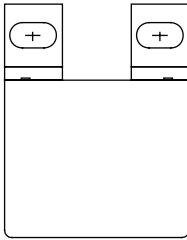
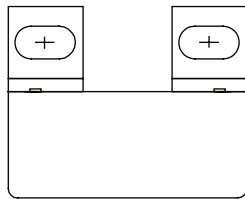
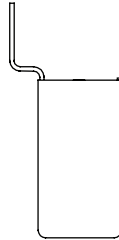


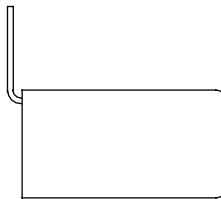
AC and Pulse Double Metallized Polypropylene Film Capacitors MMKP Radial Potted Type



Horizontally Mounted



Vertically Mounted



APPLICATIONS

Industrial motor control circuits, mounted directly on the IGBT or GTO.

REFERENCE SPECIFICATIONS

IEC 60384-17

MARKING

C-value; tolerance; rated voltage; code for dielectric material; code for factory of origin; manufacturer's type, manufacturer; year and week of manufacture

DIELECTRIC

Polypropylene film

ELECTRODES

Double metallized

CONSTRUCTION

Mono construction for 630 V version
Internal serial construction from 850 Vdc on

RATED (DC) VOLTAGE

630 V, 850 V, 1000 V, 1250 V, 1400 V, 1600 V, 2000 V, 2500 V

RATED (AC) VOLTAGE

220 V, 300 V, 350 V, 425 V, 500 V, 550 V, 700 V, 900 V

RATED PEAK-TO-PEAK VOLTAGE

630 V, 850 V, 1000 V, 1250 V, 1400 V, 1600 V, 2000 V, 2500 V

FEATURES

Low inductive construction
Low loss dielectric
Double sided metallized for high pulse ratings
RoHS compliant



RoHS
COMPLIANT

ENCAPSULATION

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

CLIMATIC TESTING CLASS ACC. TO IEC 60068-1

55/085/56

CAPACITANCE RANGE (E24 SERIES)

0.1 to 4.7 μ F

CAPACITANCE TOLERANCE

$\pm 5 \%$; $\pm 10 \%$

TABS

Tinned coated copper

RATED (DC) TEMPERATURE

85 °C

RATED (AC) TEMPERATURE

85 °C

MAXIMUM APPLICATION TEMPERATURE

85 °C

PERFORMANCE GRADE

Grade 1 (long life)

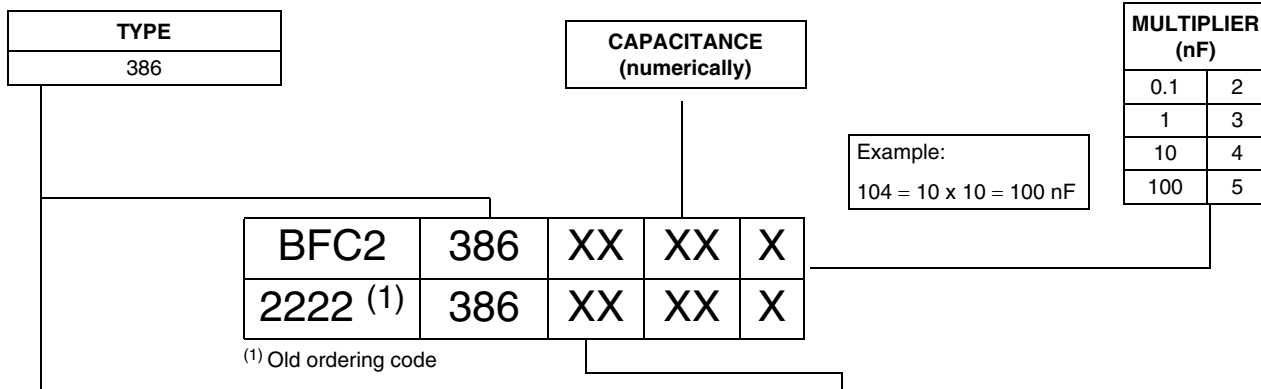
STABILITY GRADE

Grade 2

DETAIL SPECIFICATION

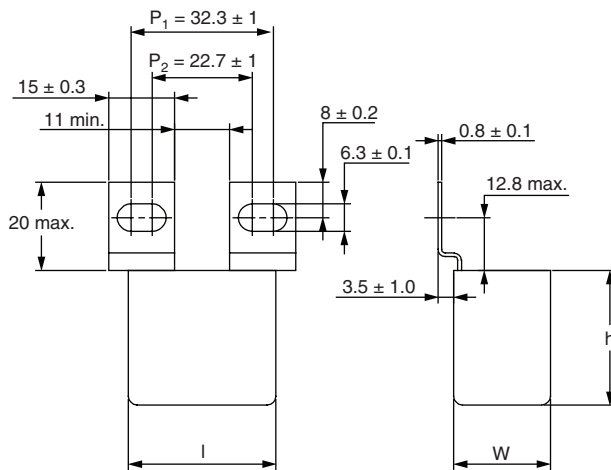
For more detailed data and test requirements contact:
dc-film@vishay.com

COMPOSITION OF CATALOG NUMBER

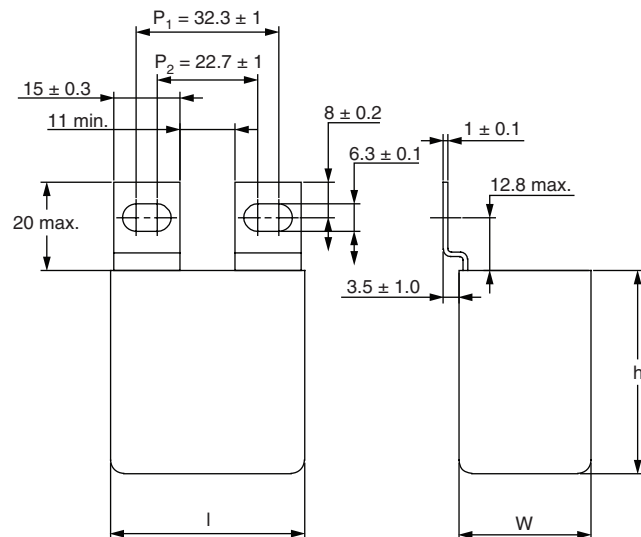


TYPE	PACKAGING	MOUNTING CONFIGURATION	PREFERRED TYPES								
			C-TOL.	630 V	850 V	1000 V	1250 V	1400 V	1600 V	2000 V	2500 V
386	Loose in box	Horizontally mounted	± 10 %	20	00	30	80	40	50	60	70
		Vertically mounted	± 10 %	22	02	32	82	42	52	62	72
			ON REQUEST								
386	Loose in box	Horizontally mounted	± 5 %	21	01	31	81	41	51	61	71
		Vertically mounted	± 5 %	23	03	33	83	43	53	63	73

Horizontally Mounted

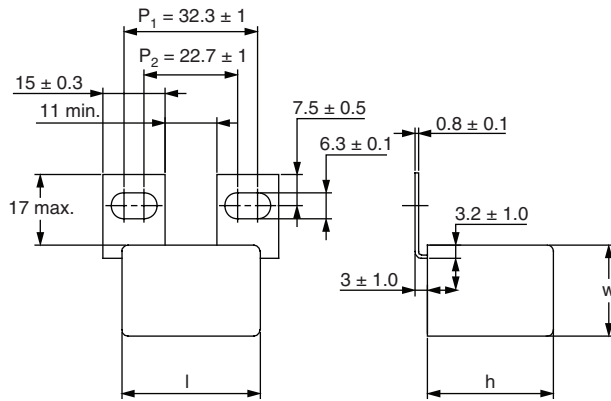


Drawing A

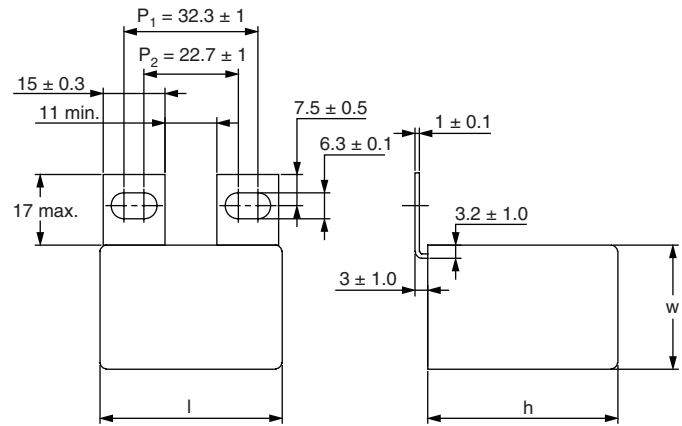


Drawing B

P₁ = Pitch 1
P₂ = Pitch 2

AC and Pulse Double Metallized Polypropylene Film Capacitors MMKP Radial Potted Type
Vertically Mounted


Drawing A



Drawing B

P_1 = Pitch 1
 P_2 = Pitch 2

SPECIFIC REFERENCE DATA

DESCRIPTION	VALUE							
	630 V	850 V	1000 V	1250 V	1400 V	1600 V	2000 V	2500 V
Capacitance range	0.33 μ F to 4.7 μ F	0.22 μ F to 2.7 μ F	0.33 μ F to 1.8 μ F	0.15 μ F to 0.82 μ F	0.1 μ F to 0.68 μ F	0.1 μ F to 0.56 μ F	0.1 μ F to 0.47 μ F	0.1 μ F to 0.27 μ F
Maximum operating DC voltage	630 V	850 V	1000 V	1250 V	1400 V	1600 V	2000 V	2500 V
Maximum operating AC voltage	220 V	300 V	350 V	425 V	500 V	550 V	700 V	900 V
Tangent of loss angle	$\leq 0.47 \mu$ F		0.56μ F $\leq C \leq 1.0 \mu$ F			$C > 1.0$ F		
at 1 kHz	$< 5 \times 10^{-4}$		$< 5 \times 10^{-4}$			$< 10 \times 10^{-4}$		
at 10 kHz	$< 10 \times 10^{-4}$		$< 10 \times 10^{-4}$			$< 20 \times 10^{-4}$		
at 100 kHz	$< 12 \times 10^{-4}$		$< 25 \times 10^{-4}$					
R between terminals at 500 V; 1 min	> 5000 M Ω							
R between terminals and case; 500 V; 1 min	$> 30\,000$ M Ω							
Withstanding (DC) voltage (cut off current 10 mA); rise time 100 V/s	1000 V; 1 min	1360 V; 1 min	1600 V; 1 min	2000 V; 1 min	2240 V; 1 min	2560 V; 1 min	3200 V; 1 min	4000 V; 1 min
Withstanding (DC) voltage between terminals and case	2840 V; 1 min							
Maximum dU/dt (V/ μ s)	630 V	850 V	1000 V	1250 V	1400 V	1600 V	2000 V	2500 V
w x h x l = 22.0 x 30.5 x 33.5	250	650	1000	1500	2000	2400	2500	5500
w x h x l = 22.0 x 38.0 x 44.0	100	350	500	750	900	1000	1000	2000
w x h x l = 30.0 x 46.0 x 44.0	75	260	350	550	650	750	750	1500
ESR at 100 kHz	6 m Ω							
ESL	Typical 15 nH							
Temperature range	- 55 $^{\circ}$ C to + 85 $^{\circ}$ C							

MMKP 386



Vishay BCcomponents AC and Pulse Double Metallized Polypropylene Film Capacitors MMKP Radial Potted Type

$U_{Rdc} = 630\text{ V}$; $U_{Rac} = 220\text{ V}/U_{pp} = 630\text{ V}$

C (μF)	DIMENSIONS w x h x l (mm)	MASS (g)	CATALOG NUMBER BFC2 386 XXXXX AND PACKAGING	
			TRAY PACKAGING	
			C-tol. = $\pm 10\%$	SPQ
Drawing A				
0.33	22.0 x 30.5 x 33.5	39	20334	56
0.39		38	20394	
0.47		38	20474	
0.56		37	20564	
0.68		37	20684	
0.82		36	20824	
1		35	20105	
1.2		35	20125	
Drawing B				
1.5	22.0 x 38.0 x 44.0	60	20155	42
1.8		58	20185	
2.2		56	20225	
2.7		54	20275	
3.3	30.0 x 46.0 x 44.0	86	20335	36
3.9		83	20395	
4.7		80	20475	

• SPQ = Standard Packing Quantity

$U_{Rdc} = 850\text{ V}$; $U_{Rac} = 300\text{ V}/U_{pp} = 850\text{ V}$

C (μF)	DIMENSIONS w x h x l (mm)	MASS (g)	CATALOG NUMBER BFC2 386 XXXXX AND PACKAGING	
			TRAY PACKAGING	
			C-tol. = $\pm 10\%$	SPQ
Drawing A				
0.22	22.0 x 30.5 x 33.5	39	00224	56
0.27		39	00274	
0.33		38	00334	
0.39		38	00394	
0.47		37	00474	
0.56		37	00564	
0.68		36	00684	
0.82		35	00824	
Drawing B				
1.0	22.0 x 38.0 x 44.0	61	00105	42
1.2		59	00125	
1.5		58	00155	
1.8	30.0 x 46.0 x 44.0	91	00185	36
2.2		88	00225	
2.7		85	00275	

• SPQ = Standard Packing Quantity

$U_{Rdc} = 1000\text{ V}$; $U_{Rac} = 350\text{ V}/U_{pp} = 1000\text{ V}$

C (μF)	DIMENSIONS w x h x l (mm)	MASS (g)	CATALOG NUMBER BFC2 386 XXXXX AND PACKAGING	
			TRAY PACKAGING	
			C-tol. = $\pm 10\%$	SPQ
Drawing A				
0.33	22.0 x 30.5 x 33.5	36	30334	56
0.39		35	30394	
0.47		34	30474	
Drawing B				
0.56	22.0 x 38.0 x 44.0	60	30564	42
0.68		59	30684	
0.82		57	30824	
1.0		55	30105	
1.2	30.0 x 46.0 x 44.0	88	30125	36
1.5		84	30155	
1.8		80	30185	

• SPQ = Standard Packing Quantity



AC and Pulse Double Metallized Polypropylene Vishay BCcomponents
Film Capacitors MMKP Radial Potted Type

$U_{Rdc} = 1250\text{ V}$; $U_{Rac} = 425\text{ V}$ / $U_{pp} = 1250\text{ V}$

C (μF)	DIMENSIONS w x h x l (mm)	MASS (g)	CATALOG NUMBER BFC2 386 XXXXX AND PACKAGING	
			TRAY PACKAGING	
			C-tol. = $\pm 10\%$	SPQ
Drawing A				
0.15 0.18 0.22 0.27	22.0 x 30.5 x 33.5	37 35 34 33	80154 80184 80224 80274	56
Drawing B				
0.33 0.39 0.47	22.0 x 38.0 x 44.0	59 58 57	80334 80394 80474	42
0.56 0.68 0.82	30.0 x 46.0 x 44.0	89 85 82	80564 80684 80824	36

• SPQ = Standard Packing Quantity

$U_{Rdc} = 1400\text{ V}$; $U_{Rac} = 500\text{ V}$ / $U_{pp} = 1400\text{ V}$

C (μF)	DIMENSIONS w x h x l (mm)	MASS (g)	CATALOG NUMBER BFC2 386 XXXXX AND PACKAGING	
			TRAY PACKAGING	
			C-tol. = $\pm 10\%$	SPQ
Drawing A				
0.1 0.12 0.15	22.0 x 30.5 x 33.5	37 36 35	40104 40124 40154	56
Drawing B				
0.18 0.22 0.27 0.33	22.0 x 38.0 x 44.0	61 59 57 56	40184 40224 40274 40334	42
0.39 0.47 0.56 0.68	30.0 x 46.0 x 44.0	89 85 82 79	40394 40474 40564 40684	36

• SPQ = Standard Packing Quantity

$U_{Rdc} = 1600\text{ V}$; $U_{Rac} = 550\text{ V}$ / $U_{pp} = 1600\text{ V}$

C (μF)	DIMENSIONS w x h x l (mm)	MASS (g)	CATALOG NUMBER BFC2 386 XXXXX AND PACKAGING	
			TRAY PACKAGING	
			C-tol. = $\pm 10\%$	SPQ
Drawing A				
0.1 0.12 0.15	22.0 x 30.5 x 33.5	37 36 35	50104 50124 40154	56
Drawing B				
0.18 0.22 0.27 0.33	22.0 x 38.0 x 44.0	61 59 58 57	50184 50224 50274 50334	42
0.39 0.47 0.56	30.0 x 46.0 x 44.0	90 87 84	50394 50474 50564	36

• SPQ = Standard Packing Quantity

MMKP 386



Vishay BCcomponents AC and Pulse Double Metallized Polypropylene Film Capacitors MMKP Radial Potted Type

$U_{Rdc} = 2000\text{ V}$; $U_{Rac} = 700\text{ V}$ / $U_{pp} = 2000\text{ V}$

C (μF)	DIMENSIONS w x h x l (mm)	MASS (g)	CATALOG NUMBER BFC2 386 XXXXX AND PACKAGING	
			TRAY PACKAGING	
			C-tol. = $\pm 10\%$	SPQ
Drawing A				
0.1 0.12	22.0 x 30.5 x 33.5	36	60104	56
		35	60124	
Drawing B				
0.15 0.18 0.22 0.27	22.0 x 38.0 x 44.0	61	60154	42
		59	60184	
		58	60224	
		57	60274	
0.33 0.39 0.47	30.0 x 46.0 x 44.0	89	60334	36
		86	60394	
		84	60474	

• SPQ = Standard Packing Quantity

$U_{Rdc} = 2500\text{ V}$; $U_{Rac} = 700\text{ V}$ / $U_{pp} = 2500\text{ V}$

C (μF)	DIMENSIONS w x h x l (mm)	MASS (g)	CATALOG NUMBER BFC2 386 XXXXX AND PACKAGING	
			TRAY PACKAGING	
			C-tol. = $\pm 10\%$	SPQ
Drawing B				
0.1 0.12 0.15 0.18	22.0 x 38.0 x 44.0	60	70104	42
		59	70124	
		57	70154	
		55	70184	
0.22 0.27	30.0 x 46.0 x 44.0	87	70224	36
		83	70274	

• SPQ = Standard Packing Quantity

MOUNTING

Normal Use

The capacitors are designed for direct mounting on IGBT or GTO.

Specific Method of Mounting to Withstand Vibration and Shock

In order to withstand vibration and shock tests, it must be ensured that the tabs are screwed tightly on the test board.

Storage Temperature

Storage temperature: $T_{stg} = -25\text{ }^{\circ}\text{C}$ to $+40\text{ }^{\circ}\text{C}$ with RH maximum 80 % without condensation.

Ratings and Characteristics Reference Conditions

Unless otherwise specified, all electrical values apply to an ambient temperature of $23\text{ }^{\circ}\text{C} \pm 1\text{ }^{\circ}\text{C}$, an atmospheric pressure of 86 kPa to 106 kPa and a relative humidity of $50\% \pm 2\%$.

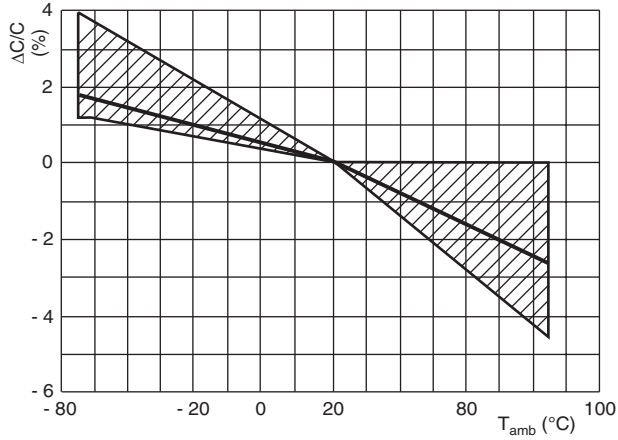
For reference testing, a conditioning period shall be applied over $96\text{ h} \pm 4\text{ h}$ by heating the products in a circulating air oven at the rated temperature and a relative humidity not exceeding 20 %.



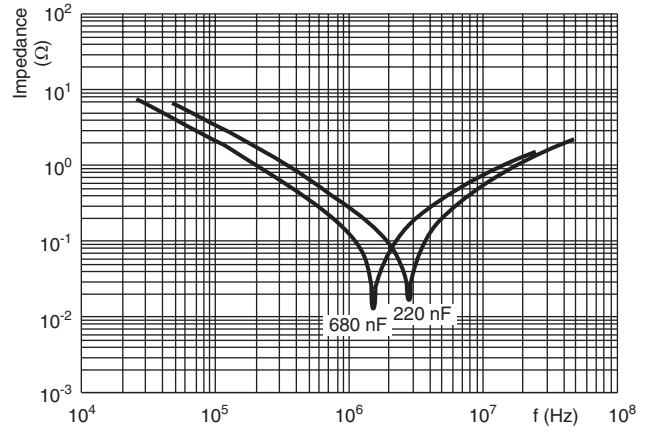
AC and Pulse Double Metallized Polypropylene Film Capacitors MMKP Radial Potted Type Vishay BCcomponents

CHARACTERISTICS

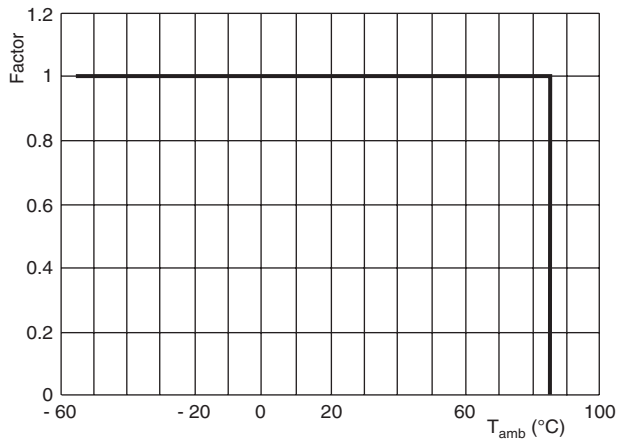
Capacitance as a function of ambient temperature (typical curve)



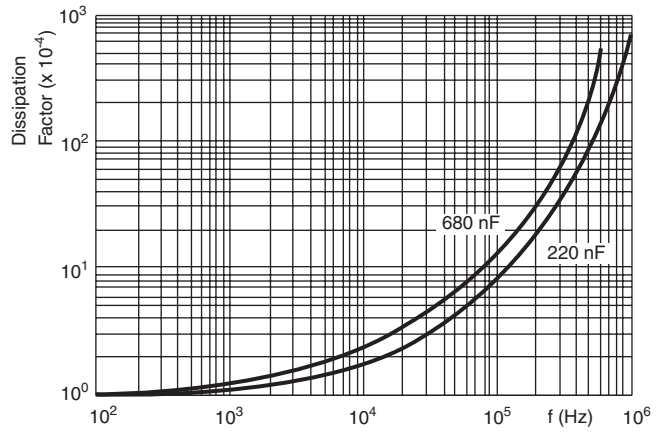
Impedance as a function of frequency (typical curve)



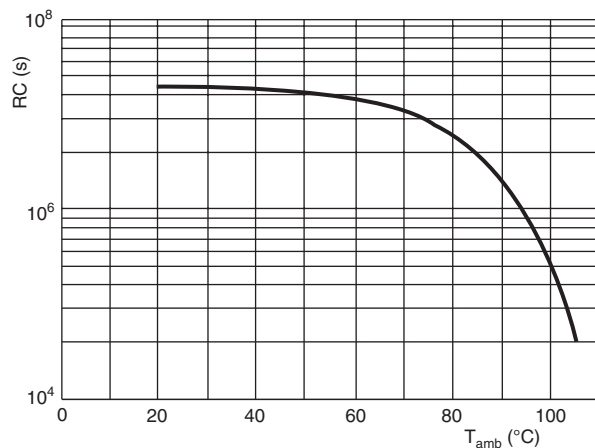
Max. DC and AC voltage as function of temperature



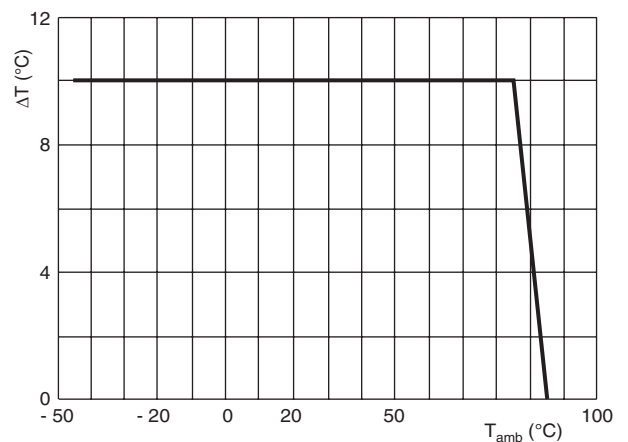
Tangent of loss angle as a function of frequency (typical curve)



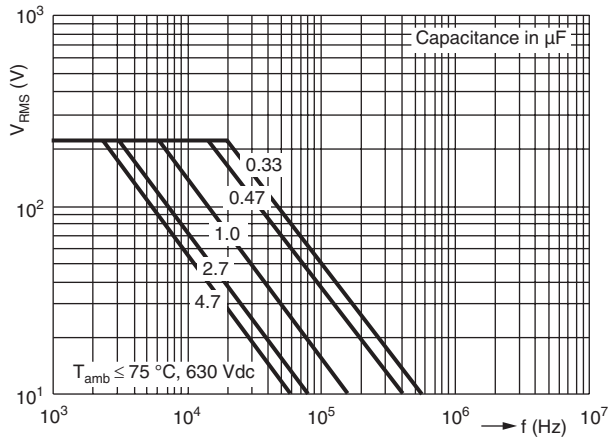
Insulation resistance as a function of ambient temperature (typical curve)



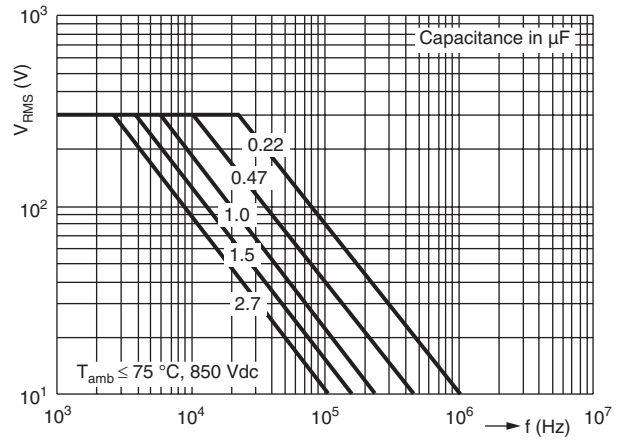
Max. allowed component temperature as a function of ambient temperature



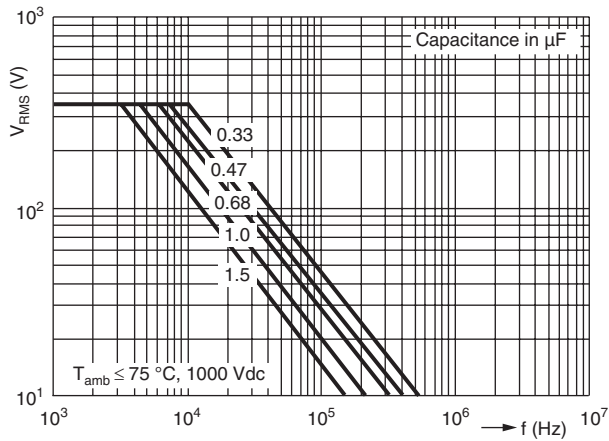
Max. AC voltage as a function of frequency



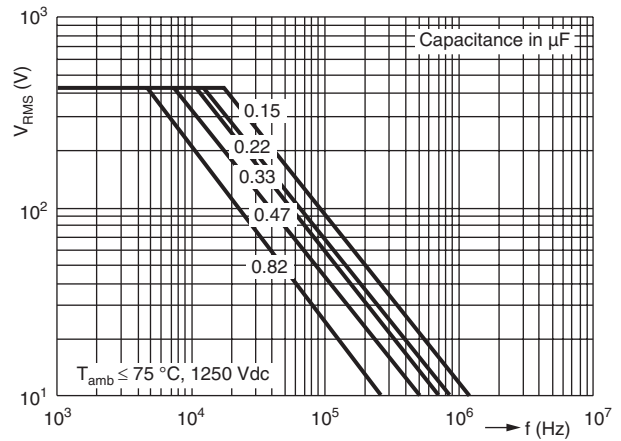
Max. AC voltage as a function of frequency



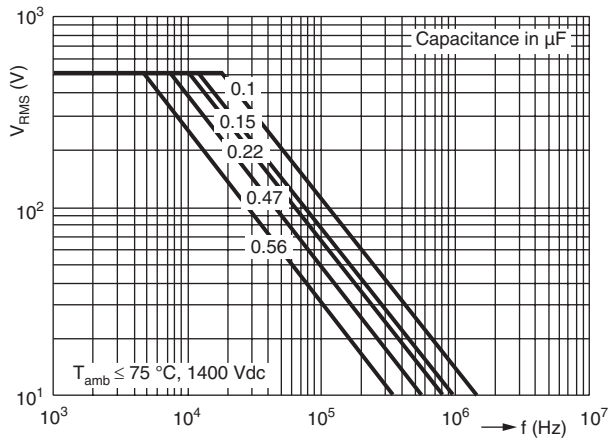
Max. AC voltage as a function of frequency



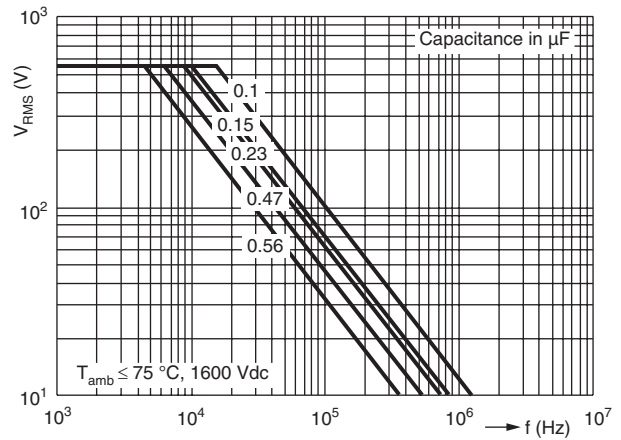
Max. AC voltage as a function of frequency



Max. AC voltage as a function of frequency

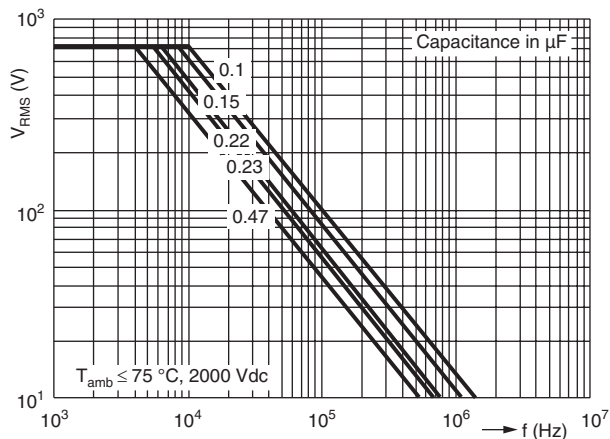


Max. AC voltage as a function of frequency

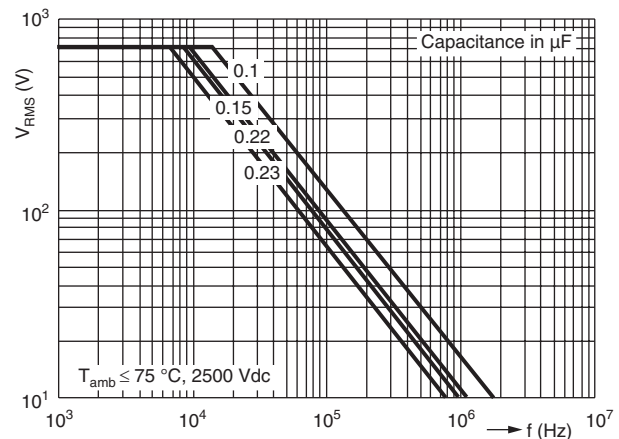


AC and Pulse Double Metallized Polypropylene Film Capacitors MMKP Radial Potted Type

Max. AC voltage as a function of frequency



Max. AC voltage as a function of frequency



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

W _{max.} (mm)	HEAT CONDUCTIVITY (mW/°C)	
	BOX LENGTH 33.5 mm	BOX LENGTH 44.0 mm
22.0	75	100
30.0	-	140

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.

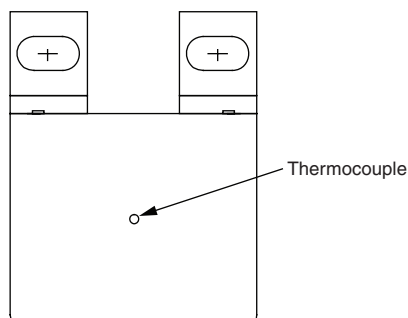
The power dissipation can be calculated according type detail specification "HQN-384-0/101: Technical Information Film Capacitors".

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.

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.

The rated voltage pulse slope is valid for ambient temperatures up to 85 °C.

4. The maximum component surface temperature rise must be lower than the limits (see figure).
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"

Voltage Conditions

ALLOWED VOLTAGES	$T_{amb} \leq 85 \text{ }^\circ\text{C}$
Maximum continuous RMS voltage	U_{Rac}
Maximum temperature RMS-overvoltage (< 24 h)	$1.25 \times U_{Rac}$
Maximum peak voltage (V_{O-P}) (< 2 s)	$1.6 \times U_{Rdc}$

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 chapters "General Data" of this specification
4.3.1 Initial measurements	Capacitance Tangent of loss angle at 100 kHz	
4.14 Component solvent resistance	Isopropylalcohol at room temperature Method: 2 Immersion time: 5 ± 0.5 min Recovery time: Min. 1 h, max. 2 h	
4.4.2 Final measurements	Visual examination Capacitance Tangent of loss angle	No visible damage Legible marking $ \Delta C/C \leq 1 \%$ of the value measured initially Increase of $\tan \delta$ ≤ 0.001 for: $100 \text{ nF} < C \leq 470 \text{ nF}$ or ≤ 0.0015 for: $C > 470 \text{ nF}$ Compared to values measured in 4.3.1



AC and Pulse Double Metallized Polypropylene Vishay BCcomponents
Film Capacitors MMKP Radial Potted Type

SUB-CLAUSE NUMBER AND TEST	CONDITIONS	PERFORMANCE REQUIREMENTS
SUB-GROUP C1B OTHER PART OF SAMPLE OF SUB-GROUP C1		
4.6.1 Initial measurements	Capacitance	
4.15 Solvent resistance of the marking	Tangent of loss angle at 100 kHz Isopropylalcohol at room temperature Method: 1 Rubbing material: Cotton wool Immersion time: 5.0 ± 0.5 min	No visible damage Legible marking
4.6 Rapid change of temperature	0A = - 55 °C 0B = + 85 °C 5 cycles Duration t = 30 min	
4.7 Vibration	Visual examination Mounting: See section "Mounting" for more information 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	No visible damage
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/s ² Duration of pulse: 11 ms	
4.9.3 Final measurements	Visual examination Capacitance Tangent of loss angle Insulation resistance	No visible damage $ \Delta C/C \leq 1\%$ of the value measured in 4.6.1 Increase of tan δ ≤ 0.001 for: 100 nF < C ≤ 470 nF or ≤ 0.0015 for: C > 470 nF Compared to values measured in 4.6.1 As 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: + 85 °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 Visual examination Capacitance Tangent of loss angle Insulation resistance	No breakdown of flashover No visible damage Legible marking $ \Delta C/C \leq 2\%$ of the value measured in 4.4.2 or 4.9.3 Increase of tan δ ≤ 0.001 for: 100 nF < C ≤ 470 nF or ≤ 0.0015 for: C > 470 nF Compared to values measured in 4.3.1. or 4.6.1 $\geq 50\%$ of values specified in section "Insulation Resistance" of this specification

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	No breakdown of flashover No visible damage Legible marking $ \Delta C/C \leq 1\%$ of the value measured in 4.11.1. Increase of $\tan \delta$ ≤ 0.001 for: $100 \text{ nF} < C \leq 470 \text{ nF}$ or ≤ 0.0015 for: $C \leq 470 \text{ nF}$ Compared to values measured in 4.11.1 $\geq 50\%$ of values specified in section "Insulation Resistance" of this specification
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 Visual examination	
	Capacitance Tangent of loss angle Insulation resistance	
SUB-GROUP C3A		
4.12.1 Endurance test at 50 Hz alternating voltage	Duration: 2000 h Voltage: $1.25 \times U_{Rac}$ at 85 °C	No visible damage Legible marking $ \Delta C/C \leq 5\%$ compared to values measured in 4.12.1.1 Increase of $\tan \delta$ ≤ 0.001 for: $100 \text{ nF} < C \leq 470 \text{ nF}$ or ≤ 0.0015 for: $C > 470 \text{ nF}$ Compared to values measured in 4.12.1.1 $\geq 50\%$ of values specified in section "Insulation Resistance" of this specification
4.12.1.1 Initial measurements	Capacitance Tangent of loss angle at 100 kHz	
4.12.1.3 Final measurements	Visual examination	
	Capacitance Tangent of loss angle Insulation resistance	
SUB-GROUP C4		
4.2.6 Temperature characteristics	Capacitance	For - 55 °C to + 20 °C: $+ 1\% \leq \Delta C/C \leq 3.75\%$ or for 20 °C to 105 °C: $- 6\% \leq \Delta C/C \leq 0\%$ As specified in section "Capacitance" of this specification. As specified in section "Insulation Resistance" of this specification
Initial measurements	Capacitance at - 55 °C	
Intermediate measurements	Capacitance at 20 °C	
Final measurements	Capacitance at + 85 °C	
	Capacitance	
	Insulation resistance	
4.13 Charge and discharge	10 000 cycles Charged to U_{Rdc} Discharge resistance: $R = \frac{U_{Rdc}}{5 \times C \times (dU/dt)}$	
4.13.1 Initial measurements	Capacitance	
4.13.3 Final measurements	Tangent of loss angle at 100 kHz	
	Capacitance	
	Tangent of loss angle	
	Insulation resistance	
		$ \Delta C/C \leq 1\%$ compared to values measured in 4.13.1 Increase of $\tan \delta$ ≤ 0.001 for: $100 \text{ nF} < C \leq 470 \text{ nF}$ or ≤ 0.0015 for: $C > 470 \text{ nF}$ Compared to values measured in 4.13.1 $\geq 50\%$ of values specified in section "Insulation Resistance" of this specification



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