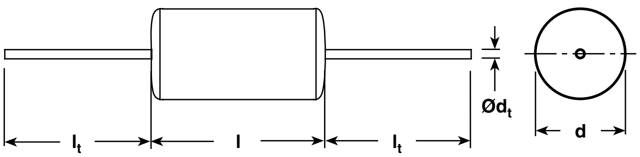
AC and Pulse Metallized Polypropylene Film Capacitors MKP Axial Type



APPLICATIONS

High current and high pulse operations

REFERENCE STANDARDS

IEC 60384-17

MARKING

Manufacturer's logo; code for dielectric material; manufacturer's type designation; C-code; rated voltage-code; tolerance-code; special n °C-value; tolerance; rated voltage; year and week; manufacturer's location

DIELECTRIC

Polypropylene film

ELECTRODES

Metallized

CONSTRUCTION

Series construction

RATED (DC) VOLTAGE

630 V, 850 V, 1250 V, 1600 V

RATED (AC) VOLTAGE

300 V, 400 V, 450 V, 600 V

FEATURES

Supplied loose in box, taped on ammopack or reel available on request

- Compliant to RoHS directive 2002/95/EC

Pb-free

e3

RoHS COMPLIANT

ENCAPSULATION

Plastic-wrapped, epoxy resin sealed. Flame retardant.

CLIMATIC TESTING CLASS ACC. TO IEC 60068-1

55/110/56

CAPACITANCE RANGE (E12 SERIES)

0.1 µF to 3.3 µF

CAPACITANCE TOLERANCE

± 5 %

LEADS

Tinned wire

RATED TEMPERATURE

85 °C

MAXIMUM APPLICATION TEMPERATURE

At 85 °C: $U_C = 1.0\ U_R$
at 110 °C: $U_C = 0.7\ U_R$

PULL TEST ON LEADS

≥ 20 N in direction of leads according to IEC 60068-2-21

BENT TEST ON LEADS

2 bends trough 90° with half of the force used in pull test

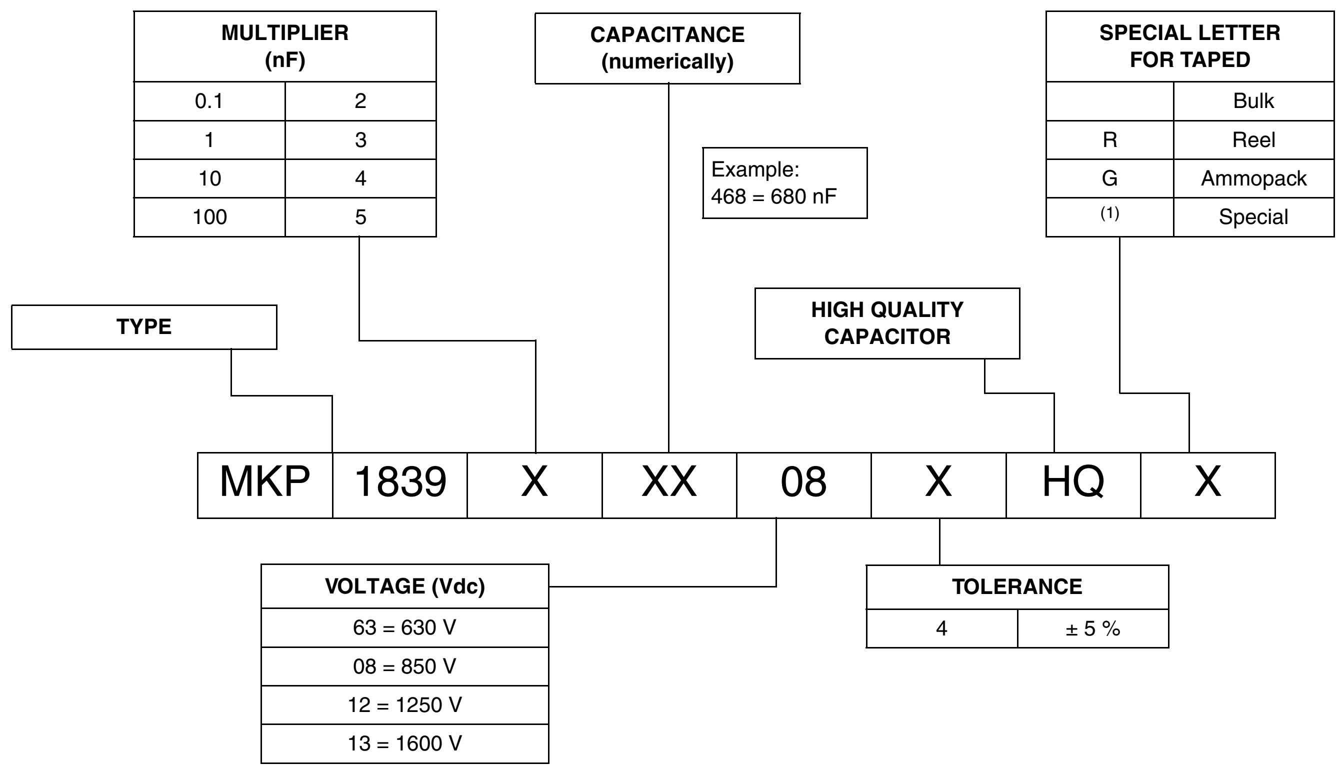
RELIABILITY

Operation life > 300 000 h
Failure rate < 5 FIT (40 °C and 0.5 x U_R)

DETAIL SPECIFICATION

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

COMPOSITION OF CATALOG NUMBER



Note

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

SPECIFIC REFERENCE DATA

DESCRIPTION	VALUE			
Tangent of loss angle:	at 1 kHz	at 10 kHz	at 100 kHz	
0.1 µF < C ≤ 0.47 µF	≤ 3 x 10^{-4}	≤ 5 x 10^{-4}	≤ 35 x 10^{-4}	
0.47 µF < C ≤ 1 µF	≤ 3 x 10^{-4}	≤ 8 x 10^{-4}	≤ 50 x 10^{-4}	
1 µF < C ≤ 3.3 µF	≤ 3 x 10^{-4}	≤ 10 x 10^{-4}	≤ 60 x 10^{-4}	
Rated voltage pulse slope	630 V_{DC}	850 V_{DC}	1250 V_{DC}	1600 V_{DC}
$(dU/dt)_R$ at U_{Rdc}	500 V/µs	1000 V/µs	1000 V/µs	1000 V/µs
U_{P-P} peak-to-peak voltage	700 V	1130 V	1400 V	1600 V
R between leads, for C ≤ 0.33 µF at 500 V, 1 min	> 100 GΩ			
RC between leads, for C > 0.33 µF at 500 V, 1 min	> 30 000 s			
R between interconnecting and wrapped film at 500 V, 1 min	> 100 GΩ			
Withstanding (DC) voltage (cut off current 10 mA), rise time 100 V/s	1008 V	1360 V	2000 V	2560 V
	1 min			
Withstanding (DC) voltage between leads and wrapped film (1.4 x U_{Rac} + 2000)	2840 V, 1 min			
Maximum application temperature	110 °C			

AC and Pulse Metallized Polypropylene Film Capacitors
MKP Axial Type

CAPACITANCE	VOLTAGE CODE 63 630 V_{DC}/300 V_{AC}					VOLTAGE CODE 08 850 V_{DC}/400 V_{AC}				
	DIMENSIONS max. (mm)		MASS	d_t ± 0.08 mm	SPQ [(1)]	DIMENSIONS max. (mm)		MASS	d_t ± 0.08 mm	SPQ [(1)]
(µF)	D	L	(g)	(mm)	Pieces	D	L	(g)	(mm)	Pieces
0.1	7	26.5	0.9	0.8	2000	8.5	31.5	1.6	0.8	1500
0.15	8	26.5	1.2	0.8	1750	10	31.5	2.3	0.8	1000
0.18	8.5	26.5	1.4	0.8	1500	11	31.5	2.7	0.8	850
0.22	9.5	26.5	1.6	0.8	1250	11.5	31.5	3.2	0.8	750
0.27	10	26.5	1.9	0.8	1000	13	31.5	3.9	0.8	1000
0.33	11	26.5	2.3	0.8	900	14	31.5	4.6	0.8	1000
0.39	10.5	31.5	2.6	0.8	900	15	31.5	5.4	0.8	1000
0.47	11	31.5	3.0	0.8	750	16.5	31.5	6.5	0.8	1000
0.56	12	31.5	3.5	0.8	650	15	31.5	5.4	0.8	1000
0.68	13	31.5	4.2	0.8	500	16.5	31.5	6.5	0.8	1000
0.82	14	31.5	5.1	0.8	1000	18	31.5	7.8	1.0	750
1	16	31.5	6.1	0.8	900	19.5	31.5	9.4	1.0	600
1.5	19	31.5	9.0	1.0	600	24	31.5	13.9	1.0	400
2.2	23	31.5	13.1	1.0	450	-	-	-	-	-
3.3	28	31.5	19.5	1.0	300	-	-	-	-	-

CAPACITANCE	VOLTAGE CODE 12 1250 V_{DC}/450 V_{AC}					VOLTAGE CODE 13 1600 V_{DC}/600 V_{AC}				
	DIMENSIONS max. (mm)		MASS	d_t ± 0.08 mm	SPQ [(1)]	DIMENSIONS max. (mm)		MASS	d_t ± 0.08 mm	SPQ [(1)]
(µF)	D	L	(g)	(mm)	Pieces	D	L	(g)	(mm)	Pieces
0.1	8.5	31.5	1.6	0.8	1500	10.5	31.5	2.7	0.8	1000
0.15	10	31.5	2.3	0.8	1000	12.5	31.5	3.9	0.8	600
0.18	11	31.5	2.7	0.8	1000	13.5	31.5	4.6	0.8	500
0.22	11.5	31.5	3.2	0.8	800	15	31.5	5.5	0.8	500
0.27	13	31.5	3.9	0.8	650	16.5	31.5	6.7	0.8	900
0.33	14	31.5	4.6	0.8	500	18	31.5	8.1	1.0	750
0.39	15	31.5	5.4	0.8	1000	19.5	31.5	9.5	1.0	600
0.47	16.5	31.5	6.5	0.8	900	21.5	31.5	11.3	1.0	500
0.56	18	31.5	7.7	1.0	750	23.5	31.5	13.4	1.0	400
0.68	20	31.5	9.2	1.0	600	25.5	31.5	16.2	1.0	350
0.82	21.5	31.5	11.1	1.0	500	-	-	-	-	-
1	23.5	31.5	13.4	1.0	400	-	-	-	-	-
1.5	-	-	-	-	-	-	-	-	-	-
2.2	-	-	-	-	-	-	-	-	-	-
3.3	-	-	-	-	-	-	-	-	-	-

Note
[(1)] SPQ = Standard Packing Quantity

MOUNTING

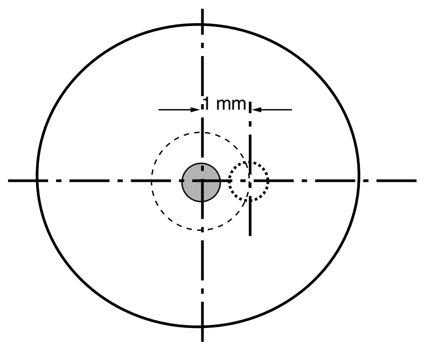
Normal Use

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.

Specific Method of Mounting to Withstand Vibration and Shock

In order to withstand vibration and shock tests, it must be ensured that the capacitor body is in good contact with the printed-circuit board.

- For L ≤ 19 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
- The maximum diameter and length of the capacitors are specified in the dimensions table
- Eccentricity as shown in the drawing below:



Storage Temperature

- Storage temperature: T_{stg} = - 25 °C to + 40 °C with RH maximum 80 % without condensation

Ratings and Characteristics Reference Conditions

Unless otherwise specified, all electrical values apply to an ambient free air 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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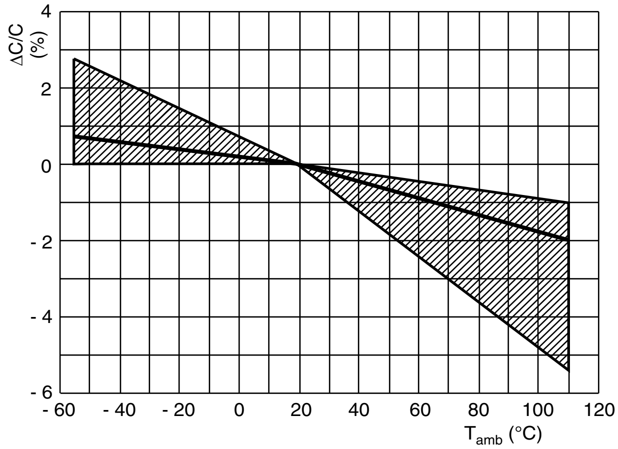
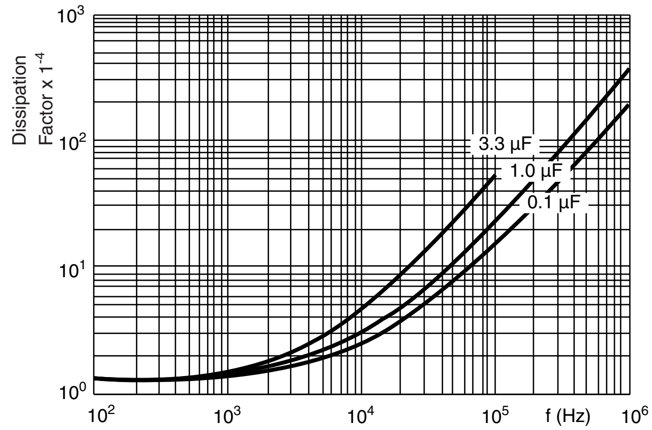
CHARACTERISTICS

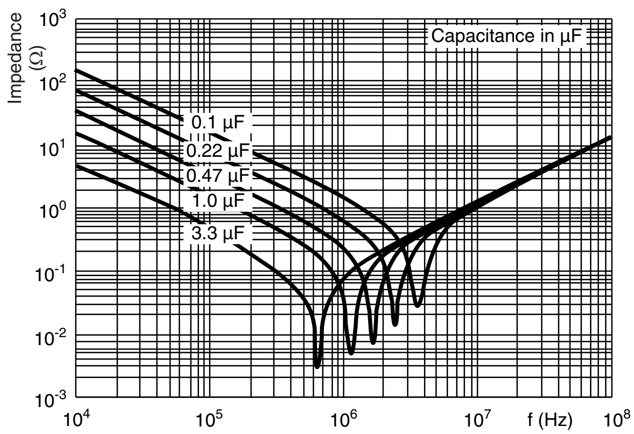
Capacitance as a function of ambient temperature (typical curve)



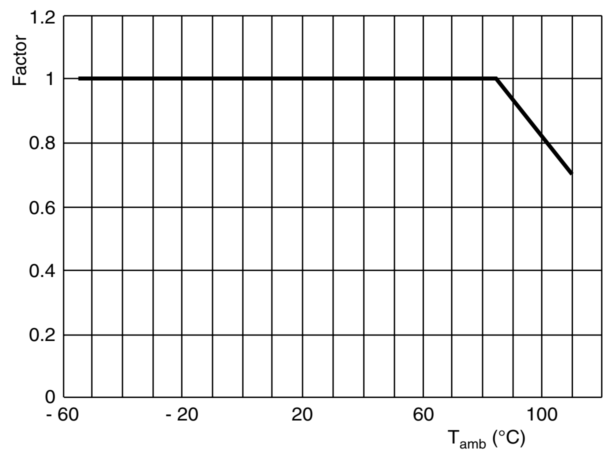
Tangent of loss angle as a function of frequency (typical curve)



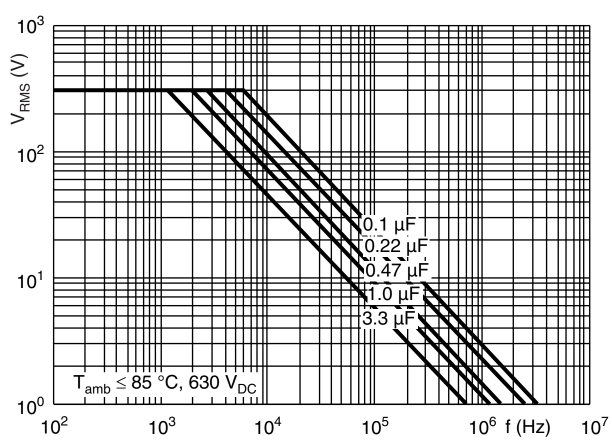
Impedance as a function of frequency (typical curve)



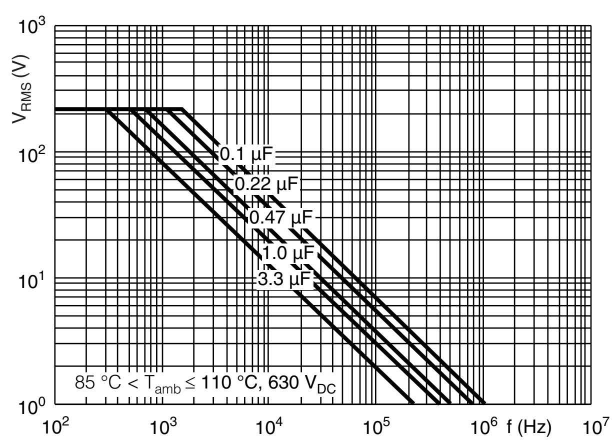
Max. DC and AC voltage as a function of temperature



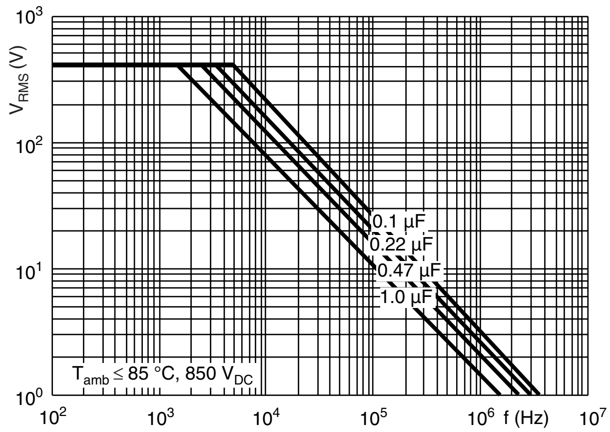
Max. RMS Voltage (sinewave) as a function of frequency



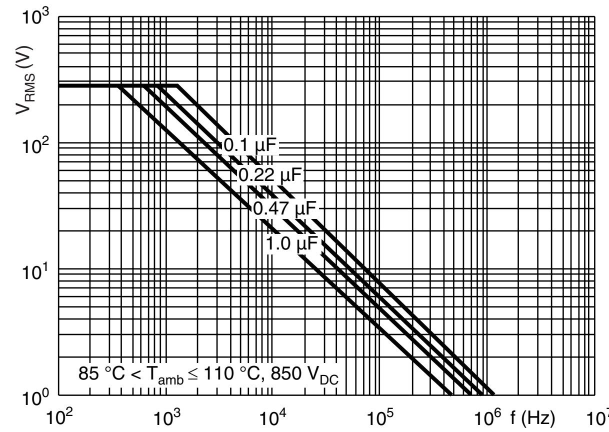
Max. RMS Voltage (sinewave) as a function of frequency



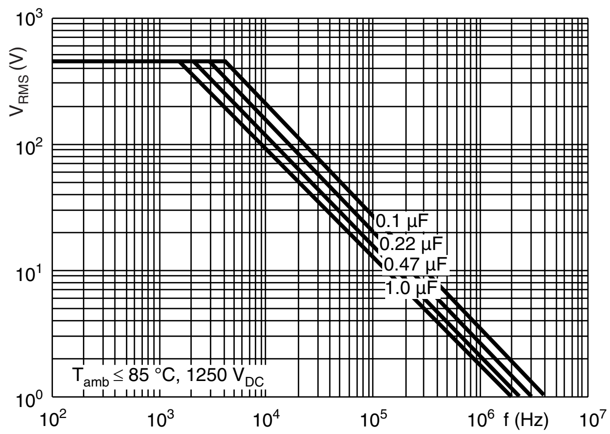
Max. RMS Voltage (sinewave) as a function of frequency



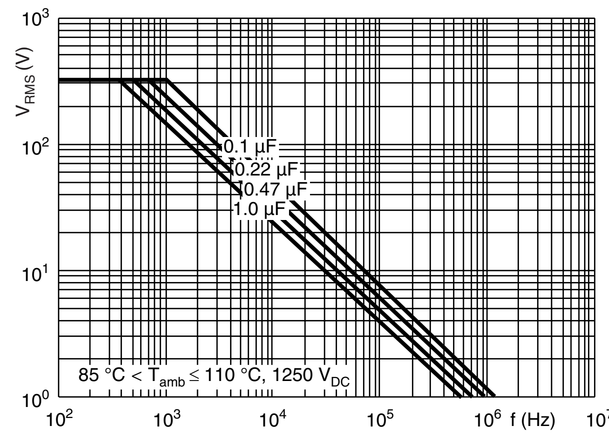
Max. RMS Voltage (sinewave) as a function of frequency



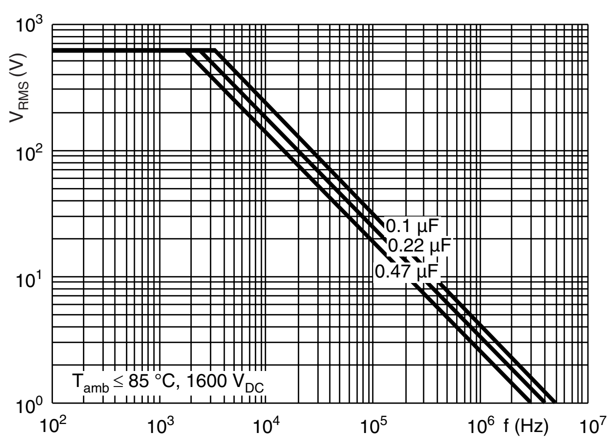
Max. RMS Voltage (sinewave) as a function of frequency



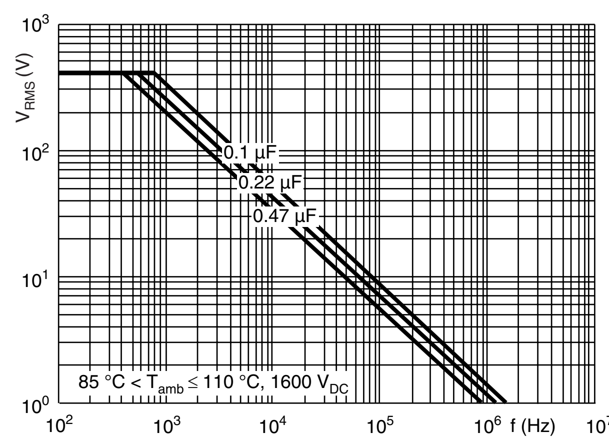
Max. RMS Voltage (sinewave) as a function of frequency



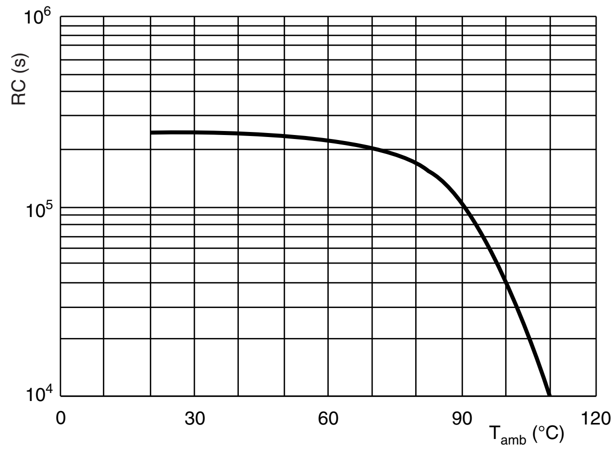
Max. RMS Voltage (sinewave) as a function of frequency



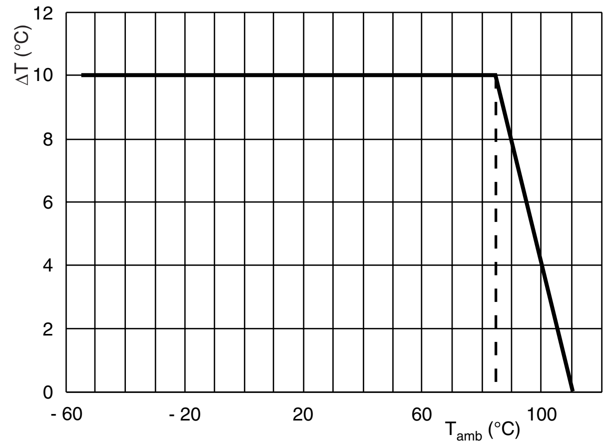
Max. RMS Voltage (sinewave) as a function of frequency



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



Max. allowed component rise (ΔT) as a function of the ambient temperature (T_{amb})



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

DIAMETER (mm)	HEAT CONDUCTIVITY (mW/°C)	
	PITCH 26.5 mm	PITCH 31.5 mm
7.0	8	-
8.0	10	-
8.5	11	12
9.5	12	-
10.0	13	15
10.5	-	16
11.0	15	17
11.5	-	18
12.0	-	19
12.5	-	20
13.0	-	21
13.5	-	22
14.0	-	23
15.0	-	25
16.0	-	28
16.5	-	29
18.0	-	32
19.0	-	34
19.5	-	36
20.0	-	37
21.5	-	40
23.0	-	44
23.5	-	45
24.0	-	47
25.5	-	51
28.0	-	57

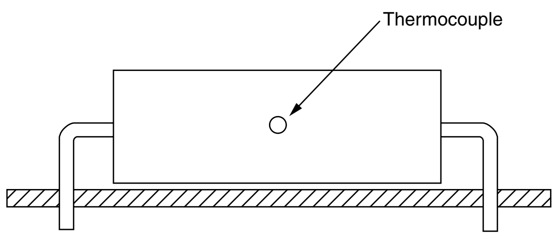
POWER DISSIPATION AND MAXIMUM COMPONENT TEMPERATURE RISE

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

- ΔT = 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.

APPLICATION NOTE AND LIMITING CONDITIONS

These capacitors are not suitable for mains applications as across-the-line capacitors without additional protection, as described hereunder. These mains applications are strictly regulated in safety standards and therefore electromagnetic interference suppression capacitors conforming the standards must be used.

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-P}) shall not be greater than the maximum (U_{P-P}) to avoid the ionisation inception level
3. The voltage pulse slope (dU/dt) shall not exceed the rated voltage pulse slope in an RC-circuit at rated voltage and without ringing. If the pulse voltage is lower than the rated DC voltage, the rated voltage pulse slope may be multiplied by U_{RDC} and divided by the applied voltage.
   For all other pulses following equation must be fulfilled:

   $$2 \times \int_0^T \left(\frac{dU}{dt}\right)^2 \times dt < U_{Rdc} \times \left(\frac{dU}{dt}\right)_{rated}$$

   T is the pulse duration.
4. The maximum component surface temperature rise must be lower than the limits (see figure max. allowed component temperature rise).
5. Since in circuits used at voltages over 280 V peak-to-peak the risk for an intrinsically active flammability after a capacitor breakdown (short circuit) increases, it is recommended that the power to the component is limited to 100 times the values mentioned in the table “Heat conductivity”.
6. When using these capacitors as across-the-line capacitor in the input filter for mains applications or as series connected with an impedance to the mains the applicant must guarantee that the following conditions are fulfilled in any case (spikes and surge voltages from the mains included).

Voltage Conditions for 6 Above

ALLOWED VOLTAGES	$T_{amb} \leq 85$ °C	85 °C < $T_{amb} \leq 110$ °C
Maximum continuous RMS voltage	U_{RAC}	See "Maximum AC voltage as a function of temperature par. characteristics"
Maximum temporary RMS-overvoltage (< 24 h)	1.25 x U_{RAC}	0.875 x U_{RAC}
Maximum peak voltage (V_{O-P}) (< 2 s)	1.6 x U_{RDC}	1.1 x U_{RDC}

INSPECTION REQUIREMENTS

General Notes:
Sub-clause numbers of tests and performance requirements refer to the "Sectional Specification, Publication IEC 60384-17 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 chapter "General Data" of this specification
4.3.1 Initial measurements	Capacitance Tangent of loss angle at 100 kHz	
4.3 Robustness of terminations	Tensile: Load 30 N; 10 s Bending: Load 15 N; 90°	No visible damage
4.4 Resistance to soldering heat	No pre-drying Method: 1A Solder bath: 280 °C ± 5 °C Duration: 10 s	
4.4.2 Final measurements	Visual examination	No visible damage Legible marking
	Capacitance	$\|\Delta C/C\| \leq 2$ % of the value measured initially
	Tangent of loss angle	Increase of tan δ: For C ≤ 470 nF ≤ 0.001 (10 x 10^{-4}) For C > 470 nF ≤ 0.0015 (15 x 10^{-4}) Compared to values measured initially
	Insulation resistance	≥ 50 % of values specified in section "Insulation Resistance" of this specification
4.14 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
SUB-GROUP C1B PART OF SAMPLE OF SUB-GROUP C1		
4.6.1 Initial measurements	Capacitance Tangent of loss angle at 100 kHz	
4.6 Rapid change of temperature	θA = - 55 °C θB = + 110 °C 5 cycles Duration t = 30 min	
	Visual examination	No visible damage

SUB-CLAUSE NUMBER AND TEST	CONDITIONS	PERFORMANCE REQUIREMENTS
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 m/s² (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 m/s² 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 initally
	Tangent of loss angle	Increase of tan δ: For C ≤ 470 nF ≤ 0.001 (10 x 10^{-4}) For C > 470 nF ≤ 0.0015 (15 x 10^{-4}) Compared to values measured initially
	Insulation resistance	≥ 50 % of values specified in section "Insulation Resistance" of this specification
SUB-GROUP C1 COMBINED SAMPLE OF SPECIMENS OF SUB-GROUPS C1A AND C1B		
4.10 Climatic sequence		
4.10.2 Dry heat	Temperature: 110 °C Duration: 16 h	
4.10.3 Damp heat cyclic Test Db, first cycle		
4.10.4 Cold	Temperature: - 55 °C Duration: 2 h	
4.10.6 Damp heat cyclic Test Db, remaining cycles		
4.10.6.2 Final measurements	Voltage proof = U_{RDC} for 1 min within 15 min after removal from testchambers	No breakdown or flashover
	Visual examination	No visible damage Legible marking
	Capacitance	$\|\Delta C/C\| \leq 3$ % of the value measured initially
	Tangent of loss angle	Increase of tan δ: For C ≤ 470 nF ≤ 0.001 (10 x 10^{-4}) For C > 470 nF ≤ 0.0015 (15 x 10^{-4}) Compared to values measured in 4.3.1 or 4.6.1 as applicable
	Insulation resistance	≥ 50 % of values specified in section "Insulation Resistance" of this specification
SUB-GROUP C2		
4.11 Damp heat steady state	Capacitance	
4.11.1 Initial measurements	Tangent of loss angle at 1 kHz	
	Visual examination	No visible damage Legible marking
4.11.3 Final measurements	Voltage proof = U_{RDC} for 1 min within 15 min after removal from testchamber	No breakdown or flashover
	Capacitance	$\|\Delta C/C\| \leq 3$ % of the value measured in 4.11.1.
	Tangent of loss angle	Increase of tan δ: For C ≤ 470 nF ≤ 0.001 (10 x 10^{-4}) For C > 470 nF ≤ 0.0015 (15 x 10^{-4}) Compared to values measured in 4.11.1
	Insulation resistance	≥ 50 % of values specified in section "Insulation Resistance" of this specification

SUB-CLAUSE NUMBER AND TEST	CONDITIONS	PERFORMANCE REQUIREMENTS
SUB-GROUP C3 A		
4.12.1 Endurance test at 50 Hz alternative voltage	Duration: 2000 h x U_{RDC} at 85 °C 0.875 x U_{RDC} at 110 °C	
4.12.1.1 Initial measurements	Capacitance Tangent of loss angle at 100 kHz	
4.12.1.3 Final measurements	Visual examination	No visible damage Legible marking
	Capacitance	$\lvert\Delta C/C\rvert \leq 5$ % compared to values measured in 4.12.1.1
	Tangent of loss angle	Increase of tan δ: For C ≤ 470 nF ≤ 0.001 (10 x 10^{-4}) For C > 470 nF ≤ 0.0015 (15 x 10^{-4}) Compared to values measured in 4.12.1.1
	Insulation resistance	≥ 50 % of values specified in section "Insulation Resistance" of this specification
SUB-GROUP C4		
4.2.6 Temperature characteristics Initial measurement Intermediate measurements	Capacitance Capacitance at - 55 °C Capacitance at 20 °C Capacitance at 110 °C	For - 55 °C to 20 °C 0 % ≤ $\lvert\Delta C/C\rvert$ ≤ 2.75 % or for 20 °C to 110 °C: - 5.5 % ≤ $\lvert\Delta C/C\rvert$ ≤ 0 % As specified in section "Capacitance" of this specification
4.13 Charge and discharge	10 000 cycles Charged to U_{RDC} Discharge resistance: $R = \frac{U_n(Vdc)}{2.5 \times C(dU/dt)}$	
4.13.1 Initial measurements	Capacitance Tangent of loss angle at 100 kHz	
4.13.3 Final measurements	Capacitance	$\lvert\Delta C/C\rvert \leq 3$ % of the value measured in 4.13.1
	Tangent of loss angle	Increase of tan δ: For C ≤ 470 nF ≤ 0.001 (10 x 10^{-4}) For C > 470 nF ≤ 0.0015 (15 x 10^{-4}) Compared to values measured in 4.13.1
	Insulation resistance	≥ 50 % of values specified in section "Insulation Resistance" of this specification

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