



**METALLIZED POLYPROPYLENE FILM  
AC AND PULSE FILM CAPACITORS  
SNUBBER MMKP 386**

Doc. No: HQN-384-17/110

Rev. : A

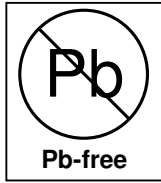
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VISHAY BCcomponents

**Snubber MMKP 386  
AC and pulse double metallized film  
capacitor**

File under TPD sheet 190, HQN-384-17/110



**AC and Pulse Double Metallized polypropylene Film Capacitors  
MMKP Radial potted Type**

**APPLICATIONS**

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

**MARKING**

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

**DIELECTRIC**

Polypropylene film

**ELECTRODES**

Double metallized film


**ENCAPSULATION**

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

**CONSTRUCTION**

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

**TABS**

Tinned coated copper 

**CAPACITANCE RANGE (E24-series)**

0.1 to 4.7  $\mu$ F

**CAPACITANCE TOLERANCE**

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

**RATED (DC) VOLTAGE**

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

**RATED (AC) VOLTAGE**

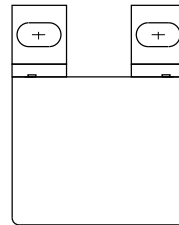
220V; 300V; 350V; 425V; 500V; 550V; 700V; 900V

**RATED PEAK-TO-PEAK VOLTAGE**

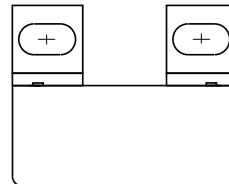
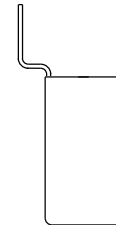
630V; 850V; 1000V; 1250V; 1400V; 1600V; 2000V; 2500V

**CLIMATIC CATEGORY**

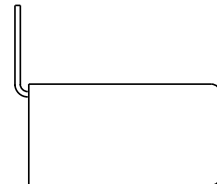
55/085/56



CBB884: horizontally mounted



CBB942: vertically mounted



**RATED (DC) TEMPERATURE**

85 °C

**RATED (AC) TEMPERATURE**

85 °C

**MAXIMUM APPLICATION TEMPERATURE**

85 °C

**REFERENCE SPECIFICATIONS**

IEC 60384-17

**PERFORMANCE GRADE**

Grade 1 (long life)

**STABILITY GRADE**

Grade 2

**FEATURES**

27.5 mm screwhole pitch.  
Low inductive construction  
Low loss dielectric  
Double sided metallization for high pulse ratings  
Supplied in tray packaging  
RoHs compliant

**DETAIL INSPECTION AND TEST REQUIREMENTS**

See Technical Product Documentation sheet 191.

**COMPOSITION OF CATALOGUE NUMBER**

TYPE AND PITCHES	
386	27.5 mm

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

**CAPACITANCE  
(numerically)**

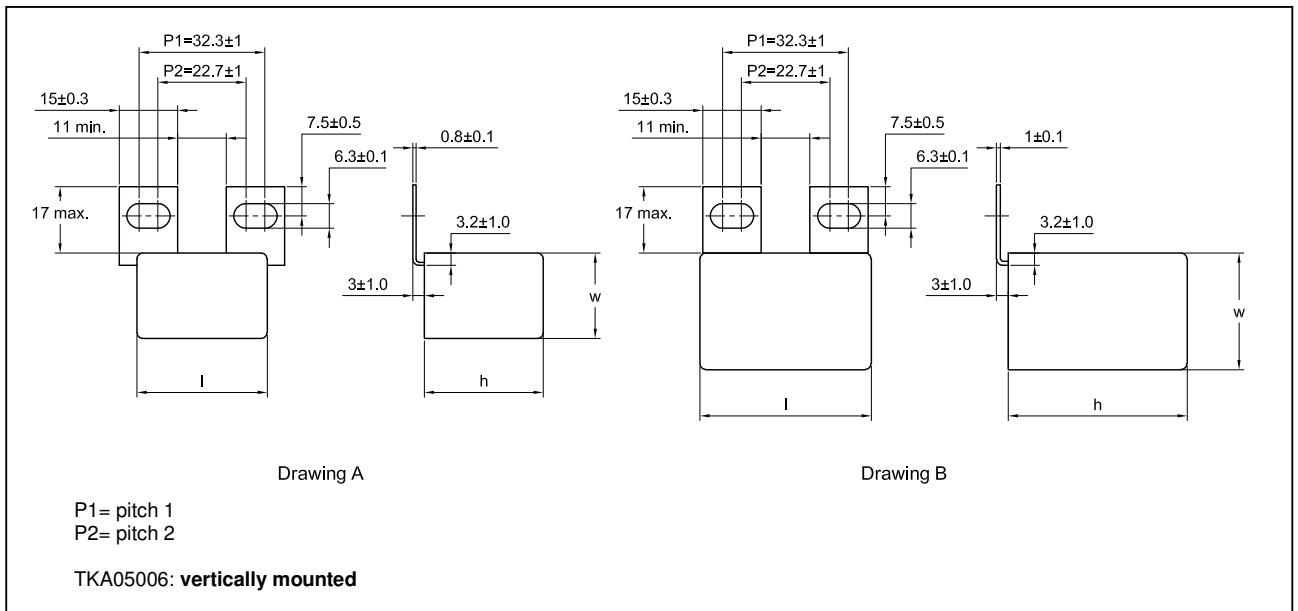
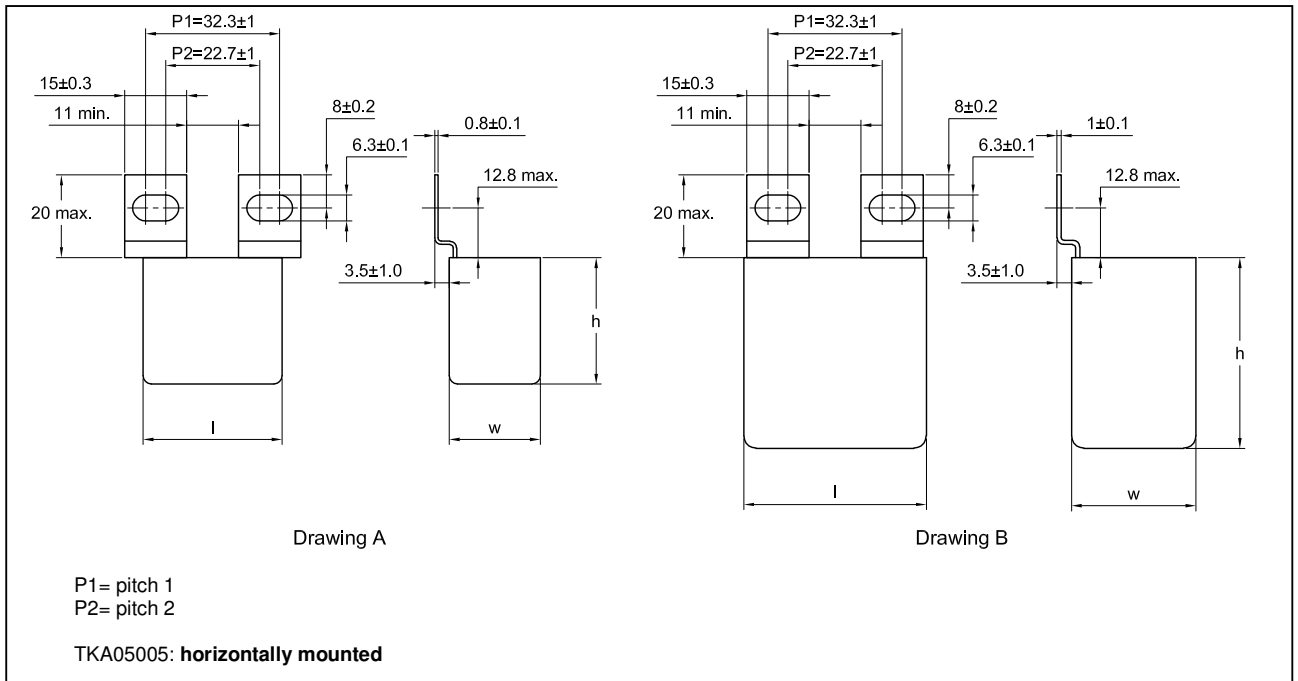
Example:  
104 = 10 x 10 = 100 nF

<b>2222</b>	<b>386</b>	<b>XX</b>	<b>XX</b>	<b>X</b>
<b>BFC2<sup>(*)</sup></b>	<b>386</b>	<b>XX</b>	<b>XX</b>	<b>X</b>

TYPE	PACKAGING	MOUNTING CONFIGURATION	C-TOL	PREFERRED TYPES							
				630V	850V	1000V	1250V	1400V	1600V	2000V	2500V
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

(\*) Use this part number for those with access to the Vishay SAP system and Partners website within the Americas

**SNUBBER**



**Electrical characteristics**

DESCRIPTION	VALUE							
	630V	850V	1000V	1250V	1400V	1600V	2000V	2500V
Capacitance range	0.33-4.7 $\mu$ F	0.22-2.7 $\mu$ F	0.33-1.8 $\mu$ F	0.15-0.82 $\mu$ F	0.1-0.68 $\mu$ F	0.1-0.56 $\mu$ F	0.1-0.47 $\mu$ F	0.1-0.27 $\mu$ F
Maximum operating d.c.voltage	630V	850V	1000V	1250V	1400V	1600V	2000V	2500V
Maximum operating a.c.voltage	220V	300V	350V	425V	500	550	700	900
Tangent of loss angle:	$\leq 0.47 \mu$ F		0.56 $\mu$ F $\leq$ C $\leq$ 1.0 $\mu$ F			C>1.0 $\mu$ F		
At 1kHz	$< 5 \times 10^{-4}$		$< 5 \times 10^{-4}$			$< 10 \times 10^{-4}$		
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 500V; 1minute	>5000 M $\Omega$							
R between terminals and case; 500V; 1minute	>30000 M $\Omega$							
Withstanding (DC)voltage (cut off current 10mA); rise time 100V/s	1000V; 1minute	1360V; 1minute	1600V; 1minute	2000V; 1minute	2240V; 1minute	2560V; 1minute	3200V; 1minute	4000V; 1minute
Withstanding (DC)voltage between terminals and case	2840V; 1minute							
Maximum dV/dt (V/ $\mu$ s)	630V	850V	1000V	1250V	1400V	1600V	2000V	2500V
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 $\Omega$							
ESL	Typical 15 nH							
Temperature range	-55 to + 85 $^{\circ}$ C							



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$U_{Rdc} = 630V$ ;  $U_{Rac} = 220V$  /  $U_{p-p} = 630V$

C ( $\mu F$ )	DIMENSIONS w x h x l (mm)	MASS (g)	CATALOGUE NUMBER AND PACKAGING	
			TRAY PACKAGING	
			C-tol = $\pm 10\%$	SPQ
			Catalogue number	
<b>Drawing A</b>				
0.33	22.0x30.5x33.5	39	2222 386 20334	56
0.39		38	2222 386 20394	
0.47		38	2222 386 20474	
0.56		37	2222 386 20564	
0.68		37	2222 386 20684	
0.82		36	2222 386 20824	
1		35	2222 386 20105	
1.2		35	2222 386 20125	
<b>Drawing B</b>				
1.5	22.0x38.0x44.0	60	2222 386 20155	42
1.8		58	2222 386 20185	
2.2		56	2222 386 20225	
2.7		54	2222 386 20275	
3.3	30.0x46.0x44.0	86	2222 386 20335	30
3.9		83	2222 386 20395	
4.7		80	2222 386 20475	

$U_{Rdc} = 850V$ ;  $U_{Rac} = 300V$  /  $U_{p-p} = 850V$


C ( $\mu F$ )	DIMENSIONS w x h x l (mm)	MASS (g)	CATALOGUE NUMBER AND PACKAGING	
			TRAY PACKAGING	
			C-tol = $\pm 10\%$	SPQ
			Catalogue number	
<b>Drawing A</b>				
0.22	22.0x30.5x33.5	39	2222 386 00224	56
0.27		39	2222 386 00274	
0.33		38	2222 386 00334	
0.39		38	2222 386 00394	
0.47		37	2222 386 00474	
0.56		37	2222 386 00564	
0.68		36	2222 386 00684	
0.82		35	2222 386 00824	
<b>Drawing B</b>				
1.0	22.0x38.0x44.0	61	2222 386 00105	42
1.2		59	2222 386 00125	
1.5		58	2222 386 00155	
1.8	30.0x46.0x44.0	91	2222 386 00185	30
2.2		88	2222 386 00225	
2.7		85	2222 386 00275	

$U_{Rdc} = 1000V; U_{Rac} = 350V / U_{p-p} = 1000V$ 

C ( $\mu F$ )	DIMENSIONS w x h x l (mm)	MASS (g)	CATALOGUE NUMBER AND PACKAGING	
			TRAY PACKAGING	
			C-tol = $\pm 10\%$	SPQ
			Catalogue number	
<b>Drawing A</b>				
0.33	22.0x30.5x33.5	36	2222 386 30334	56
0.39		35	2222 386 30394	
0.47		34	2222 386 30474	
<b>Drawing B</b>				
0.56	22.0x38.0x44.0	60	2222 386 30564	42
0.68		59	2222 386 30684	
0.82		57	2222 386 30824	
1.0		55	2222 386 30105	
1.2	30.0x46.0x44.0	88	2222 386 30125	30
1.5		84	2222 386 30155	
1.8		80	2222 386 30185	

 $U_{Rdc} = 1250V; U_{Rac} = 425V / U_{p-p} = 1250V$ 

C ( $\mu F$ )	DIMENSIONS w x h x l (mm)	MASS (g)	CATALOGUE NUMBER AND PACKAGING	
			TRAY PACKAGING	
			C-tol = $\pm 10\%$	SPQ
			Catalogue number	
<b>Drawing A</b>				
0.15	22.0x30.5x33.5	37	2222 386 80154	56
0.18		35	2222 386 80184	
0.22		34	2222 386 80224	
0.27		33	2222 386 80274	
<b>Drawing B</b>				
0.33	22.0x38.0x44.0	59	2222 386 80334	42
0.39		58	2222 386 80394	
0.47		57	2222 386 80474	
0.56	30.0x46.0x44.0	89	2222 386 80564	30
0.68		85	2222 386 80684	
0.82		82	2222 386 80824	

 <b>VISHAY</b> BCcomponents Film Capacitors	<b>METALLIZED POLYPROPYLENE FILM AC AND PULSE FILM CAPACITORS SNUBBER MMKP 386</b>	Doc. No: HQN-384-17/110
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$U_{Rdc} = 1400V$ ;  $U_{Rac} = 500V$  /  $U_{p-p} = 1400V$

C ( $\mu F$ )	DIMENSIONS w x h x l (mm)	MASS (g)	CATALOGUE NUMBER AND PACKAGING	
			TRAY PACKAGING	
			C-tol = $\pm 10\%$	SPQ
			Catalogue number	
<b>Drawing A</b>				
0.1	22.0x30.5x33.5	37	2222 386 40104	56
0.12		36	2222 386 40124	
0.15		35	2222 386 40154	
<b>Drawing B</b>				
0.18	22.0x38.0x44.0	61	2222 386 40184	42
0.22		59	2222 386 40224	
0.27		57	2222 386 40274	
0.33		56	2222 386 40334	
0.39	30.0x46.0x44.0	89	2222 386 40394	30
0.47		85	2222 386 40474	
0.56		82	2222 386 40564	
0.68		79	2222 386 40684	

$U_{Rdc} = 1600V$ ;  $U_{Rac} = 550V$  /  $U_{p-p} = 1600V$

C ( $\mu F$ )	DIMENSIONS w x h x l (mm)	MASS (g)	CATALOGUE NUMBER AND PACKAGING	
			TRAY PACKAGING	
			C-tol = $\pm 10\%$	SPQ
			Catalogue number	
<b>Drawing A</b>				
0.1	22.0x30.5x33.5	37	2222 386 50104	56
0.12		36	2222 386 50124	
0.15		35	2222 386 50154	
<b>Drawing B</b>				
0.18	22.0x38.0x44.0	61	2222 386 50184	42
0.22		59	2222 386 50224	
0.27		58	2222 386 50274	
0.33		57	2222 386 50334	
0.39	30.0x46.0x44.0	90	2222 386 50394	30
0.47		87	2222 386 50474	
0.56		84	2222 386 50564	





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$U_{Rdc} = 2000V$ ;  $U_{Rac} = 700V$  /  $U_{p-p} = 2000V$

C ( $\mu F$ )	DIMENSIONS w x h x l (mm)	MASS (g)	CATALOGUE NUMBER AND PACKAGING	
			TRAY PACKAGING	
			C-tol = $\pm 10\%$	SPQ
			Catalogue number	
<b>Drawing A</b>				
0.1	22.0x30.5x33.5	36	2222 386 60104	56
0.12		35	2222 386 60124	
<b>Drawing B</b>				
0.15	22.0x38.0x44.0	61	2222 386 60154	42
0.18		59	2222 386 60184	
0.22		58	2222 386 60224	
0.27		57	2222 386 60274	
0.33	30.0x46.0x44.0	89	2222 386 60334	30
0.39		86	2222 386 60394	
0.47		84	2222 386 60474	

$U_{Rdc} = 2500V$ ;  $U_{Rac} = 700V$  /  $U_{p-p} = 2500V$

C ( $\mu F$ )	DIMENSIONS w x h x l (mm)	MASS (g)	CATALOGUE NUMBER AND PACKAGING	
			TRAY PACKAGING	
			C-tol = $\pm 10\%$	SPQ
			Catalogue number	
<b>Drawing B</b>				
0.1	22.0x38.0x44.0	60	2222 386 70104	42
0.12		59	2222 386 70124	
0.15		57	2222 386 70154	
0.18		55	2222 386 70184	
0.22	30.0x46.0x44.0	87	2222 386 70224	30
0.27		83	2222 386 70274	

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## CONSTRUCTION

### Description

- Low-inductive wound cell of double metallized polyester carrier film and polypropylene (PP) film, potted with epoxy resin in a flame retardant case
- Tinned-coated copper tabs.

### 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

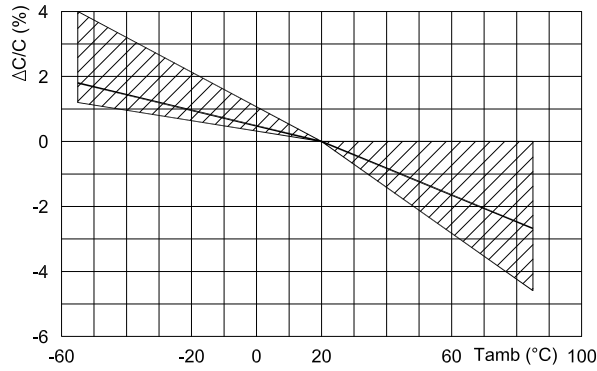
- Storage temperature: T<sub>stg</sub> = -25 to +40 °C with RH maximum 80% without condensation.

### RATINGS AND CHARACTERISTICS REFERENCE CONDITIONS

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

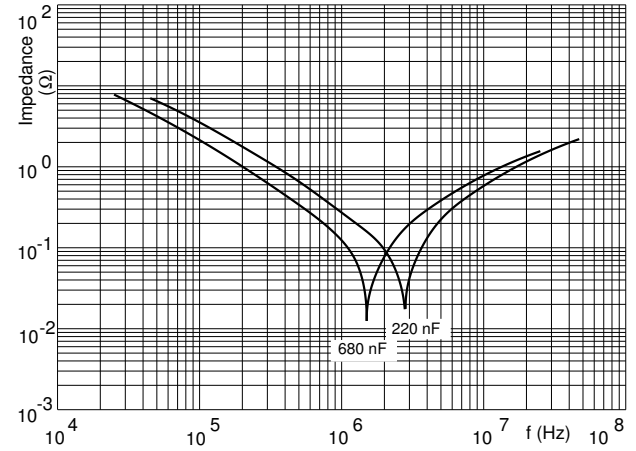
For reference testing, a conditioning period shall be applied over 96 ± 4 hours by heating the products in a circulating air oven at the rated temperature and a relative humidity not exceeding 20%.

**CHARACTERISTICS**  
**Capacitance**



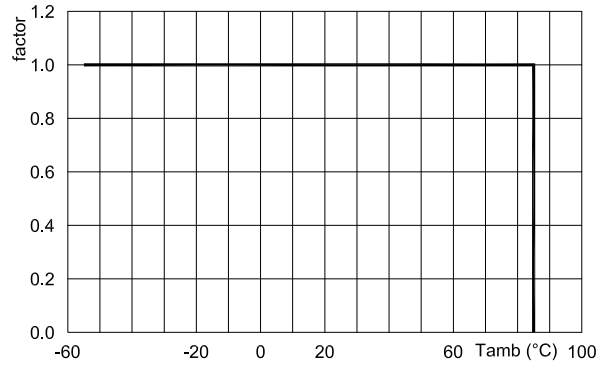
TKA05002

**Impedance**



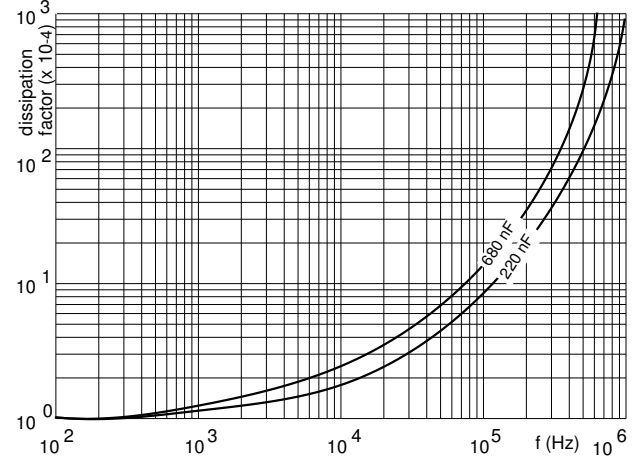
CBB898

**Max DC and AC voltage as a function of temperature**



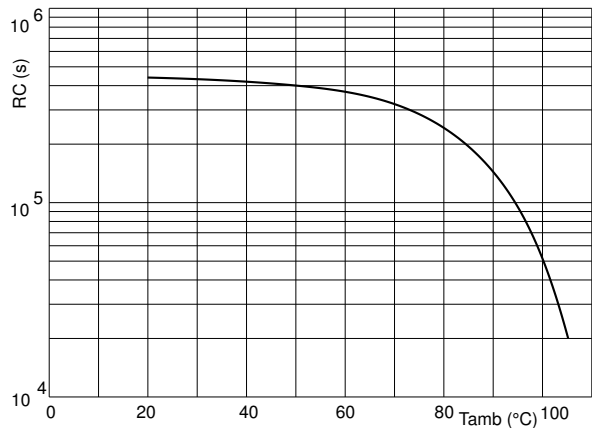
TKA05003

**Tangent of loss angle (typical value)**



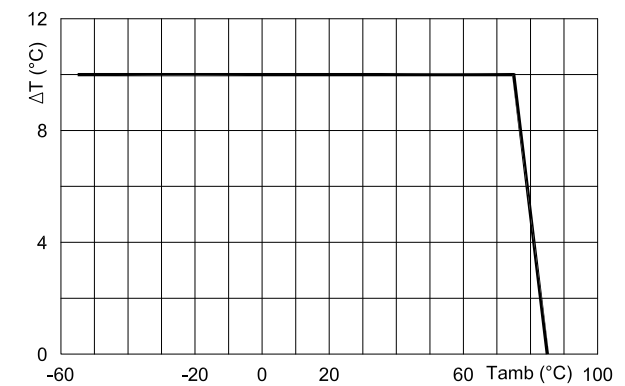
CBB900

**Insulation resistance**



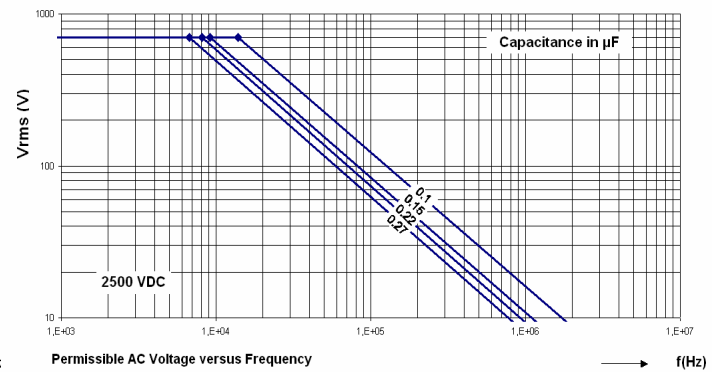
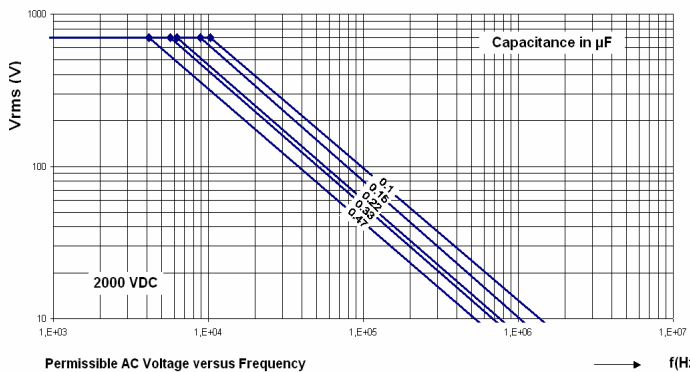
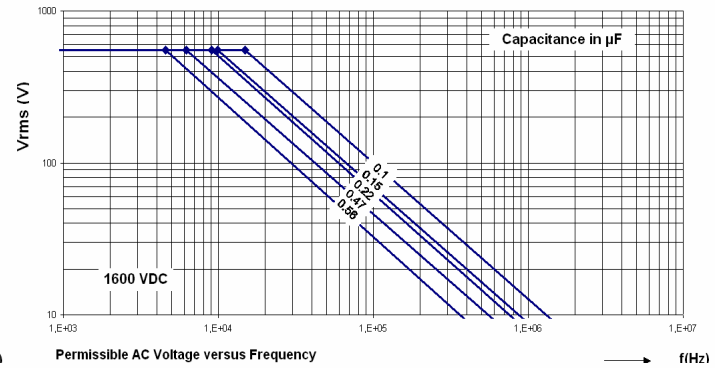
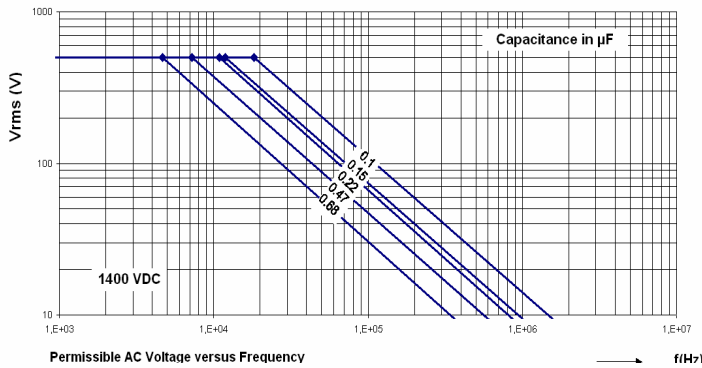
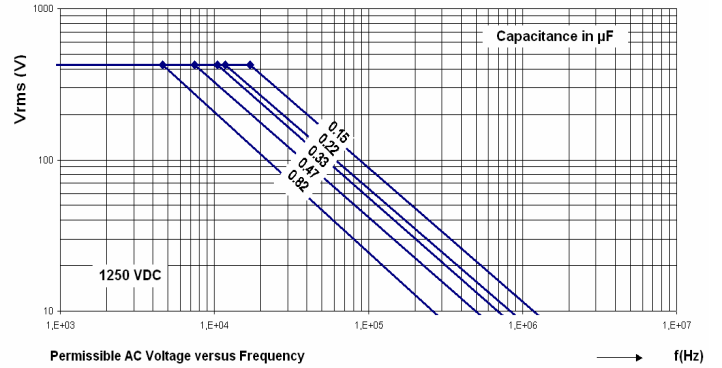
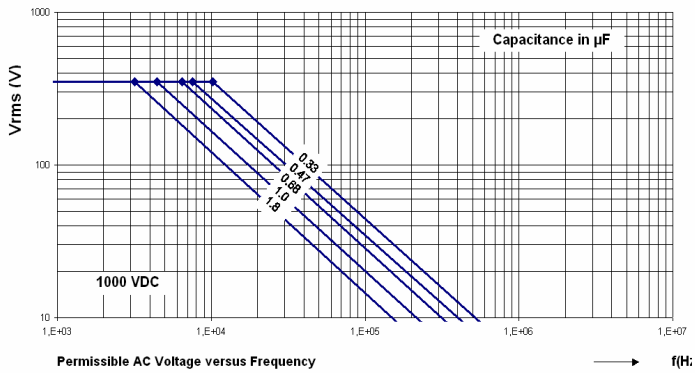
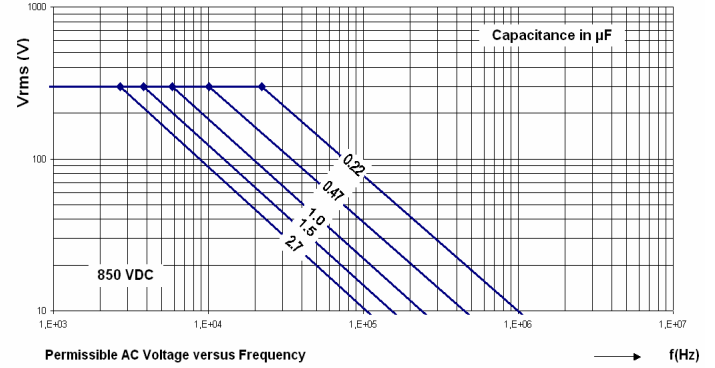
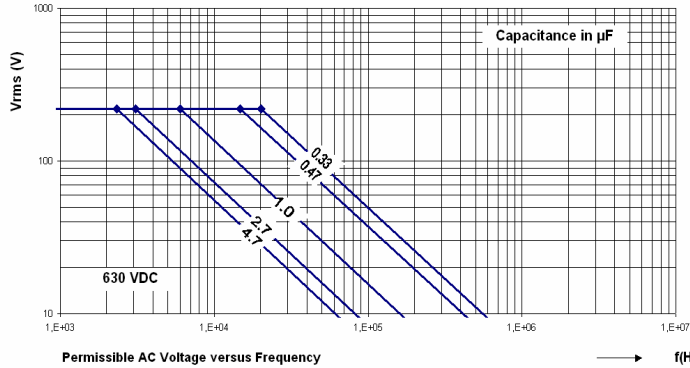
CBB895


**Max allowed component temperature rise**



TKA05004

**Max RMS voltage (sinewave) as a function of frequency for Tamb ≤ 75°C**



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**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 ambient temperature.

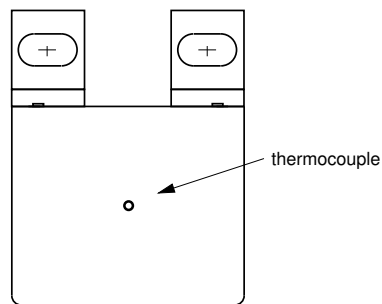
The power dissipation can be calculated according Type detail specification "HQN-384-0/101: Technical information film capacitors".

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:



CBB885

CBB885

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 peak 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 280V 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**

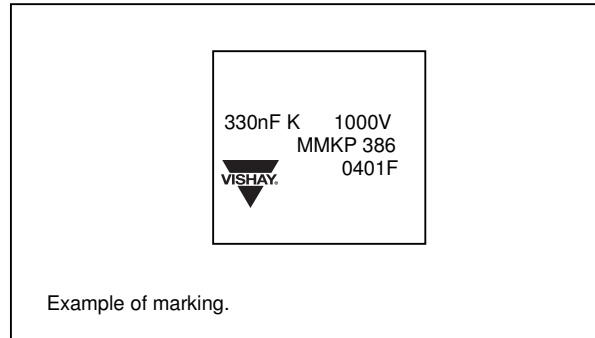
ALLOWED VOLTAGES	$T_{amb} \leq 85 \text{ }^\circ\text{C}$
Maximum continuous RMS voltage	$U_{Rac}$
Maximum temperature RMS-overvoltage (<24 hours)	$1.25 \times U_{Rac}$
Maximum peak voltage ( $V_{o-p}$ ) (<2s)	$1.6 \times U_{Rdc}$

**MARKING**

**Product marking**

The capacitors are marked by tamper printing on the side , with the following information:

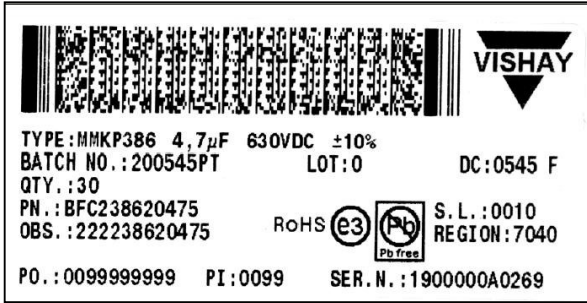
1. Rated capacitance code in accordance with "IEC 60062"
2. Tolerance on rated capacitance; J=±5%; K=±10%
3. Rated (DC) voltage (e.g.1000 V)
4. Code for dielectric material (MMKP)
5. Code for factory of origin (F)
6. Manufacturer's type designation (386)
7. Manufacturer
8. Year and week of manufacture (e.g. 0401)





**Package marking**

The package containing the capacitors is marked as shown

Barcode label marking	
LINE	MARKING EXPLANATION
1	Manufacturer's logo
2	Product type description, capacitance value, voltage and tolerance
3	Batch number, lot number, year and week code
4	Quantity
5	Product system code
6	Product code number
7	Region

TYPE:MMKP386 4,7 $\mu$ F 630VDC  $\pm$ 10%  
 BATCH NO.:200545PT LOT:0 DC:0545 F  
 QTY.:30  
 PN.:BFC238620475 S.L.:0010  
 OBS.:222238620475 RoHS   REGION:7040  
 PO.:0099999999 PI:0099 SER.N.:1900000A0269

LB050040

**QUICK REFERENCE TEST REQUIREMENTS**

TEST	PROCEDURE (quick reference)	REQUIREMENTS
<b>Robustness of terminations</b>		
Component solvent resistance	Isopropyl alcohol; 23 °C; 5 minutes	
<b>Robustness of component</b>		
Vibration: "IEC 60068-2-6"	10 to 55 Hz; amplitude 0.75 mm or acceleration 98 m/s <sup>2</sup> ; 6 hours	$\Delta C/C$   ≤ 1 % $\Delta \tan \delta \leq 10 \times 10^{-4}$ (C ≤ 470 nF) $\Delta \tan \delta \leq 15 \times 10^{-4}$ (C > 470 nF)
Shock: "IEC 60068-2-27"	Half sinewave; 490 m/s <sup>2</sup> ; 11 ms	
<b>Climatic sequence</b>		
Dry heat: "IEC 60068-2-2"	16 hours; 85 °C	$\Delta C/C$   ≤ 2 %  $\Delta \tan \delta \leq 10 \times 10^{-4}$ (C ≤ 470 nF) $\Delta \tan \delta \leq 15 \times 10^{-4}$ (C > 470 nF)
Damp heat, cyclic, test Db, first cycle, "IEC 60068-2-30"		
Cold: "IEC 60068-2-1"	2 hours; -55 °C	$R_{ins} \geq 50\%$ of specified value
Damp heat, cyclic, test Db, Remaining cycles: "IEC 60068-2-30"		
<b>Other applicable tests</b>		
Damp heat, steady state: "IEC 60068-2-3"	56 days; 40 °C; 90 to 95 % RH	$\Delta C/C$   ≤ 1 % $\Delta \tan \delta \leq 10 \times 10^{-4}$ (C ≤ 470 nF) $\Delta \tan \delta \leq 15 \times 10^{-4}$ (C > 470 nF) $R_{ins} \geq 50\%$ of specified value
Endurance (AC): "IEC 60384-17"	2000 hours: 1.25 x U <sub>Rac</sub> ; (RMS) ; 50 Hz; 85 °C	$\Delta C/C$   ≤ 5 % $\Delta \tan \delta \leq 10 \times 10^{-4}$ (C ≤ 470 nF) $\Delta \tan \delta \leq 15 \times 10^{-4}$ (C > 470 nF) $R_{ins} \geq 50\%$ of specified value
Heat storage: "IEC 60384-17"	2000 hours; 85 °C	$\Delta C/C$   ≤ 1 % $\Delta \tan \delta \leq 10 \times 10^{-4}$ (C ≤ 470 nF) $\Delta \tan \delta \leq 15 \times 10^{-4}$ (C > 470 nF)
Passive flammability: "IEC 60384-1"	Class B	No burning
Endurance (DC): "IEC 60384-17"	2000 hours; 1.25 x U <sub>Rdc</sub> ; ; 85 °C	$\Delta C/C$   ≤ 2 % $\Delta \tan \delta \leq 10 \times 10^{-4}$ (C ≤ 470 nF) $\Delta \tan \delta \leq 15 \times 10^{-4}$ (C > 470 nF) $R_{ins} \geq 50\%$ of specified value



