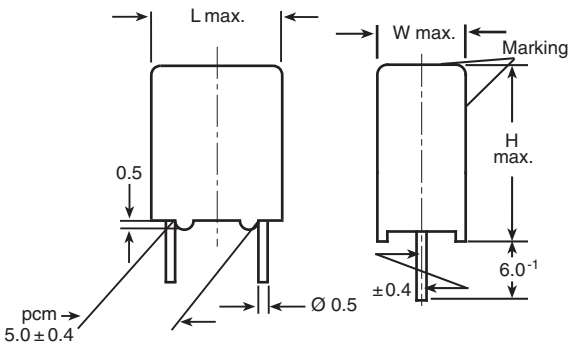
# AC and Pulse Film Foil Capacitors
# KP Radial Potted Type




Dimensions in millimeters

## MAIN APPLICATIONS

Oscillator, timing and LC/RC filter circuits, high frequency coupling of fast digital and analog IC's.

## REFERENCE STANDARDS

IEC 60384-13

## MARKING

C-value; tolerance; rated voltage; sub-class; manufacturer's type; code for dielectric material; manufacturer's location; manufacturer's logo; year and week

## DIELECTRIC

Polypropylene film

## ELECTRODES

Tin foil

## CONSTRUCTION

Mono construction

## RATED DC VOLTAGES

63 V, 250 V, 630 V

## RATED AC VOLTAGES

40 V, 160 V, 250 V

## FEATURES

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

Pb-free

e3

RoHS COMPLIANT

HALOGEN FREE

## ENCAPSULATION

Plastic case, epoxy resin sealed, flame retardant UL-class 94 V-0

## CLIMATIC TESTING CLASS ACCORDING TO IEC 60068-1

55/100/56

## CAPACITANCE RANGE

100 pF to 0.022 µF

## CAPACITANCE TOLERANCE

± 10 % , ± 5 %, ± 2.5 %, ± 2 %, ± 1 %

## LEADS

Tinned wire

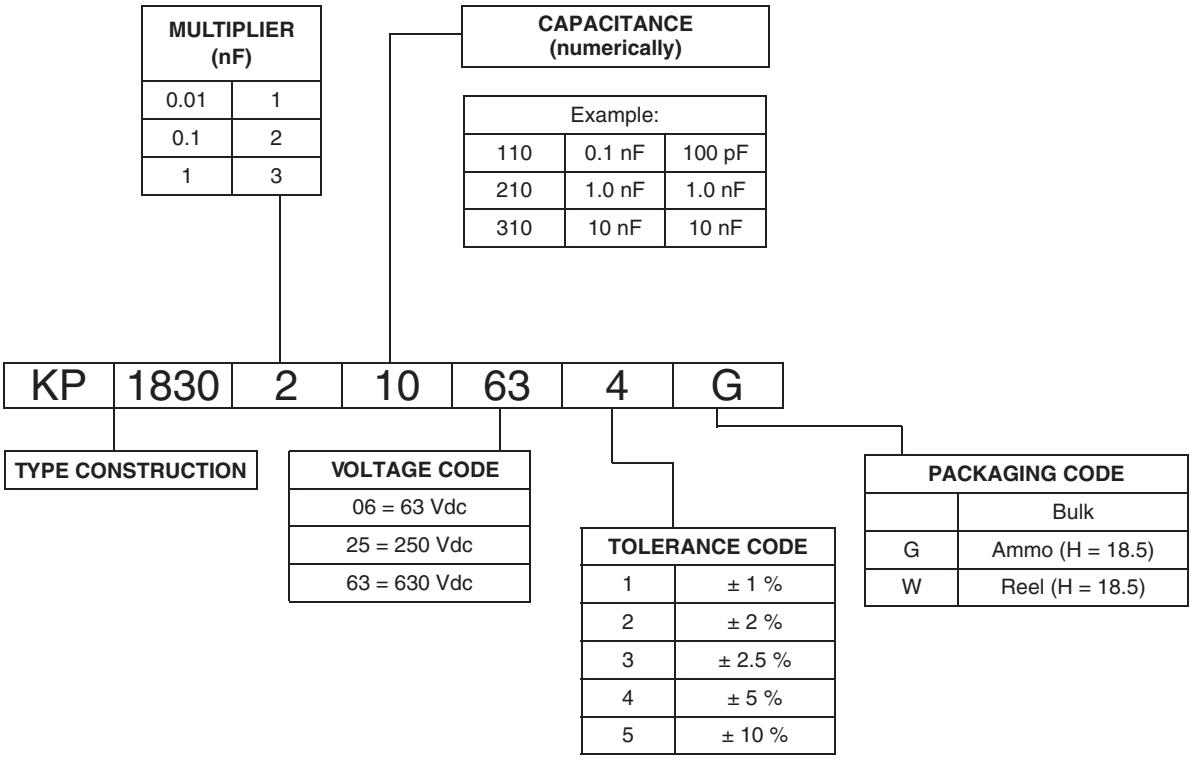
## MAXIMUM APPLICATION TEMPERATURE

100 °C

## DETAIL SPECIFICATION

For more detailed data and test requirements contact: dc-film@vishay.com

## COMPOSITION OF CATALOG NUMBER




## SPECIFIC REFERENCE DATA

| DESCRIPTION | VALUE | | | |
|---|---|---|---|---|
| Tangent of loss angle: | at 1 kHz | at 10 kHz | at 100 kHz | at 1 MHz |
| C ≤ 1000 pF | - | $5 \times 10^{-4}$ | - | $10 \times 10^{-4}$ |
| 1000 pF < C ≤ 5000 pF | - | $5 \times 10^{-4}$ | $10 \times 10^{-4}$ | - |
| 5000 pF < C ≤ 20 000 pF | - | $10 \times 10^{-4}$ | $15 \times 10^{-4}$ | - |
| 20 000 pF < C < 33 000 pF | - | $15 \times 10^{-4}$ | $25 \times 10^{-4}$ | - |

| Pitch (mm) | Maximum pulse rise time $(dU/dt)_R$ [V/µs] |
|---|---|
| 5 | > 10 000 |

| | |
|---|---|
| R between leads, for C ≤ 0.33 µF at 100 V, 1 min | > 500 000 MΩ |
| R between leads and case, 100 V, 1 min | > 30 000 MΩ |
| Withstanding (DC) voltage (cut off current 10 mA), rise time 100 V/s | 1.6 x $U_{RDC}$, 1 min |
| Withstanding (DC) voltage between leads and case | 2 x $U_{RDC}$, 1 min |
| Maximum application temperature | 100 °C |

| CAPACITANCE | CAPACITANCE CODE | VOLTAGE CODE 06 63 $V_{DC}$ / 40 $V_{AC}$ | | | VOLTAGE CODE 25 250 $V_{DC}$ / 160 $V_{AC}$ | | | VOLTAGE CODE 63 630 $V_{DC}$ / 250 $V_{AC}$ | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | W (mm) | H (mm) | L (mm) | W (mm) | H (mm) | L (mm) | W (mm) | H (mm) | L (mm) |
| 100 pF | -110 | - | - | - | - | - | - | 4.5 | 6.0 | 7.2 |
| 110 pF | -111 | - | - | - | - | - | - | 4.5 | 6.0 | 7.2 |
| 120 pF | -112 | - | - | - | - | - | - | 4.5 | 6.0 | 7.2 |
| 130 pF | -113 | - | - | - | - | - | - | 4.5 | 6.0 | 7.2 |
| 150 pF | -115 | - | - | - | - | - | - | 4.5 | 6.0 | 7.2 |
| 160 pF | -116 | - | - | - | - | - | - | 4.5 | 6.0 | 7.2 |
| 180 pF | -118 | - | - | - | - | - | - | 4.5 | 6.0 | 7.2 |
| 200 pF | -120 | - | - | - | - | - | - | 4.5 | 6.0 | 7.2 |
| 220 pF | -122 | - | - | - | - | - | - | 4.5 | 6.0 | 7.2 |
| 240 pF | -124 | - | - | - | - | - | - | 4.5 | 6.0 | 7.2 |
| 270 pF | -127 | - | - | - | - | - | - | 4.5 | 6.0 | 7.2 |
| 300 pF | -130 | - | - | - | - | - | - | 4.5 | 6.0 | 7.2 |
| 330 pF | -133 | - | - | - | - | - | - | 4.5 | 6.0 | 7.2 |
| 360 pF | -136 | - | - | - | - | - | - | 4.5 | 6.0 | 7.2 |
| 390 pF | -139 | - | - | - | - | - | - | 4.5 | 6.0 | 7.2 |
| 430 pF | -143 | - | - | - | - | - | - | 4.5 | 6.0 | 7.2 |
| 470 pF | -147 | - | - | - | - | - | - | 4.5 | 6.0 | 7.2 |
| 510 pF | -151 | - | - | - | - | - | - | 4.5 | 6.0 | 7.2 |
| 560 pF | -156 | - | - | - | - | - | - | 4.5 | 6.0 | 7.2 |
| 620 pF | -162 | - | - | - | - | - | - | 4.5 | 6.0 | 7.2 |
| 680 pF | -168 | - | - | - | - | - | - | 4.5 | 6.0 | 7.2 |
| 750 pF | -175 | - | - | - | - | - | - | 4.5 | 6.0 | 7.2 |
| 820 pF | -182 | - | - | - | - | - | - | 4.5 | 6.0 | 7.2 |
| 910 pF | -191 | - | - | - | - | - | - | 4.5 | 6.0 | 7.2 |
| 1000 pF | -210 | - | - | - | - | - | - | 4.5 | 6.0 | 7.2 |
| 1100 pF | -211 | - | - | - | - | - | - | 4.5 | 6.0 | 7.2 |
| 1200 pF | -212 | - | - | - | - | - | - | 4.5 | 6.0 | 7.2 |
| 1300 pF | -213 | - | - | - | - | - | - | 4.5 | 6.0 | 7.2 |
| 1500 pF | -215 | - | - | - | - | - | - | 4.5 | 6.0 | 7.2 |
| 1600 pF | -216 | - | - | - | - | - | - | 4.5 | 6.0 | 7.2 |
| 1800 pF | -218 | - | - | - | - | - | - | 4.5 | 6.0 | 7.2 |
| 2000 pF | -220 | - | - | - | 4.5 | 6.0 | 7.2 | 5.5 | 7.0 | 7.2 |
| 2200 pF | -222 | - | - | - | 4.5 | 6.0 | 7.2 | 5.5 | 7.0 | 7.2 |
| 2400 pF | -224 | 4.5 | 6.0 | 7.2 | 4.5 | 6.0 | 7.2 | 5.5 | 7.0 | 7.2 |
| 2700 pF | -227 | 4.5 | 6.0 | 7.2 | 4.5 | 6.0 | 7.2 | 5.5 | 7.0 | 7.2 |
| 3000 pF | -230 | 4.5 | 6.0 | 7.2 | 5.5 | 7.0 | 7.2 | 5.5 | 7.0 | 7.2 |
| 3300 pF | -233 | 4.5 | 6.0 | 7.2 | 5.5 | 7.0 | 7.2 | 5.5 | 7.0 | 7.2 |
| 3600 pF | -236 | 4.5 | 6.0 | 7.2 | 5.5 | 7.0 | 7.2 | 7.5 | 7.0 | 7.2 |
| 3900 pF | -239 | 4.5 | 6.0 | 7.2 | 5.5 | 7.0 | 7.2 | 7.5 | 9.0 | 7.2 |
| 4300 pF | -243 | 4.5 | 6.0 | 7.2 | 5.5 | 7.0 | 7.2 | 7.5 | 9.0 | 7.2 |
| 4700 pF | -247 | 4.5 | 6.0 | 7.2 | 5.5 | 7.0 | 7.2 | 7.5 | 9.0 | 7.2 |
| 5100 pF | -251 | 4.5 | 6.0 | 7.2 | 7.5 | 9.0 | 7.2 | 7.5 | 9.0 | 7.2 |
| 5600 pF | -256 | 4.5 | 6.0 | 7.2 | 7.5 | 9.0 | 7.2 | 7.5 | 9.0 | 7.2 |
| 6200 pF | -262 | 4.5 | 6.0 | 7.2 | 7.5 | 9.0 | 7.2 | 7.5 | 9.0 | 7.2 |
| 6800 pF | -268 | 4.5 | 6.0 | 7.2 | 7.5 | 9.0 | 7.2 | 7.5 | 9.0 | 7.2 |
| 7500 pF | -275 | 5.5 | 7.0 | 7.2 | 7.5 | 9.0 | 7.2 | 9.0 | 10.0 | 7.2 |
| 8200 pF | -282 | 5.5 | 7.0 | 7.2 | 7.5 | 9.0 | 7.2 | 9.0 | 10.0 | 7.2 |
| 9100 pF | -291 | 5.5 | 7.0 | 7.2 | 7.5 | 9.0 | 7.2 | 9.0 | 10.0 | 7.2 |
| 0.010 µF | -310 | 5.5 | 7.0 | 7.2 | 7.5 | 9.0 | 7.2 | 9.0 | 10.0 | 7.2 |
| 0.011 µF | -311 | 5.5 | 7.0 | 7.2 | 9.0 | 10.0 | 7.2 | - | - | - |
| 0.012 µF | -312 | 5.5 | 7.0 | 7.2 | 9.0 | 10.0 | 7.2 | - | - | - |
| 0.013 µF | -313 | 5.5 | 7.0 | 7.2 | 9.0 | 10.0 | 7.2 | - | - | - |
| 0.015 µF | -315 | 5.5 | 7.0 | 7.2 | 9.0 | 10.0 | 7.2 | - | - | - |
| 0.016 µF | -316 | 9.0 | 10.0 | 7.2 | - | - | - | - | - | - |
| 0.018 µF | -318 | 9.0 | 10.0 | 7.2 | - | - | - | - | - | - |
| 0.020 µF | -320 | 9.0 | 10.0 | 7.2 | - | - | - | - | - | - |
| 0.022 µF | -322 | 7.5 | 9.0 | 7.2 | - | - | - | - | - | - |

**Note**

- Further C-values upon request

## RECOMMENDED PACKAGING

| LETTER CODE | TYPE OF PACKAGING | HEIGHT (H) (mm) | REEL DIAMETER (mm) | ORDERING CODE EXAMPLE | PITCH 5 |
|---|---|---|---|---|---|
| G | Ammo | 18.5 | S [1] | KP1830-310-065-G | X |
| W | Reel | 18.5 | 350 | KP1830-310-065-W | X |
| - | Bulk | - | - | KP1830-310-065 | X |

**Note**

[1] S = box size 55 mm x 210 mm x 340 mm (W x H x L)

## EXAMPLE OF ORDERING CODE

| TYPE | CAPACITANCE CODE | VOLTAGE CODE | TOLERANCE CODE | PACKAGING CODE |
|---|---|---|---|---|
| KP1830 | 210 | 63 | 1 | G |
| Tolerance codes: 1 = 1 % (F); 2 = 2 % (G); 3 = 2.5 % (H); 4 = 5 % (J); 5 = 10 % (K) | | | | |

**Note**

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

## MOUNTING

### Normal Use

The capacitors are designed for mounting on printed-circuit boards. The capacitors packed in bandoliers are designed for mounting on 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 of Withstand Vibration and Shock

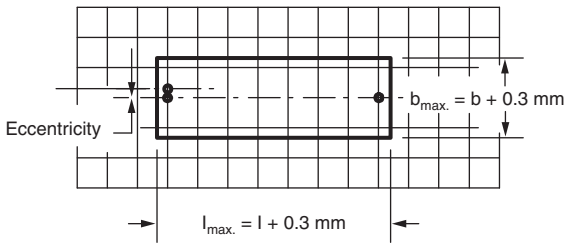
In order to withstand vibration and shock tests, it must be ensured that the stand-off pips are in good contact with the printed-circuit board.

- For pitches ≤ 15 mm the 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 length and width of film capacitors is shown in the drawing:

- Eccentricity as in drawing. 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: $h_{max.} \leq h + 0.4$ mm or $h_{max.} \leq h' + 0.4$ mm




### Storage Temperature

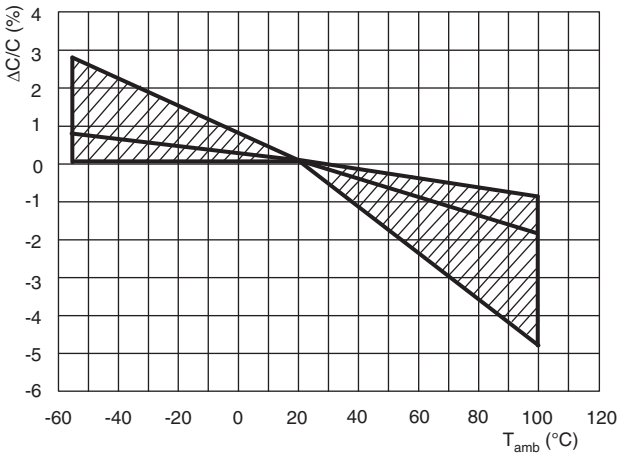
$T_{stg}$ = -25 °C to +35 °C with RH maximum 75 % without condensation

### Ratings and Characteristics Reference Conditions

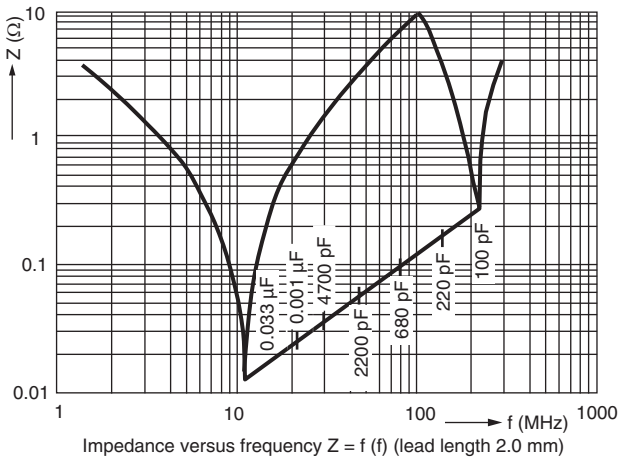
Unless otherwise specified, all electrical values apply to an ambient free temperature of 23 °C ± 1 °C, an atmospheric pressure of 86 kPa to 106 kPa and a relative humidity of 50 % ± 2 %.

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

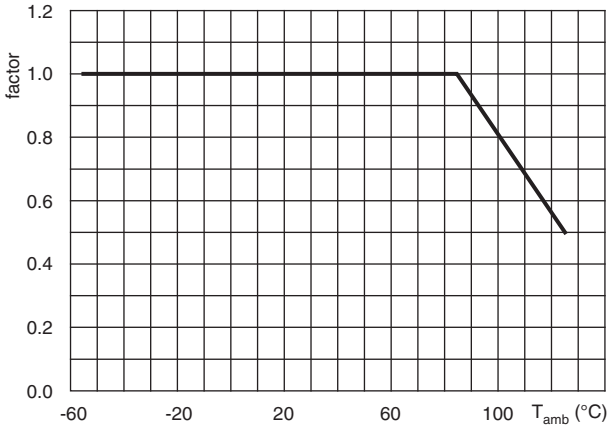



Capacitance as a function of ambient temperature (typical curve)

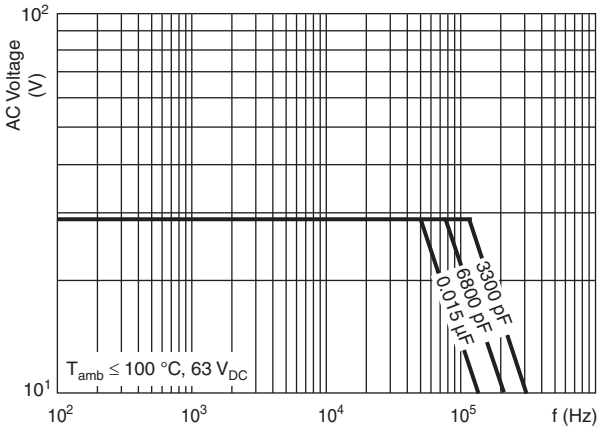



Impedance versus frequency Z = f (f) (lead length 2.0 mm)

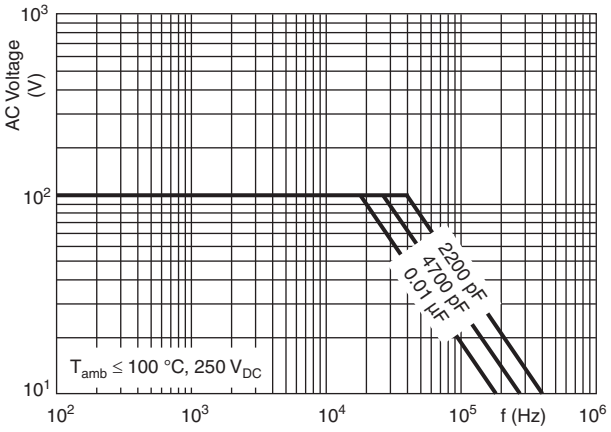
Impedance as a function of frequency (typical curve)



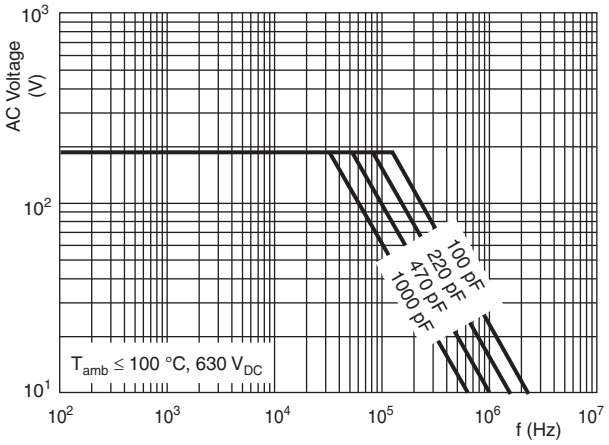

Maximum DC and AC voltage as a function of temperature




Maximum RMS voltage as a function of frequency




Maximum RMS voltage as a function of frequency




Maximum RMS voltage as a function of frequency

## HEAT CONDUCTIVITY (G) AS A FUNCTION OF ORIGINAL PITCH AND CAPACITOR BODY THICKNESS IN mW/°C

| $W_{max.}$ (mm) | HEAT CONDUCTIVITY (mW/°C) |
|---|---|
| | PITCH 5 mm |
| 4.5 | 3 |
| 5.5 | 4 |
| 7.5 | 6 |
| 9.0 | 7 |

## POWER DISSIPATION AND MAXIMUM COMPONENT TEMPERATURE RISE

The power dissipation must be limited in order not to exceed the maximum allowed component temperature rise as a function of the free air ambient temperature.

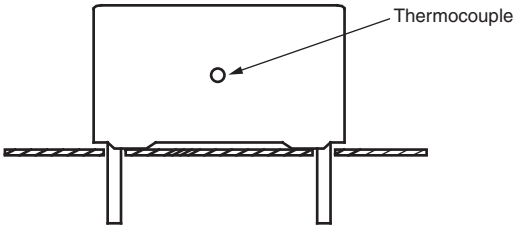
The power dissipation can be calculated according type detail specification “HQN-384-01/101: Technical Information Film Capacitors” with the typical $t_{gd}$ of the curves.

The component temperature rise ($\Delta T$) can be measured (see section “Measuring the component temperature” for more details) or calculated by $\Delta T = P/G$:

- $\Delta T$ = component temperature rise (°C)
- P = power dissipation of the component (mW)
- G = heat conductivity of the component (mW/°C)

## MEASURING THE COMPONENT TEMPERATURE

A thermocouple must be attached to the capacitor body as in:




The temperature is measured in unloaded ($T_{amb}$) and maximum loaded condition ($T_C$).

The temperature rise is given by $\Delta T = T_C - T_{amb}$.

To avoid radiation or convection, the capacitor should be tested in a wind-free box.

## APPLICATION NOTE AND LIMITING CONDITIONS

To select the capacitor for a certain application, the following conditions must be checked:

1. The peak voltage ($U_p$) shall not be greater than the rated DC voltage ($U_{RDC}$).
2. The peak-to-peak voltage ($U_{p\text{-}p}$) shall not be greater than the maximum ($U_{p\text{-}p}$) to avoid the ionization inception level.
3. The maximum component surface temperature rise must be lower than the limits.
4. The maximum application temperature must be lower than 105 °C.
5. There is no limit for the voltage pulse slope in the application.

## INSPECTION REQUIREMENTS

### General Notes

Sub-clause numbers of tests and performance requirements refer to the “Sectional Specification, Publication IEC 60384-13 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 |
| 4.3.1 Initial measurements | Capacitance at 1 kHz<br>Tangent of loss angle at 100 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 predrying<br>Method: 1A<br>Solder bath: 280 °C ± 5 °C<br>Duration: 5 s | |
| 4.14 Component solvent resistance | Isopropylalcohol at room temperature<br>Method: 2<br>Immersion time: 5.0 min ± 0.5 min<br>Recovery time: min. 1 h, max. 2 h | |
| 4.4.2 Final measurements | Visual examination | No visible damage<br>Legible marking |
| | Capacitance | $\lvert\Delta C/C\rvert \leq 2$ % of the value measured in 4.3.1 |
| **SUB-GROUP C1B PART OF SAMPLE OF SUB-GROUP C1** | | |
| 4.6.1 Initial measurements | Capacitance at 1 kHz<br>Tangent of loss angle at 100 kHz | |
| 4.14 Solvent resistance of the marking | Isopropylalcohol at room temperature<br>Method: 1<br>Rubbing material: cotton wool<br>Immersion time: 5.0 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<br>Duration t = 30 min | |
| 4.7 Vibration | Visual examination<br>Mounting:<br>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/s$^2$<br>(whichever is less severe)<br>Total duration 6 h | No visible damage |
| 4.7.2 Final inspection | Visual examination | No visible damage |
| | Capacitance | $\lvert\Delta C/C\rvert \leq 2$ % of the value measured in 4.6.1 |
| | Tangent of loss angle | As specified in section “Tangent of loss angle” of this specification |

| SUB-CLAUSE NUMBER AND TEST | CONDITIONS | PERFORMANCE REQUIREMENTS |
|---|---|---|
| 4.9 Shock | Mounting:<br>See section “Mounting” of this specification<br>Pulse shape: half sine<br>Acceleration: 490 m/s²<br>Duration of pulse: 11 ms | |
| 4.9.3 Final measurements | Visual examination | No visible damage |
| | Capacitance | $\|\Delta C/C\| \leq 2$ % of the value measured in 4.6.1. |
| **SUB-GROUP C1 COMBINED SAMPLE OF SPECIMENS OF SUB-GROUPS C1A AND C1B** | | |
| 4.10 Climatic sequence | | |
| 4.10.2 Dry heat | Temperature: +100 °C<br>Duration: 16 h | |
| 4.10.3 Damp heat cyclic<br>Test Db, first cycle | | |
| 4.10.4 Cold | Temperature: -55 °C<br>Duration: 2 h | |
| 4.10.6 Damp heat cyclic<br>Test Db, remaining cycles | Recovery 1 h to 2 h | |
| 4.10.6.2 Final measurements | Voltage proof = $U_{RDC}$ for 1 min within 15 min after removal from testchamber | No breakdown or flash-over |
| | Visual examination | No visible damage<br>Legible marking |
| | Capacitance | $\|\Delta C/C\| \leq 2$ % of the value measured in 4.10.2 |
| | Tangent of loss angle | As specified in section “Tangent of loss angle” of this specification or ≤ 1.4 times the value measured in 4.3.1 whichever is greater |
| | Insulation resistance | ≥ 50 % of values specified in section “Insulation resistance” of this specification |
| **SUB-GROUP C2** | | |
| 4.11 Damp heat steady state | | |
| 4.11.1 Initial measurements | Capacitance at 1 kHz<br>Tangent of loss angle at 1 kHz | |
| | Voltage proof = $U_{RDC}$ for 1 min within 15 min after removal from testchamber | No breakdown or flash-over |
| 4.11.3 Final measurements | Visual examination | No visible damage<br>Legible marking |
| | Capacitance | $\|\Delta C/C\| \leq 1$ % of the value measured in 4.11.1. |
| | Tangent of loss angle | As specified in section “Tangent of loss angle” of this specification or ≤ 1.4 times the value measured in 4.11.1 whichever is greater |
| | Insulation resistance | ≥ 50 % of values specified in section “Insulation resistance” of this specification |

| SUB-CLAUSE NUMBER AND TEST | CONDITIONS | PERFORMANCE REQUIREMENTS |
|---|---|---|
| **SUB GROUP C3** | | |
| 4.12 Endurance | Duration: 2000 h<br>1.5 x $U_{RDC}$ at 85 °C<br>1.05 x $U_{RDC}$ at 100 °C | |
| 4.12.1 Initial measurements | Capacitance at 1 kHz<br>Tangent of loss angle at 100 kHz | |
| 4.12.5 Final measurements | Visual examination | No visible damage<br>Legible marking |
| | Capacitance | $\|\Delta C/C\| \leq 2$ % of the value measured in 4.12.1 |
| | Tangent of loss angle | As specified in section “Tangent of loss angle” of this specification or ≤ 1.4 times the value measured in 4.12.1 whichever is greater |
| | Insulation resistance | As specified in section “Insulation resistance” of this specification |

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