VISHAY

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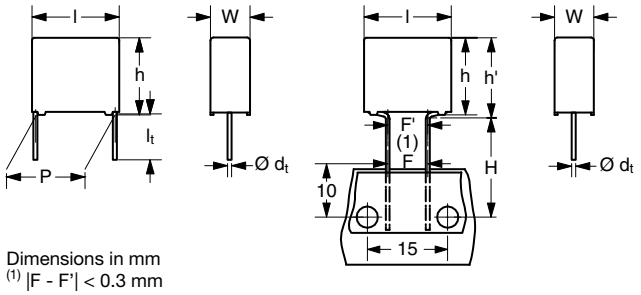
MKP 385

Vishay BCcomponents

AC and Pulse Metallized Polypropylene Film Capacitors
MKP Radial Potted Type



Dimensions in mm
(1) |F - F'| < 0.3 mm
F = 7.5 mm + 0.6 mm / - 0.1 mm

FEATURES

RoHS COMPLIANT

- 7.5 mm bent back pitch, 10 mm and 15 mm lead pitch
- Low contact resistance
- Low loss dielectric
- Small dimensions for high density packaging
- Supplied loose in box and taped on reel
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

APPLICATIONS

Where steep pulses occur e.g. SMPS (switch mode power supplies). Electronic lighting e.g. ballast. Motor control circuits.

REFERENCE SPECIFICATIONS

IEC 60384-17

MARKING

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

DIELECTRIC

Polypropylene film

ELECTRODES

Metallized

CONSTRUCTION

Internal serial construction

RATED (DC) VOLTAGE

1600 V, 2000 V

RATED (AC) VOLTAGE

550 V, 700 V

RATED PEAK-TO-PEAK VOLTAGE

1600 V, 2000 V

ENCAPSULATION

Flame retardant plastic case and epoxy resin UL-class 94 V-0

CLIMATIC CLASS ACCORDING TO IEC 60068-1

55/110/56

CAPACITANCE RANGE (E24 SERIES)

0.00047 µF to 0.033 µF

CAPACITANCE TOLERANCE

± 5 %

LEADS

Tinned wire

RATED (DC) TEMPERATURE

85 °C

RATED (AC) TEMPERATURE

85 °C

MAXIMUM APPLICATION TEMPERATURE

110 °C

MAXIMUM OPERATING TEMPERATURE FOR LIMITED TIME

125 °C

PERFORMANCE GRADE

Grade 1 (long life)

STABILITY GRADE

Grade 2

DETAIL SPECIFICATION

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

For technical questions, contact: dc-film@vishay.com
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COMPOSITION OF CATALOG NUMBER

TYPE AND PITCHES	
385	10.0/7.5 mm
	15.0/7.5 mm
	10.0 mm
	15.0 mm

MULTIPLIER (nF)	
0.1	2
1	3
10	4
100	5

CAPACITANCE (numerically)

Example:
104 = 10 x 10 = 100 nF

BFC2	385	XX	YY	Y
2222 (1)	385	XX	YY	Y

(1) old ordering number

TYPE	PACKAGING	LEAD CONFIGURATION	PREFERRED TYPES				
			C-TOL.	1600 V		2000 V	
385	Loose in box	lead length 3.5 + 1/- 0.5 mm or 3.5 ± 0.3 mm	± 5 %	00	50	60	80
	Taped on reel (1)	H = 18.5 mm; P_0 = 12.7 mm reel diameter = 500 mm	± 5 %	02	52	62	82
	Taped on reel (bent back to 7.5 mm) (1)	H = 16.0 mm; P_0 = 15.0 mm reel diameter = 500 mm	± 5 %	03	53	63	83
	Ammopack (1)	H = 18.5 mm; P_0 = 12.7 mm	± 5 %	06	56	66	86
	Ammopack (bent back to 7.5 mm) (1)	H = 16.0 mm; P_0 = 15.0 mm	± 5 %	08	58	68	88
					ON REQUEST		
385	Loose in box	lead length 5.0 ± 1.0 mm	± 5 %	01	51	61	81
	Loose in box	lead length 25.0 ± 2.0 mm	± 5 %	04	54	64	84
	Taped on reel (bent back to 7.5 mm) (1)	H = 16.0 mm; P_0 = 15.0 mm reel diameter = 356 mm	± 5 %	05	55	65	85
	Loose in box	lead length 3.2 + 0.3/- 0.6 mm	± 5 %	07	57	67	87

Note

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

SPECIFIC REFERENCE DATA (1600 V_{DC})

DESCRIPTION	VALUE	
Tangent of loss angle:	at 10 kHz	at 100 kHz
	≤ 5 x 10^{-4}	≤ 15 x 10^{-4}
Rated voltage pulse slope $(dU/d_t)_R$		
P = 10 mm and 10 mm bent back to 7.5 mm	4000 V/µs	
P = 15 mm and 15 mm bent back to 7.5 mm	2000 V/µs	
R between leads, for C ≤ 1 µF at 500 V; 1 min	> 100 000 MΩ	
R between leads and case; 500 V; 1 min	> 30 000 MΩ	
Ionization (AC) voltage (typical value) at 20 pC peak discharge	> 600 V	
Withstanding (DC) voltage (cut off current 10 mA); rise time 100 V/s	2560 V; 1 min	
Withstanding (DC) voltage between leads and case	2840 V; 1 min	
Maximum application temperature	110 °C	

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U_{RDC} = 1600 V; U_{RAC} = 550 V; U_{P-P} = 1600 V; C-TOL. = ± 5 %

C (µF)	DIMENSIONS w x h (h') x l (mm)	MASS (g) (1)	CATALOG NUMBER BFC2 385 XXYYY AND PACKAGING							
			LOOSE IN BOX		REEL			AMMOPACK		C VALUE
			LEADS 3.5 mm + 1 mm / - 0.5 mm (2)	LEADS 25.0 mm ± 2.0 mm	ORIGINAL PITCH	PITCH = 7.5 mm (BENT BACK)		ORIGINAL PITCH	PITCH = 7.5 mm (BENT BACK)	
						Ø 500 mm	Ø 365 mm			
			XX (SPQ)	XX (SPQ)	XX (SPQ)	XX (SPQ)	XX (SPQ)	XX (SPQ)	XX (SPQ)	..YYY
PITCH = 10 mm ± 0.4 mm; d_t = 0.60 mm ± 0.06 mm					PITCH = 10.0 mm	PITCH = 7.5 mm (BENT BACK)		PITCH = 10.0 mm	PITCH = 7.5 mm (BENT BACK)	
0.002 0.0022 0.0024 0.0027 0.003	4.0 x 10.0 (12.0) x 12.5	0.66	**50...** (1000)	**54...** (1250)	**52...** (1400)	**53...** (2000)	-	**56...** (950)	**58...** (1300)	**202** **222** **242** **272** **302**
0.0033 0.0036 0.0039 0.0043	5.0 x 11.0 (13.0) x 12.5	0.90	**50...** (1000)	**54...** (1250)	**52...** (1000)	**53...** (1900)	-	**56...** (750)	**58...** (1000)	**332** **362** **392** **432**
0.0047 0.0051 0.0056 0.0062 0.0068	6.0 x 12.0 (14.0) x 12.5	1.1	**50...** (750)	**54...** (750)	**52...** (900)	**53...** (1500)	-	**56...** (600)	**58...** (850)	**472** **512** **562** **622** **682**
PITCH = 15 mm ± 0.4 mm; d_t = 0.60 mm ± 0.06 mm					PITCH = 15.0 mm	PITCH = 7.5 mm (BENT BACK)				
0.0039 0.0043 0.0047 0.0051 0.0056 0.0062 0.0068	5.0 x 11.0 (13.0) x 17.5	1.1	**00...** (1250)	**04...** (1000)	**02...** (1100)	**03...** (950)	**05...** (550)	-	-	**392** **432** **472** **512** **562** **622** **682**
0.0075 0.0082			**50...** (1250)	**54...** (1000)	**52...** (1100)	**53...** (950)	**55...** (550)	-	-	**752** **822**
0.0091 0.010 0.011 0.012	6.0 x 12.0 (14.0) x 17.5	1.4	**50...** (1000)	**54...** (1000)	**52...** (900)	**53...** (800)	**55...** (450)	-	-	**912** **103** **113** **123**
PITCH = 15 mm ± 0.4 mm; d_t = 0.80 mm ± 0.08 mm					PITCH = 15.0 mm	PITCH = 7.5 mm (BENT BACK)				
0.013 0.015 0.016	7.0 x 13.5 (15.5) x 17.5	2.0	**50...** (1000)	**54...** (500)	**52...** (800)	**53...** (700)	**55...** (400)	-	-	**133** **153** **163**
0.018 0.020 0.022 0.024	8.5 x 15.0 (17.0) x 17.5	2.5	**50...** (1000)	**54...** (500)	**52...** (650)	**53...** (550)	**55...** (300)	-	-	**183** **203** **223** **243**
0.027 0.030 0.033	10.0 x 16.5 (18.5) x 17.5	3.3	**50...** (500)	**54...** (500)	**52...** (600)	**53...** (500)	**55...** (250)	-	-	**273** **303** **333**

Notes

- SPQ = Standard Packing Quantity

(1) Net weight for short lead component

(2) l_t = 3.5 mm ± 0.3 mm for pitch = 15 mm

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SPECIFIC REFERENCE DATA (2000 V_{DC})

DESCRIPTION	VALUE	
Tangent of loss angle:	at 10 kHz	at 100 kHz
	≤ 5 x 10^{-4}	≤ 15 x 10^{-4}
Rated voltage pulse slope $(dU/d_t)_R$		
P = 10 mm and 10 mm bent back to 7.5 mm	4000 V/µs	
P = 15 mm and 15 mm bent back to 7.5 mm	2000 V/µs	
R between leads, for C ≤ 1 µF at 500 V; 1 min	> 100 000 MΩ	
R between leads and case; 500 V; 1 min	> 30 000 MΩ	
Ionization (AC) voltage (typical value) at 20 pC peak discharge	> 750 V	
Withstanding (DC) voltage (cut off current 10 mA); rise time 100 V/s	3200 V; 1 min	
Withstanding (DC) voltage between leads and case	2840 V; 1 min	
Maximum application temperature	110 °C	

U_{RDC} = 2000 V; U_{RAC} = 700 V; U_{P-P} = 2000 V; C-TOL. = ± 5 %

C (µF)	DIMENSIONS w x h (h') x l (mm)	MASS (g) (1)	CATALOG NUMBER BFC2 385 XXYYY AND PACKAGING							C VALUE
			LOOSE IN BOX		REEL			AMMOPACK		
			LEADS 3.5 mm + 1 mm / - 0.5 mm (2)	LEADS 25.0 mm ± 2.0 mm	ORIGINAL PITCH	PITCH = 7.5 mm (BENT BACK)		ORIGINAL PITCH	PITCH = 7.5 mm (BENT BACK)	
						Ø 500 mm	Ø 365 mm			
			XX (SPQ)	XX (SPQ)	XX (SPQ)	XX (SPQ)	XX (SPQ)	XX (SPQ)	XX (SPQ)	..YYY
PITCH = 10 mm ± 0.4 mm; d_t = 0.60 mm ± 0.06 mm						PITCH = 10.0 mm	PITCH = 7.5 mm (BENT BACK)		PITCH = 10.0 mm	PITCH = 7.5 mm
0.00047	4.0 x 10.0 (12.0) x 12.5	0.66	**60...** (1000)	**64...** (1250)	**62...** (1400)	**63...** (2000)	-	**66...** (950)	**68...** (1300)	**471**
0.00051										**511**
0.00056										**561**
0.00062										**621**
0.00068										**681**
0.00075										**751**
0.00082										**821**
0.00091										**911**
0.001										**102**
0.0011										**112**
0.0012										**122**
0.0013										**132**
0.0015										**152**
0.0016										**162**
0.0018	5.0 x 11.0 (13.0) x 12.5	0.90	**60...** (1000)	**64...** (1000)	**62...** (1100)	**63...** (1900)	-	**66...** (750)	**68...** (1000)	**182**
0.002										**202**
0.0022										**222**
0.0024										**242**
0.0027	6.0 x 12.0 (14.0) x 12.5	1.1	**60...** (750)	**64...** (750)	**62...** (900)	**63...** (1500)	-	**66...** (600)	**68...** (850)	**272**
0.003										**302**
0.0033										**332**
0.0036										**362**

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C (µF)	DIMENSIONS w x h (h') x l (mm)	MASS (g) (1)	CATALOG NUMBER BFC2 385 XXYYY AND PACKAGING							
			LOOSE IN BOX		REEL			AMMOPACK		C VALUE
			LEADS 3.5 mm + 1 mm / - 0.5 mm (2)	LEADS 25.0 mm ± 2.0 mm	ORIGINAL PITCH	PITCH = 7.5 mm (BENT BACK)		ORIGINAL PITCH	PITCH = 7.5 mm (BENT BACK)	
						Ø 500 mm	Ø 365 mm			
			XX (SPQ)	XX (SPQ)	XX (SPQ)	XX (SPQ)	XX (SPQ)	XX (SPQ)	XX (SPQ)	..YYY
PITCH = 15 mm ± 0.4 mm; d_t = 0.60 mm ± 0.06 mm					PITCH = 15.0 mm	PITCH = 7.5 mm (BENT BACK)				
0.00047 0.00051 0.00056 0.00062 0.00068 0.00075 0.00082 0.00091 0.0010 0.0011 0.0012 0.0013 0.0015 0.0016 0.0018	5.0 x 11.0 (13.0) x 17.5	1.1	**80...** (1250)	**84...** (1000)	**82...** (1100)	**83...** (950)	**85...** (550)	-	-	**471** **511** **561** **621** **681** **751** **821** **911** **102** **112** **122** **132** **152** **162** **182**
PITCH = 15 mm ± 0.4 mm; d_t = 0.60 mm ± 0.06 mm					PITCH = 15.0 mm	PITCH = 7.5 mm (BENT BACK)				
0.0020 0.0022 0.0024 0.0027 0.0030 0.0033 0.0036	5.0 x 11.0 (13.0) x 17.5	1.1	**80...** (1250)	**84...** (1000)	**82...** (1100)	**83...** (950)	**85...** (550)	-	-	**202** **222** **242** **272** **302** **332** **362**
0.0039 0.0043 0.0047			**60...** (1250)	**64...** (1000)	**62...** (1100)	**63...** (950)	**65...** (550)	-	-	**392** **432** **472**
0.0051 0.0056 0.0062 0.0068	6.0 x 12.0 (14.0) x 17.5	1.4	**60...** (1000)	**64...** (1000)	**62...** (900)	**63...** (800)	**65...** (450)	-	-	**512** **562** **622** **682**
PITCH = 15 mm ± 0.4 mm; d_t = 0.80 mm ± 0.08 mm					PITCH = 15.0 mm	PITCH = 7.5 mm (BENT BACK)				
0.0075 0.0082 0.0091 0.010	7.0 x 13.5 (15.5) x 17.5	2	**60...** (1000)	**64...** (500)	**62...** (800)	**63...** (700)	**65...** (400)	-	-	**752** **822** **912** **103**
0.011 0.012 0.013	8.5 x 15.0 (17.0) x 17.5	2.5	**60...** (1000)	**64...** (500)	**62...** (650)	**63...** (550)	**65...** (300)	-	-	**113** **123** **133**
0.015 0.016 0.018 0.020	10.0 x 16.5 (18.5) x 17.5	3.3	**60...** (500)	**64...** (500)	**62...** (600)	**63...** (500)	**65...** (250)	-	-	**153** **163** **183** **203**

Notes

- SPQ = Standard Packing Quantity

(1) Net weight for short lead component

(2) l_t = 3.5 mm ± 0.3 mm for pitch = 15 mm

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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.

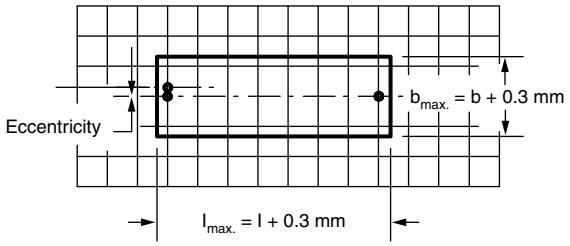
Specific Method of Mounting to Withstand Vibration and Shock

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 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: $h_{max.} \leq h + 0.3$ 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 %.

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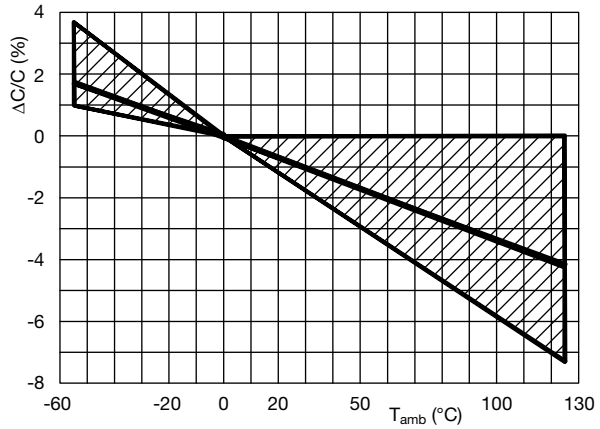
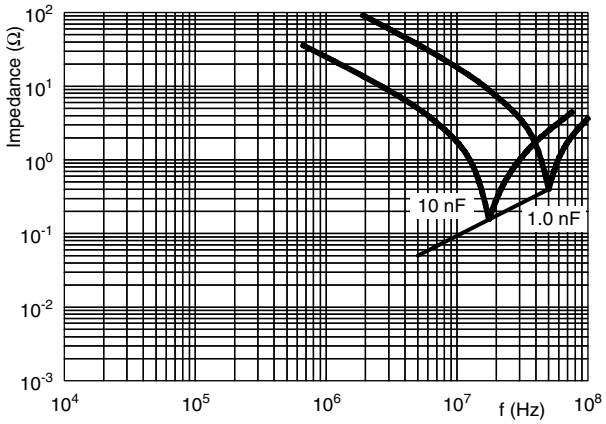
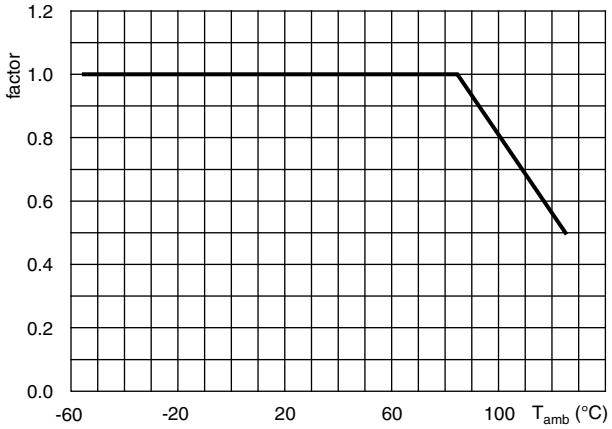
CHARACTERISTICS



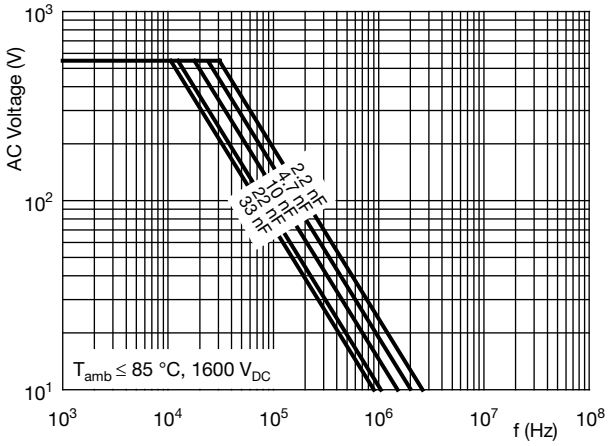
Capacitance as a function of ambient temperature (typical curve) (1 kHz)



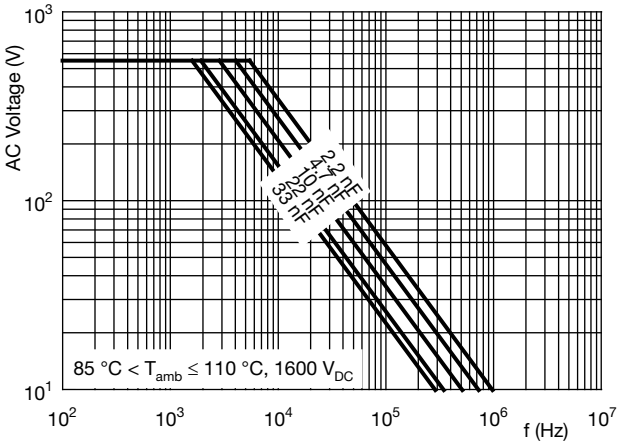
Impedance as a function of frequency (typical curve)



Max. DC and AC voltage as a function of temperature



Max. RMS voltage as a function of frequency



Max. RMS voltage as a function of frequency

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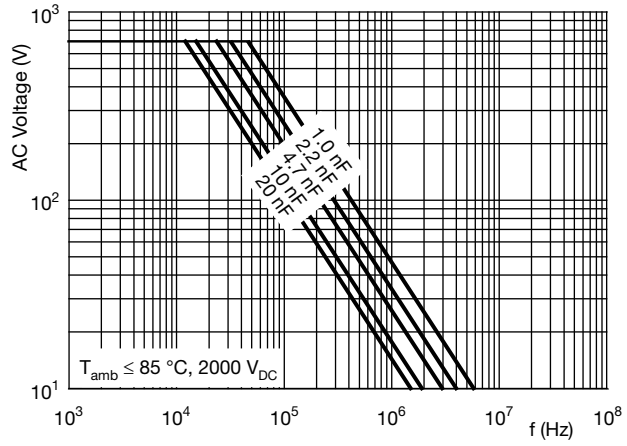
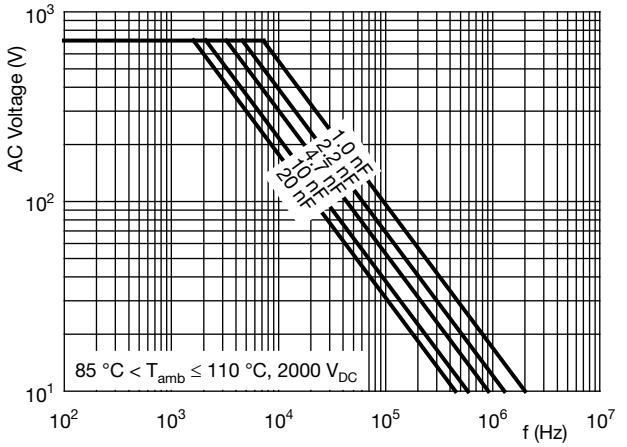
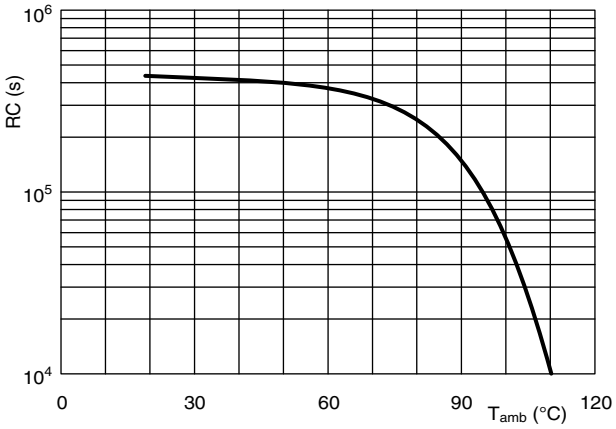


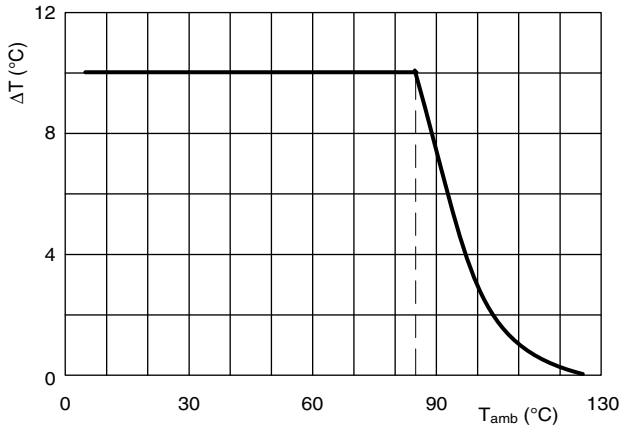
Max. RMS voltage as a function of frequency



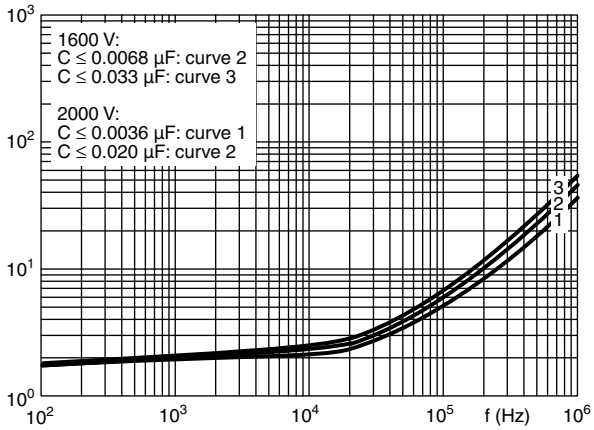
Max. RMS voltage as a function of frequency



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



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



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

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

$W_{max.}$ (mm)	HEAT CONDUCTIVITY (mW/°C)	
	PITCH 10 mm	PITCH 15 mm
4.0	6.5	-
5.0	7.5	10
6.0	9.0	11
7.0	-	12
8.5	-	16
10.0	-	18

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.

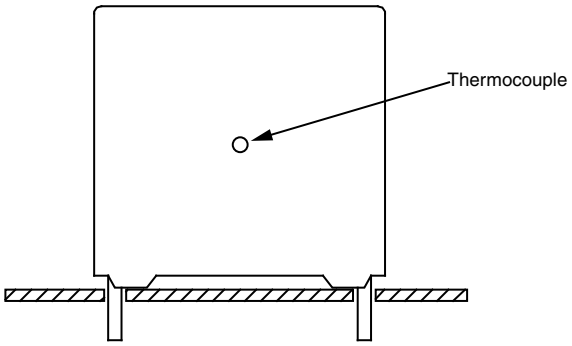
The power dissipation can be calculated according type detail specification “HQN-384-01/101: Technical Information Film Capacitors” with the typical tgd of the curves.

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 box.

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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 ($U_{p\text{-}p}$) shall not be greater than the maximum ($U_{p\text{-}p}$) to avoid the ionization inception level
3. The voltage peak slope (dU/d_t) 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 Fig. “Maximum 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	110 °C < $T_{amb} \leq 125$ °C
Maximum continuous RMS voltage	U_{RAC}	0.7 x U_{RAC}	0.5 x U_{RAC}
Maximum temporary RMS-overvoltage (< 24 h)	1.25 x U_{RAC}	0.875 x U_{RAC}	0.625 x U_{RAC}
Maximum peak voltage ($V_{o\text{-}p}$) (< 2 s)	1.6 x U_{RDC}	1.1 x U_{RDC}	0.8 x U_{RDC}

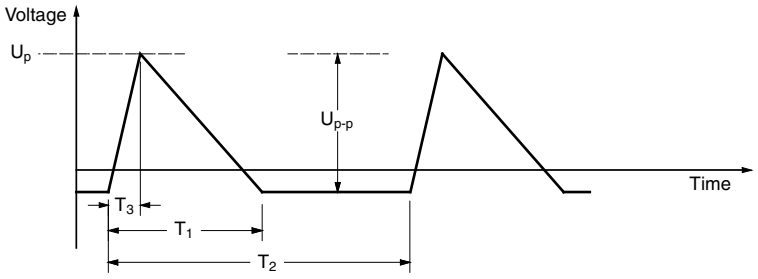
Example

C = 4n7 1600 V used for the voltage signal shown in next figure.
$U_{p\text{-}p}$ = 1000 V; U_p = 900 V; T_1 = 12 µs; T_2 = 64 µs; T_3 = 4 µs
The ambient temperature is 80 °C. In case of failure, the oscillation is blocked.

Checking the conditions:

1. The peak voltage U_p = 900 V is lower than 1600 V_{DC}
2. The peak-to-peak voltage 1000 V is lower than 2 √2 x 550 V_{AC} = 1600 $U_{p\text{-}p}$
3. The voltage pulse slope dU/dt = 1000 V/4 µs = 250 V/µs.
   This is lower than 4000 V/µs (see specific reference data for each version)
4. The dissipated power is 35 mW as calculated with fourier terms and typical tgd.
   The temperature rise for $w_{max.}$ = 6.0 and pitch = 10 mm will be 35 mW/9 mW/°C = 3.9 °C
   This is lower than 10 °C temperature rise at 80 °C, according figure.
5. Oscillation is blocked
6. Not applicable

Voltage signal:



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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 chapters “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 10 N; 10 s Bending: load 5 N; 4 x 90°	No visible damage
4.4	Resistance to soldering heat	Method: 1A Solder bath: 280 °C ± 5 °C Duration: 10 s	
4.14	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	$\lvert\Delta C/C\rvert \leq 1\ \% + 5$ pF of the value measured initially
		Tangent of loss angle	Increase of tan δ: ≤ 0.0005 Compared to values measured in 4.3.1
SUB-GROUP C1B PART OF SAMPLE OF SUB-GROUP C1			
4.6.1	Initial measurements	Capacitance Tangent of loss angle at 100 kHz	
4.15	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
4.6	Rapid change of temperature	θA = -55 °C θB = +105 °C 5 cycles Duration t = 30 min	
4.6.1	Inspection	Visual examination	No visible damage
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/s^2 (whichever is less severe) Total duration 6 h	

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SUB-CLAUSE NUMBER AND TEST	CONDITIONS	PERFORMANCE REQUIREMENTS
4.7.2 Final inspection	Visual examination	No visible damage
4.9 Shock	Mounting: see section “Mounting” of this specification Pulse shape: half sine Acceleration: 490 m/s² Duration of pulse: 11 ms	
4.9.3 Final measurements	Visual examination	No visible damage
	Capacitance	For C $\lvert\Delta C/C\rvert \leq 2$ % or of the value measured in 4.6.1.
	Tangent of loss angle	Increase of tan δ: ≤ 0.0005 Compared to values measured in 4.6.1
	Insulation resistance	As specified in section “Insulating 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: +105 °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 testchamber	No breakdown of flash-over
	Visual examination	No visible damage Legible marking
	Capacitance	$\lvert\Delta C/C\rvert \leq 2$ % of the value measured in 4.4.2 or 4.9.3
	Tangent of loss angle	Increase of tan δ: ≤ 0.005 Compared to values measured in 4.3.1 or 4.6.1
	Insulation resistance	≥ 50 % of values specified in section “Insulation Resistance” of this specification

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SUB-CLAUSE NUMBER AND TEST	CONDITIONS	PERFORMANCE REQUIREMENTS
SUB-GROUP C2		
4.11 Damp heat steady state	56 days, 40 °C, 90 % to 95 % RH no load	
4.11.1 Initial measurements	Capacitance Tangent of loss angle at 1 kHz	
4.11.3 Final measurements	Voltage proof = U_{RDC} for 1 min within 15 min after removal from testchamber	No breakdown of flash-over
	Visual examination	No visible damage Legible marking
	Capacitance	$\lvert\Delta C/C\rvert \leq 1$ % + 5 pF of the value measured in 4.11.1.
	Tangent of loss angle	Increase of tan δ: ≤ 0.0005 Compared to values measured in 4.11.1
	Insulation resistance	≥ 50 % of values specified in section “Insulation Resistance” of this specification
SUB GROUP C3A		
4.12.1 Endurance	Duration: 2000 h Temperature: 85 °C Voltage: 1.25 x U_{RAC} V_{RMS}, 50 Hz Duration: 2000 h Temperature: 105 °C	
4.12.1.1 Initial measurements	Voltage: 0.875 x U_{RAC} V_{RMS}, 50 Hz Capacitance Tangent of loss angle at 100 kHz	
4.12.1.3 Final measurements	Visual examination	No visible damage Legible marking Temperature: 85 °C
	Capacitance	$\lvert\Delta C/C\rvert \leq 5$ % for C > 10 nF $\lvert\Delta C/C\rvert \leq 8$ % for C $\leq$ 10 nF compared to values measured in 4.12.1.1
	Tangent of loss angle	Increase of tan δ: ≤ 0.005 Compared to values measured in 4.12.1.1
	Insulation resistance	≥ 50 % of values specified in section “Insulation Resistance” of this specification
SUB GROUP C3B		
4.12.2 Endurance test at 50 Hz alternating voltage	Duration: 500 h	
4.12.2.1 Initial measurements	Voltage: 0.625 x U_{RAC} at 125 °C Capacitance Tangent of loss angle: at 100 kHz	
4.12.2.3 Final measurements	Visual examination	No visible damage Legible marking
	Capacitance	$\lvert\Delta C/C\rvert \leq 10$ % for C + 100 pF compared values measured in 4.42.2.1
	Tangent of loss angle	Increase of tan δ: ≤ 0.0005 Compared to values measured in 4.12.2.1
	Insulation resistance	≥ 50 % of values specified in section “Insulation Resistance” of this specification

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SUB-CLAUSE NUMBER AND TEST		CONDITIONS	PERFORMANCE REQUIREMENTS
SUB-GROUP C4			
4.2.6	Temperature characteristics Initial measurements Intermediate measurements	Capacitance Capacitance at -55 °C Capacitance at -20 °C Capacitance at +125 °C	For -55 °C to +20 °C: +1 % ≤ |ΔC/C| ≤ 3.75 % or for 20 °C to 125 °C -7.5 % ≤ |ΔC/C| ≤ 0 % compared to values measured in 4.12.1.1
	Final measurement	Capacitance	As specified in section “Capacitance” of this specification
		Insulation resistance	As specified in section “Insulation Resistance” of this specification
4.13	Charge and discharge	10 000 cycles Charged to U_R V_{DC} Discharge resistance: $R = \frac{U_R}{C \times (2.5 \times (dU/dt)_R)}$	
4.13.1	Initial measurements	Capacitance Tangent of loss angle: at 100 kHz or	
4.13.3	Final measurements	Capacitance	|ΔC/C| ≤ 1 % compared to values measured in 4.13.1
		Tangent of loss angle	Increase of tan δ: ≤ 0.0005 Compared to values measured in 4.13.1
		Insulation resistance	≥ 50 % of values specified in section “Insulation Resistance” of this specification
SUB-GROUP ADD 1			
A.1	Ignition of lamp test		
A.1.1	Initial measurements	Capacitance Tangent of loss angle at 100 kHz	
A.1. 2	Ignition of lamp test	Temperature: 85 °C 1000 cycles: 1 s ON 29 s OFF Frequency: 60 kHz Voltage: 1600 V type: 2800 V_{pp} 2000 V type: 3000 V_{pp}	
A.1. 2	Final measurements	Visual examination	No visible damage
		Capacitance	|ΔC/C| ≤ 5 % of the value measured in A.1.1
		Tangent of loss angle at 100 kHz	Increase of tan δ: ≤ 0.0005 Compared to values measured in A.1.1
		Insulation resistance	≥ 50 % of values specified in section “Insulation Resistance” of this specification

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