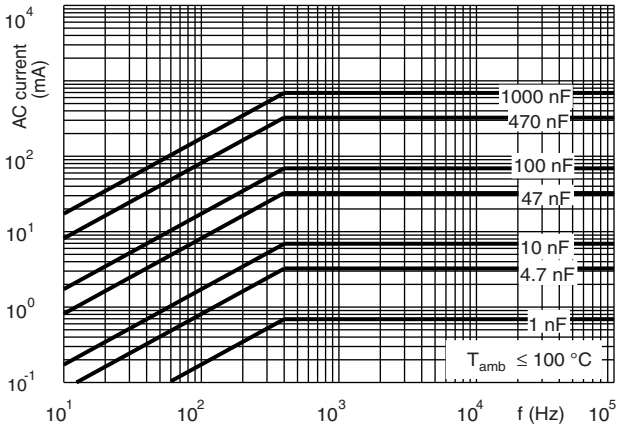


Impedance



Resonant frequency





Max. RMS voltage and AC current (sinewave)

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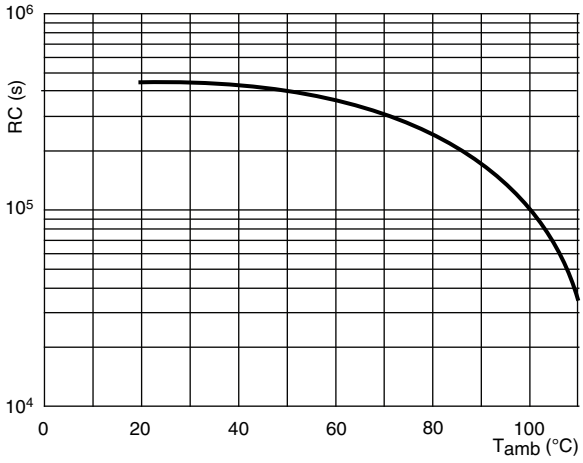

Capacitance

APPLICATION NOTES

- For X2 electromagnetic interference suppression in standard across the line applications (50 Hz/60 Hz) with a maximum mains voltage of 310 V_{AC}.
- 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 te 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 ≤ 470 nF and 110 °C for C > 470 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

1. Sub-clause numbers of tests and performance requirements refer to the “Sectional Specification, IEC-Publication EN 132400 (IEC 60384-14) and section one of this specification”.
2. In this table: D = Destructive
   ND = Non destructive

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 ≤ 470 nF at 100 kHz 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

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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	No visible damage Legible marking
		Capacitance	$\lvert\Delta C/C\rvert \leq 5$ % of the value measured initially
		Tangent of loss angle	Increase of tan δ: ≤ 0.008 Compared to values measured initially
		Insulation resistance	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 ≤ 470 nF at 100 kHz For C > 470 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		θA = - 55 °C θB = + 105 °C 5 cycles	
SUB-GROUP C1B PART OF SAMPLE OF SUB-GROUP C1	**D**		
4.6.1 Inspection		Duration t = 30 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/s² (whichever is less severe) Total duration 6 h	No visible damage
4.7.2 Final inspection		Visual examination	No visible damage

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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/s² Duration of pulse: 11 ms	
4.9.2 Final measurements		Visual examination	No visible damage
		Capacitance	$\|\Delta C/C\| \leq 5$ % of the value measured initially
		Tangent of loss angle	Increase of tan δ: ≤ 0.008 Compared to values measured initially
		Insulation resistance	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	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 δ: ≤ 0.008 compared to values measured in 4.11.1
		Voltage proof 1200 V_{DC}; 1 min between term	No permanent breakdown or flash-over
		Insulation resistance	≥ 50 % of values specified in section “Insulation Resistance” of this specification

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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	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 δ: ≤ 0.008 Compared to values measured in 4.12.1.
		Voltage proof 1200 V_{DC}; 1 min between term	No permanent breakdown or flash-over
		Insulation resistance	$\geq$ 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 nF at 100 kHz For C > 470 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 Ω ± 5 %	
SUB GROUP C3	**D**		
4.14.7 Final measurements		Visual examination	No visible damage Legible marking
		Capacitance	$\|\Delta C/C\| \leq 10$ % compared to values measured in 4.13.1.
		Tangent of loss angle	Increase of tan δ: ≤ 0.008 Compared to values measured in 4.13.1.
		Voltage proof 1200 V_{DC}; 1 min between terminations 2050 V_{DC}; 1 min between terminations and case	No permanent breakdown or flash-over
		Insulation resistance	$\geq$ 50 % of values specified in section "Insulation Resistance" of this specification

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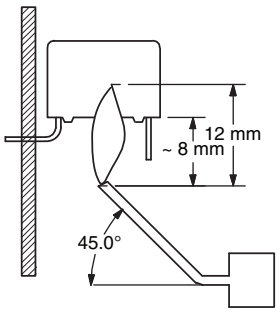
GROUP C INSPECTION REQUIREMENTS			
SUB-CLAUSE NUMBER AND TEST	**D OR ND**	**CONDITIONS**	**PERFORMANCE REQUIREMENTS**
SUB-GROUP C 4	**D**		
4.15 Charge and discharge		10 000 cycles (50 c/s) charge to U_R half sinewave Duration: 5 ms Discharge resistance: $R = \frac{385\ V_{DC}}{1.5 \times C(dU/dt)}$ $R_{min.} = 2.2$	
4.15.1 Initial measurements		Capacitance Tangent of loss angle For C ≤ 470 nF at 100 kHz For C > 470 nF at 10 kHz	
4.15.3 Final measurements		Capacitance	$\lvert\Delta C/C\rvert \leq 10$ % compared to values measured in 4.15.1.
		Tangent of loss angle	Increase of tan δ: ≤ 0.008 Compared to values measured in 4.15.1
		Insulation resistance	≥ 50 % of values specified in section “Insulation Resistance” of this specification
SUB-GROUP C5	**D**		
4.16 Radio frequency characteristic		Resonance frequency	As specified in section “Resonant Frequency” of this specification. ± 10 %
SUB-GROUP C6	**D**		
4.17 Passive flammability Class B		Bore of gas jet: Ø 0.5 mm Fuel: Butane Test duration for actual volume V in mm³: V ≤ 250: 10 s 250 < V ≤ 500: 20 s 500 < V ≤ 1750: 30 s V > 1750: 60 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 C7	**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.

For technical questions, contact: rfi@vishay.com
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