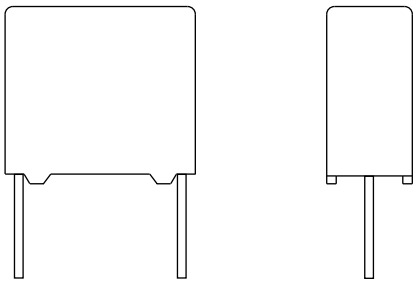
# Interference Suppression Film Capacitors
# MKP Radial Potted Type



## FEATURES

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

Pb-free

e3

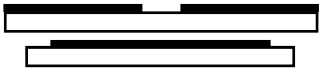
RoHS COMPLIANT

## APPLICATIONS

Y2 class

For Y2 electromagnetic interference suppression between line and ground applications (50 Hz / 60 Hz) with a maximum mains voltage of 300 $V_{AC}$.

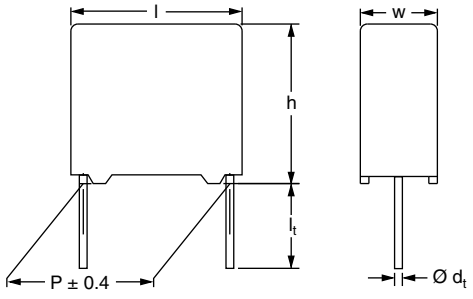
For application limitations refer to section “Application Notes”.

| QUICK REFERENCE DATA | |
|---|---|
| Capacitance range (E12 series) | 0.001 µF to 0.047 µF (preferred values according to E6) |
| Capacitance tolerance | ± 20 %; ± 10 % |
| Climatic testing class according to EN60068-1 | 55/105/56/C for product volumes ≤ 1750 $mm^3$<br>55/105/56/B for product volumes > 1750 $mm^3$ |
| Rated AC voltage | 300 $V_{AC}$; 50 Hz to 60 Hz |
| Permissible DC voltage | 1000 $V_{DC}$ |
| Maximum application temperature | 105 °C |
| Reference standards | IEC 60384-14 ed-4 (2013) edition and EN 60384-14<br>IEC 60065 requires, pass. flamm. class B for volumes > 1750 $mm^3$<br>UL 60384-14 |
| Dielectric | Polypropylene film |
| Electrodes | Metallized film |
| Construction | Series construction (for > 10 mm pitch)<br>  <br>Triple construction (for > 7.5 mm and 10 mm pitch)<br> |
| 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 designation; code for dielectric material; manufacturer location; year and week |

**Note**

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

## DIMENSIONS in millimeters



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## COMPOSITION OF CATALOG NUMBER

| TYPE AND PITCHES | |
|---|---|
| 336 6 Y2 | 10.0 mm |
| | 15.0 mm |

**CAPACITANCE (numerically)**

| MULTIPLIER (nF) | |
|---|---|
| 0.1 | 2 |
| 1 | 3 |

**Example:**
103 = 10 x 1 = 10 nF

| | | | | |
|---|---|---|---|---|
| BFC2 | 336 | 6X | XX | X |
| 2222(*) | 336 | 6X | XX | X |

(*) Old ordering code

| TYPE | PACKAGING | LEAD CONFIGURATION | C-TOL. | PREFERRED TYPES |
|---|---|---|---|---|
| 336 6 Y2 | Loose in box | Lead length 3.5 mm + 1 mm/- 0.5 mm (pitch = 10 mm) or 3.5 mm ± 0.3 mm (pitch = 15 mm) | ± 20 % | BFC2 336 60... |
| | | Lead length 25.0 mm ± 2.0 mm | | BFC2 336 66... |
| **TYPE** | **PACKAGING** | **LEAD CONFIGURATION** | **C-TOL.** | **ON REQUEST** |
| 336 6 Y2 | Loose in box | Lead length 3.5 mm + 1 mm/- 0.5 mm (pitch = 10 mm) or 3.5 mm ± 0.3 mm (pitch = 15 mm) | ± 10 % | BFC2 336 61... |
| | | Lead length 25.0 mm ± 2.0 mm | | BFC2 336 67... |
| | Taped on reel (1) | H = 18.5 mm; $P_0$ = 12.7 mm; reel diameter 500 mm | ± 20 % | BFC2 336 63... |
| | | | ± 10 % | BFC2 336 64... |

**Note**

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

| SPECIFIC REFERENCE DATA | |
|---|---|
| **DESCRIPTION** | **VALUE** |
| Rated AC voltage ($U_{RAC}$) | 300 V |
| Permissible DC voltage ($U_{RDC}$) | 1000 V |
| Tangent of loss angle | at 10 kHz |
| | ≤ 20 x $10^{-4}$ |
| Rated voltage pulse slope $(dU/dt)_R$ at 420 $V_{DC}$ | 200 V/µs |
| R between leads, for C ≤ 0.33 µF at 100 V; 1 min | > 15 000 MΩ |
| 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 | 2100 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 CODE

| $U_{RAC}$ (V) | CAP. (µF) | DIMENSIONS w x h x l (mm) | MASS (g) (3) | CATALOG NUMBER BFC2 336 6..... AND PACKAGING | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | LOOSE IN BOX | | | | REEL (500 mm) (1)(2) | |
| | | | | $l_t$ = 3.5 mm + 1 mm/- 0.5 mm (10 mm) OR 3.5 mm ± 0.3 mm (= 15 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 |
| 300 | PITCH = 10.0 mm ± 0.4 mm; $d_t$ = 0.6 mm ± 0.06 mm; C-TOL. = ± 20 % | | | | | | | | |
| | 0.0010 | 4.0 x 10.0 x 12.5 | 0.6 | 60102 | 1000 | 66102 | 1250 | 63102 | 1400 |
| | 0.0015 | | | 60152 | | 66152 | | 63152 | |
| | 0.0022 | | | 60222 | | 66222 | | 63222 | |
| | 0.0033 | | | 60332 | | 66332 | | 63332 | |
| | 0.0047 | 5.0 x 11.0 x 12.5 | 0.82 | 60472 | | 66472 | 1000 | 63472 | 1100 |
| | 0.0068 | | | 60682 | | 66682 | | 63682 | |
| | PITCH = 15.0 mm ± 0.4 mm; $d_t$ = 0.6 mm ± 0.06 mm; C-TOL. = ± 20 % | | | | | | | | |
| | 0.0068 | 5.0 x 11.0 x 17.5 | 1.0 | 69005 | 1000 | 69009 | 1000 | 69006 | 1100 |
| | 0.010 | | | 60103 | | 66103 | | 63103 | |
| | 0.015 | 6.0 x 12.0 x 17.5 | 1.4 | 60153 | | 66153 | | 63153 | 900 |
| | PITCH = 15.0 mm ± 0.4 mm; $d_t$ = 0.8 mm ± 0.08 mm; C-TOL. = ± 20 % | | | | | | | | |
| | 0.022 | 7.0 x 13.5 x 17.5 | 1.8 | 60223 | 750 | 66223 | 500 | 63223 | 800 |
| | 0.033 | 8.5 x 15.0 x 17.5 | 2.4 | 60333 | | 66333 | | 63333 | 650 |
| | 0.047 | 10.0 x 16.5 x 17.5 | 3.0 | 60473 | 500 | 66473 | 450 | 63473 | 600 |
| | PITCH = 10.0 mm ± 0.4 mm; $d_t$ = 0.6 mm ± 0.06 mm; C-TOL. = ± 10 % | | | | | | | | |
| | 0.0010 | 4.0 x 10.0 x 12.5 | 0.6 | 61102 | 1000 | 67102 | 1250 | 64102 | 1400 |
| | 0.0012 | | | 61122 | | 67122 | | 64122 | |
| | 0.0015 | | | 61152 | | 67152 | | 64152 | |
| | 0.0018 | | | 61182 | | 67182 | | 64182 | |
| | 0.0022 | | | 61222 | | 67222 | | 64222 | |
| | 0.0027 | | | 61272 | | 67272 | | 64272 | |
| | 0.0033 | | | 61332 | | 67332 | | 64332 | |
| | 0.0039 | | | 61392 | | 67392 | | 64392 | |
| | 0.0047 | 5.0 x 11.0 x 12.5 | 1.1 | 61472 | 1000 | 67472 | 1000 | 64472 | 1100 |
| | 0.0056 | | | 61562 | | 67562 | | 64562 | |
| | PITCH = 15.0 mm ± 0.4 mm; $d_t$ = 0.80 mm ± 0.08 mm; C-TOL. = ± 10 % | | | | | | | | |
| | 0.0056 | 5.0 x 11.0 x 17.5 | 1.0 | 69001 | 1000 | 69007 | 1000 | 69003 | 1100 |
| | 0.0068 | | | 61682 | | 67682 | | 64682 | |
| | 0.0082 | | | 61822 | | 67822 | | 64822 | |
| | 0.010 | | | 61103 | | 67103 | | 64103 | |
| | 0.012 | | | 61123 | | 67123 | | 64123 | |
| | 0.015 | 6.0 x 12.0 x 17.5 | 1.4 | 61153 | | 67153 | | 61153 | 900 |
| | 0.018 | | | 61183 | | 67183 | | 64183 | |
| | PITCH = 15.0 mm ± 0.4 mm; $d_t$ = 0.80 mm ± 0.08 mm; C-TOL. = ± 10 % | | | | | | | | |
| | 0.022 | 7.0 x 13.5 x 17.5 | 1.8 | 61223 | 750 | 67223 | 500 | 64223 | 800 |
| | 0.027 | 8.5 x 15.0 x 17.5 | 2.4 | 61273 | | 67273 | | 64273 | 650 |
| | 0.033 | | | 61333 | | 67333 | | 64333 | |
| | 0.039 | 10.0 x 16.5 x 17.5 | 3.0 | 61393 | 500 | 67393 | 450 | 61393 | 600 |
| | 0.047 | | | 61473 | | 67473 | | 64473 | |

**Notes**

- SPQ = Standard packing quantity

(1) H = in-tape height; $P_0$ = sprocket hole distance; for detailed specifications refer to packaging information: www.vishay.com/doc?28139

(2) Reel diameter = 365 mm is available on request

(3) Weight for short lead product only



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| APPROVALS | | | | |
|---|---|---|---|---|
| **SAFETY APPROVALS Y2** | **VOLTAGE** | **VALUE** | **FILE NUMBERS** | **LINKS** |
| EN 60384-14 (ENEC)<br>(= IEC 60384-14 ed-4 (2013)) | 300 $V_{AC}$ | 1 nF to 47 nF | ENEC16/FI/19/10005 | www.vishay.com/doc?28204 |
| UL 60384-14 | 300 $V_{AC}$ | 1 nF to 47 nF | E354331 | www.vishay.com/doc?28189 |
| CSA-E384-14 | 300 $V_{AC}$ | 1 nF to 47 nF | E354331 | |
| CB-test-certificate | 300 $V_{AC}$ | 1 nF to 47 nF | FI-39831 | www.vishay.com/doc?28203 |
| 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 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 stand-off pips are in good contact with the printed-circuit board:

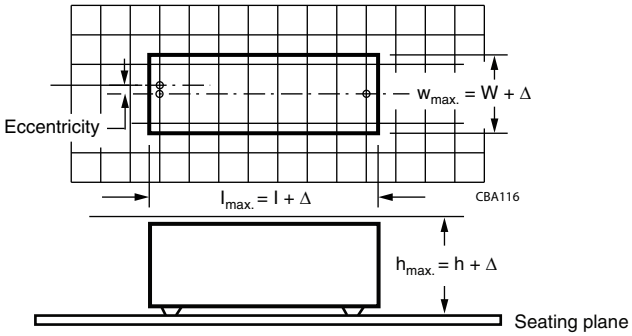
- The capacitors shall be mechanically fixed by the leads

### 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 ≤ 15 mm, $\Delta w = \Delta l = 0.3$ mm; $\Delta h = 0.1$ 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

### 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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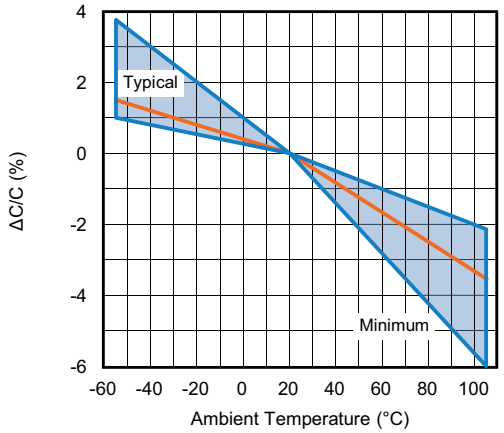
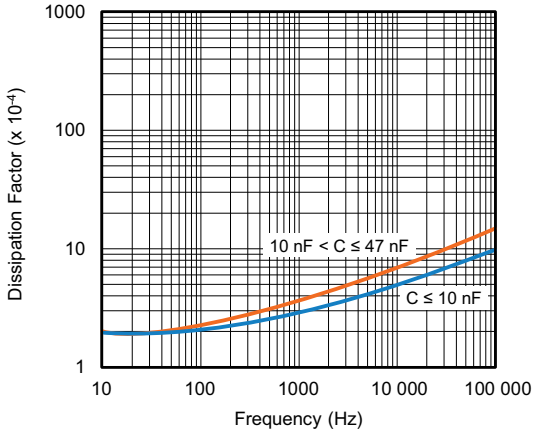
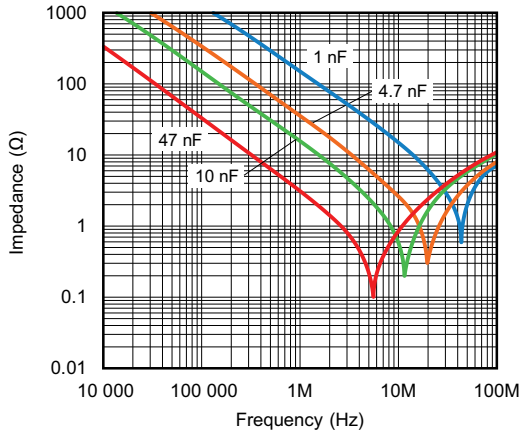
## CHARACTERISTICS



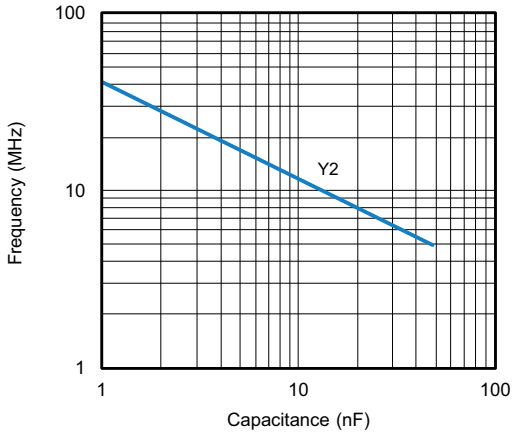

Capacitance as a function of ambient temperature (typical curve)



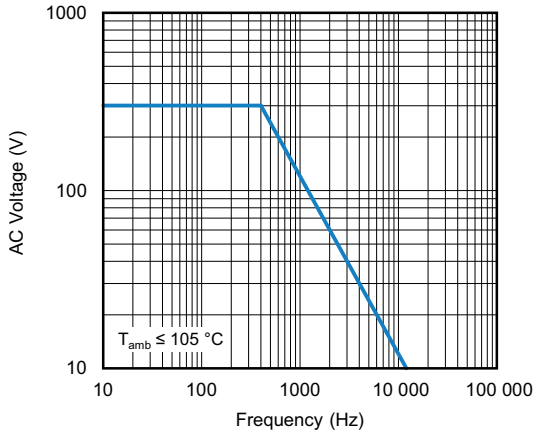

Tangent of loss angle as a function of frequency (typical curve)



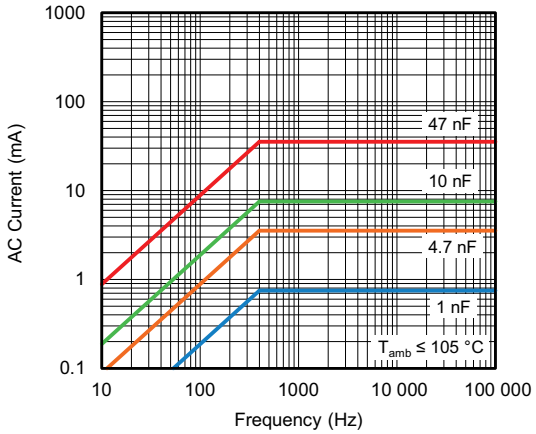

Impedance as a function of frequency (typical curve)




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



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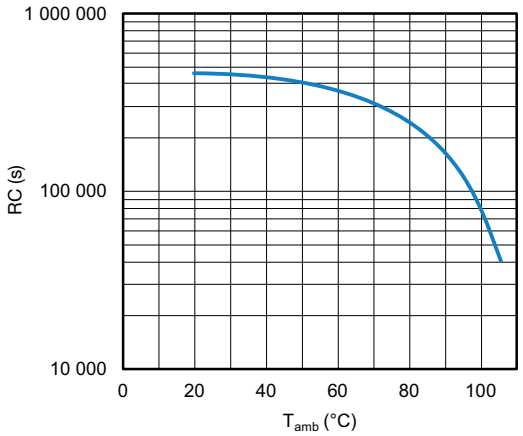


Insulation resistance as a function of ambient temperature
(typical curve)

## APPLICATION NOTES

- For Y2 electromagnetic interference suppression between line and ground (50 Hz / 60 Hz) with a maximum mains voltage of 300 $V_{AC}$ ± 10 % instability
- 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: rfi@vishay.com
- These capacitors are not intended for continuous pulse applications. For these situations, capacitors of the AC and pulse program must be used
- The maximum ambient temperature must not exceed 105 °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 420 $V_{DC}$ and divided by the applied voltage



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## 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<br>Tangent of loss angle at 10 kHz | |
| 4.3 Robustness of terminations | | Tensile: Load 10 N; 10 s<br>Bending: Load 5 N; 4 x 90° | No visible damage |
| 4.4 Resistance to soldering heat | | No pre-drying<br>Method: 1A<br>Solder bath: 260 °C<br>Duration: 10 s | |
| 4.19 Component solvent resistance | | Isopropylalcohol at room temperature<br>Method: 2<br>Immersion time: 5 min ± 0.5 min<br>Recovery time:<br>Min. 1 h, max. 2 h | |
| 4.4.2 Final measurements | | Visual examination | No visible damage<br>Legible marking |
| | | Capacitance | $\lvert\Delta C/C\rvert \leq 5$ % of the value measured initially |
| | | Tangent of loss angle | Increase of tan $\delta$: $\leq 0.008$<br>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<br>Tangent of loss angle at 10 kHz | |
| 4.20 Solvent resistance of the marking | | Isopropylalcohol at room temperature<br>Method: 1<br>Rubbing material: Cotton wool<br>Immersion time: 5 min ± 0.5 min | No visible damage<br>Legible marking |
| 4.6 Rapid change of temperature | | $\theta A$ = - 55 °C<br>$\theta B$ = + 105 °C<br>5 cycles | |
| 4.6.1 Inspection | | Duration t = 30 min | |



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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** | | |
| 4.7 Vibration | | Visual examination<br>Mounting: See section “Mounting” of this specification<br>Procedure B4<br>Frequency range: 10 Hz to 55 Hz.<br>Amplitude: 0.75 mm or<br>Acceleration 98 m/s²<br>(whichever is less severe)<br>Total duration 6 h | No visible damage |
| 4.7.2 Final inspection | | Visual examination | No visible damage |
| 4.9 Shock | | Mounting: See section “Mounting” for more information<br>Pulse shape: Half sine<br>Acceleration: 490 m/s²<br>Duration of pulse: 11 ms | |
| 4.9.2 Final measurements | | Visual examination | No visible damage |
| | | Capacitance | $\lvert\Delta C/C\rvert \leq 5$ % of the value measured initially |
| | | Tangent of loss angle | Increase of tan $\delta$:<br>$\leq 0.008$<br>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<br>Measured in 4.4.2 and 4.9.2<br>Tangent of loss angle:<br>Measured initially in C1A and C1B | |
| 4.11.2 Dry heat | | Temperature: 105 °C<br>Duration: 16 h | |
| 4.11.3 Damp heat cyclic<br>Test Db<br>First cycle | | | |
| 4.11.4 Cold | | Temperature: - 55 °C<br>Duration: 2 h | |
| 4.11.5 Damp heat cyclic<br>Test Db<br>remaining cycles | | | |


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| GROUP C INSPECTION REQUIREMENTS | | | |
|---|---|---|---|
| **SUB-CLAUSE NUMBER AND TEST** | **D OR ND** | **CONDITIONS** | **PERFORMANCE REQUIREMENTS** |
| **SUB-GROUP C1 COMBINED SAMPLE OF SPECIMENS OF SUB-GROUPS C1A AND C1B** | **D** | | |
| 4.11.6 Final measurements | | Visual examination | No visible damage<br>Legible marking |
| | | Capacitance | $\|\Delta C/C\| \leq 5$ % of the value measured in 4.11.1. |
| | | Tangent of loss angle | Increase of tan $\delta$:<br>$\leq 0.008$<br>Compared to values measured in 4.11.1. |
| | | Voltage proof<br>2250 $V_{DC}$; 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 C2** | **D** | | |
| 4.12 Damp heat steady state | | 56 days, 40 °C, 90 % to 95 % RH no load<br>capacitance | |
| 4.12.1 Initial measurements | | Capacitance<br>Tangent of loss angle at 10 kHz | |
| 4.12.3 Final measurements | | Visual examination | No visible damage<br>Legible marking |
| | | Capacitance | $\|\Delta C/C\| \leq 5$ % of the value measured in 4.12.1. |
| | | Tangent of loss angle | Increase of tan $\delta$:<br>$\leq 0.007$<br>Compared to values measured in 4.12.1. |
| | | Voltage proof<br>2250 $V_{DC}$; 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<br>Tangent of loss angle at 10 kHz | |
| 4.13 Impulse voltage | | 3 successive impulses, full wave, peak voltage:<br>5 kV<br>Max. 24 pulses | No selfhealing breakdowns or flashover |
| 4.14 Endurance | | Duration: 1000 h<br>1.7 $U_{RAC}$ at 105 °C<br>Once in every hour the voltage is increased to 1000 $V_{RMS}$ for 0.1 s via resistor of 47 Ω ± 5 % | |


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| GROUP C INSPECTION REQUIREMENTS | | | |
|---|---|---|---|
| **SUB-CLAUSE NUMBER AND TEST** | **D OR ND** | **CONDITIONS** | **PERFORMANCE REQUIREMENTS** |
| **SUB-GROUP C3** | **D** | | |
| 4.14.7 Final measurements | | Visual examination | No visible damage<br>Legible marking |
| | | Capacitance | $\|\Delta C/C\| \leq 10$ % compared to values measured in 4.13.1. |
| | | Tangent of loss angle | Increase of tan $\delta$:<br>$\leq 0.007$<br>Compared to values measured in 4.13.1. |
| | | Voltage proof<br>2250 $V_{DC}$;<br>1 min between terminations | No permanent breakdown or flash-over |
| | | Insulation resistance | $\geq 50$ % of values specified in section "Insulation resistance" of this specification |
| **SUB-GROUP C4** | **D** | | |
| 4.15 Charge and discharge | | 10 000 cycles<br>(50 c/s) charge to $U_R$ half sinewave<br>Duration: 5 ms<br>Discharge resistance:<br>$R = \frac{420\ V_{DC}}{1.5 \times C((dU)/(dt))}$<br>$R_{min.} = 2.2\ \Omega$ | |
| 4.15.1 Initial measurements | | Capacitance<br>Tangent of loss angle at 10 kHz | |
| 4.15.3 Final measurements | | Capacitance | $\|\Delta C/C\| \leq 10$ % compared to values measured in 4.15.1. |
| | | Tangent of loss angle | Increase of tan $\delta$:<br>$\leq 0.008$<br>Compared to values measured in 4.15.1. |
| | | Insulation resistance | $\geq 50$ % 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 % |


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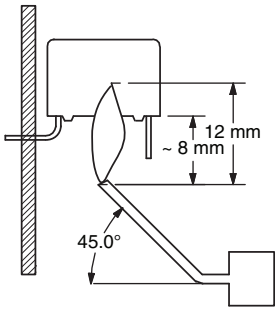
| GROUP C INSPECTION REQUIREMENTS | | | |
|---|---|---|---|
| **SUB-CLAUSE NUMBER AND TEST** | **D OR ND** | **CONDITIONS** | **PERFORMANCE REQUIREMENTS** |
| **SUB-GROUP C6** | **D** | | |
| 4.17 Passive flammability<br>Class B | | Bore of gas jet: Ø 0.5 mm<br>Fuel: Butane<br>Test duration for actual volume V in $mm^3$:<br>$V \leq 250$: 10 s<br>$250 < V \leq 500$: 20 s<br>$500 < V \leq 1750$: 30 s<br>$V > 1750$: 60 s<br>One flame application<br>  <br> | 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 5 kV discharges on the test capacitor connected to $U_R$ | The cheese cloth around the capacitors shall not burn with a flame.<br>No electrical measurements are required. |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