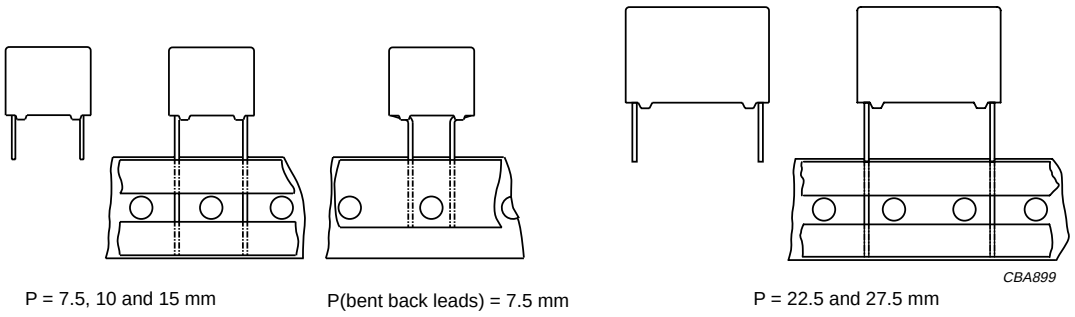
Interference suppression film capacitors MKP 338 2

MKP RADIAL POTTED TYPE

PITCH 7.5/10/15/22.5/27.5 mm
PITCH 7.5 mm (bent back leads)



P = 7.5, 10 and 15 mm

P(bent back leads) = 7.5 mm

P = 22.5 and 27.5 mm

Fig.1 Simplified outlines.

FEATURES

- 7.5 to 27.5 mm lead pitch
- Supplied loose in box, taped on ammopack or reel
- Consists of a low-inductive wound cell of metallized polypropylene film, potted in a flame-retardant case.

APPLICATIONS

- For X2 electromagnetic interference suppression
- Specially designed to meet the REQUIREMENTS of the *"IEC 60384-14 2nd edition and EN 132400"*, requiring for X2 a 2.5 kV peak pulse voltage test and both UL1414 and CSA-C22.2 No 1 specifications.

DETAIL SPECIFICATION

For more detailed data and test requirements see *"Type detail specification HQN-384-14/111"*.

QUICK REFERENCE DATA

DESCRIPTION	VALUE
Capacitance range (E12 series)	1 nF to 3.3 μF
Capacitance tolerance	±20%; ±10%; ±5%
Rated (AC) voltage, 50 to 60 Hz	275 V
Rated (DC) voltage	630 V
Climatic category	55/105/56/B
Rated temperature	105 °C
Maximum application temperature	105 °C
Reference specifications	IEC 60384-14 2nd edition and EN 132400
Safety approvals: 250 V 275 V	 CSA-C22.2 No 1; UL1414; note 1 UL1283; CSA-C22.2 No 8; CCEE; note 2 SEV; VDE; FI; N; D; S; IMQ; ÖVE; note 1
Materials	qualified in accordance with UL94V-O
Safety class	X2

Notes

1. Approved.
2. Pending.

SAFETY APPROVALS

SAFETY APPROVALS (X2)		VOLTAGE	VALUE	FILE NUMBERS
	UL1414	250 V (AC)	1 nF to 1 µF	E112471
	UL1283	275 V (AC)	1 nF to 3.3 µF	pending
	CSA-C22.2 No.1-M90	250 V (AC)	1 nF to 1 µF	LR94054
	CSA-C22.2 No.8-M90	275 V (AC)	1 nF to 3.3 µF	pending
	SEV (EN132400)	275 V (AC)	1 nF to 3.3 µF	98.7 70718.01
	VDE (EN132400)	275 V (AC)	1 nF to 3.3 µF	115223
	FI (EN132400)	275 V (AC)	1 nF to 3.3 µF	FI 11681
	NEMKO (EN132400)	275 V (AC)	1 nF to 3.3 µF	P98102295
	DEMKO (EN132400)	275 V (AC)	1 nF to 3.3 µF	308077
	SEMKO (EN132400)	275 V (AC)	1 nF to 3.3 µF	9839136/02
	IMQ (EN132400)	275 V (AC)	1 nF to 3.3 µF	V4693
	ÖVE (EN132400)	275 V (AC)	1 nF to 3.3 µF	E260-009-00
	CCEE	275 V (AC)	1 nF to 3.3 µF	pending

COMPOSITION OF CATALOGUE NUMBER

TYPE AND PITCHES	
338 2 X2	7.5 mm
	7.5 mm (bent back)
	10.0 mm
	15.0 mm
	22.5 mm
	27.5 mm

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

CAPACITANCE (numerically)

Example:
104 = 10 × 10 = 100 nF

2222	338	2X	XX	X

TYPE	PACKAGING(1)	STANDARD DIMENSIONS		PREFERRED TYPES	
338 2 X2	loose in box	lead length 3.5 mm	±20%	0	see handbook
		lead length 5.0 mm		2	
		lead length 25.0 mm		4	
	taped	pitch = 7.5 mm or bent back to 7.5 mm		6	
		ALTERNATIVE LARGER PITCH SIZES		**ON REQUEST**	
338 2 X2	loose in box	lead length 3.5 mm	±20%	1	see data sheet
		lead length 5.0 mm		3	
		lead length 25.0 mm		5	
	taped	H = 18.5 mm; for P_0 = 12.7 mm; note 2		7	
		ALTERNATIVE C-TOL		**ON REQUEST**	
338 2 X2	loose in box	lead length 3.5 mm	±10%	2222 338 2....	see type detail specification
			±5%	2222 338 2....	
		lead length 5.0 mm	±10%	2222 338 2....	
			±5%	2222 338 2....	
		lead length 25.0 mm	±10%	2222 338 2....	
			±5%	2222 338 2....	
	taped	pitch = 7.5 mm or bent back to 7.5 mm	±10%	2222 338 2....	
			±5%	2222 338 2....	
		H = 18.5 mm; for P_0 = 12.7 mm; note 2	±10%	2222 338 2....	
			±5%	2222 338 2....	

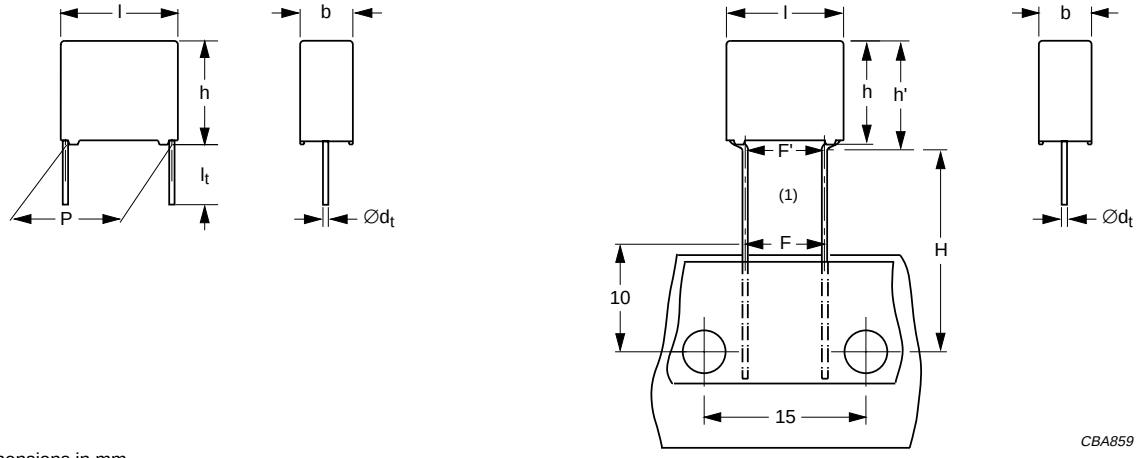
Notes

1. For SPQ refer to this handbook, chapter *"Packaging information"*; taped on reel pitch = 27.5 mm is not available.
2. H = in-tape height; for detailed specifications refer to this handbook, chapter *"Packaging information"*.

Interference suppression film capacitors MKP 338 2

MKP 338 2 GENERAL DATA

PITCH 7.5/10 mm
PITCH 7.5 mm (bent back leads)



Dimensions in mm.

(1) $|F - F'| < 0.3$ m.
$F = 7.5\ ^{+0.6}_{-0.1}$ mm.

Fig.3 Outline.

Specific reference data for the 275 V AC (X2) capacitors

DESCRIPTION	VALUE		
	at 1 kHz	**at 10 kHz**	**at 100 kHz**
Tangent of loss angle: C ≤ 100 nF	$\leq 10 \times 10^{-4}$	$\leq 20 \times 10^{-4}$	$\leq 100 \times 10^{-4}$
Rated voltage pulse slope (dU/dt)R at 385 V (DC)	100 V/μs		
R between leads, for C ≤ 0.33 μF at 100 V; 1 minute	>15000 MΩ		
R between leads and case; 100 V; 1 minute	>30000 MΩ		
Withstanding (DC) voltage (cut off current 10 mA); rise time 100 V/s	2200 V; 1 minute		
Withstanding (AC) voltage between leads and case	2050 V; 1 minute		

U_{Rac} = 275 V (X2); U_{Rdc} = 630 V

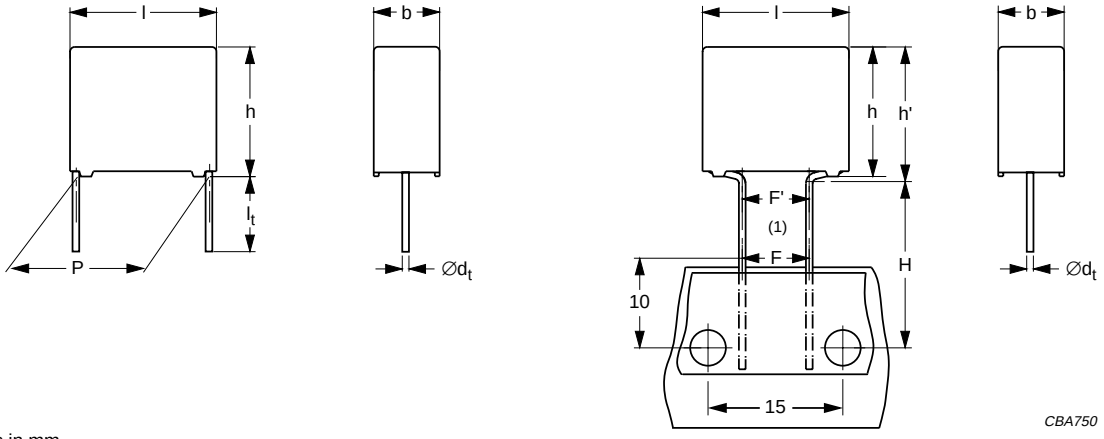
C (µF)	DIMENSIONS(1) b × h (h') × l (mm)	MASS (g)	CATALOGUE NUMBER			
			LOOSE IN BOX			AMMOPACK OR REEL(2)
			short leads		long leads	
			l_t = 3.5 +1/–0.5 mm	l_t = 5.0 ±1.0 mm	l_t = 25.0 ±2.0 mm	
			C-tol = ±20%			C-tol = ±20%
			catalogue number(3)	last 5 digits(3)		last 5 digits(3)
Pitch = 7.5 ±0.4 mm; d_t = 0.50 ±0.05 mm						**ammopack; pitch = 7.5 mm; d_t = 0.50 mm**
0.001	4.0 × 9.0 × 10.0	0.5	2222 338 20**102**	.. 22**102**	.. 24**102**	.. 26**102**
0.0015			2222 338 20**152**	.. 22**152**	.. 24**152**	.. 26**152**
0.0022			2222 338 20**222**	.. 22**222**	.. 24**222**	.. 26**222**
0.0033			2222 338 20**332**	.. 22**332**	.. 24**332**	.. 26**332**
0.0047			2222 338 20**472**	.. 22**472**	.. 24**472**	.. 26**472**
0.0068			2222 338 20**682**	.. 22**682**	.. 24**682**	.. 26**682**
0.01			2222 338 20**103**	.. 22**103**	.. 24**103**	.. 26**103**
0.015			2222 338 20**153**	.. 22**153**	.. 24**153**	.. 26**153**
0.022			2222 338 20**223**	.. 22**223**	.. 24**223**	.. 26**223**
0.033	5.0 × 10.5 × 10.0	0.9	2222 338 20**333**	.. 22**333**	.. 24**333**	.. 26**333**
0.047	6.0 × 11.5 × 10.0	1.0	2222 338 20**473**	.. 22**473**	.. 24**473**	.. 26**473**
Pitch = 10.0 ±0.4 mm; d_t = 0.60 ±0.06 mm						**reel; pitch = 7.5 mm (bent back); d_t = 0.60 mm**
0.068	6.0 × 12.0 (14.0) × 12.5	1.3	2222 338 20**683**	.. 22**683**	.. 24**683**	.. 26**683**
0.1			2222 338 20**104**	.. 22**104**	.. 24**104**	.. 26**104**

Notes

1. Dimensions in brackets for bent back leads.
2. H = in-tape height; P_0 = sprocket hole distance; for detailed specifications refer to this handbook, chapter *"Packaging information"*:
   a) For pitch = 7.5 mm: H = 18.5 mm and P_0 = 12.7 mm.
   b) For pitch = 7.5 mm (bent back): H = 16.0 mm and P_0 = 15.0 mm.
   The reel diameter = 500 mm; reel diameter = 356 mm is available on request.
3. The shading indicates preferred types.

MKP 338 2 GENERAL DATA

PITCH 15/22.5/27.5 mm
PITCH 7.5 mm (bent back leads)



Dimensions in mm.

(1) $|F - F'| < 0.3$ m.
F = 7.5 +0.6/–0.1 mm.

Fig.4 Outline.

Specific reference data for the 275 V AC (X2) capacitors

DESCRIPTION	VALUE		
	at 1 kHz	at 10 kHz	at 100 kHz
Tangent of loss angle:			
100 nF < C ≤ 470 nF	$\leq 10 \times 10^{-4}$	$\leq 20 \times 10^{-4}$	$\leq 100 \times 10^{-4}$
470 nF < C ≤ 1 µF	$\leq 20 \times 10^{-4}$	$\leq 70 \times 10^{-4}$	–
C > 1 µF	$\leq 30 \times 10^{-4}$	–	–
Rated voltage pulse slope (dU/dt)R at 385 V (DC)	100 V/µs		
R between leads, for C ≤ 0.33 µF at 100 V; 1 minute	>15000 MΩ		
RC between leads, for C > 0.33 µF at 100 V; 1 minute	>5000 s		
R between leads and case; 100 V; 1 minute	>30000 MΩ		
Withstanding (DC) voltage (cut off current 10 mA); rise time 100 V/s:			
C ≤ 1 µF	2200 V; 1 minute		
C > 1 µF	1800 V; 1 minute		
Withstanding (AC) voltage between leads and case	2050 V; 1 minute		

U_{Rac} = 275 V (X2); U_{Rdc} = 630 V

C (µF)	DIMENSIONS[1] b × h (h') × l (mm)	MASS (g)	CATALOGUE NUMBER			
			LOOSE IN BOX			REEL[2][3]
			short leads		long leads	
			l_t = 3.5 ±0.3 mm	l_t = 5.0 ±1.0 mm	l_t = 25.0 ±2.0 mm	
			C-tol = ±20%			C-tol = ±20%
			catalogue number[4]	last 5 digits[4]		last 5 digits[4]
Pitch = 15.0 ±0.4 mm; d_t = 0.80 ±0.08 mm						**pitch = 7.5 mm (bent back); d_t = 0.80 mm**
0.15	7.0 × 13.5 (15.5) × 17.5	1.9	2222 338 20**154**	.. 22**154**	.. 24**154**	.. 26**154**
0.22	8.5 × 15.0 (17.0) × 17.5	2.6	2222 338 20**224**	.. 22**224**	.. 24**224**	.. 26**224**
0.33	10.0 × 16.5 (18.5) × 17.5	3.1	2222 338 20**334**	.. 22**334**	.. 24**334**	.. 26**334**
Pitch = 22.5 ±0.4 mm; d_t = 0.80 ±0.08 mm						
0.47	8.5 × 18.0 × 26.0	4.4	2222 338 20**474**	.. 22**474**	.. 24**474**	not available
0.68	10.0 × 19.5 × 26.0	5.5	2222 338 20**684**	.. 22**684**	.. 24**684**	
1	12.0 × 22.0 × 26.0	7.8	2222 338 20**105**	.. 22**105**	.. 24**105**	
Pitch = 27.5 ±0.4 mm; d_t = 0.80 ±0.08 mm						
1.5	15.0 × 25.0 × 31.0	12.8	2222 338 20**155**	.. 22**155**	.. 24**155**	not available
2.2	18.0 × 28.0 × 31.0	17.2	2222 338 20**225**	.. 22**225**	.. 24**225**	
3.3	21.0 × 31.0 × 31.0	20.4	2222 338 20**335**	.. 22**335**	.. 24**335**	

Notes

1. Dimensions in brackets for bent back leads.
2. H = in-tape height; P_0 = sprocket hole distance; for detailed specifications refer to this handbook, chapter *"Packaging information"*.
3. For pitch = 7.5 mm (bent back): H = 16.0 mm and P_0 = 15.0 mm.
   The reel diameter = 500 mm; reel diameter = 356 mm is available on request.
4. The shading indicates preferred types.

CONSTRUCTION

Description

- Low-inductive wound cell of metallized polypropylene (PP) film, potted with epoxy resin in a flame-retardant case
- Radial leads, solder-coated:
  - Copper clad steel wire for original pitch = 7.5 and 10 mm
  - Copper wire for original pitch = 15, 22.5 and 27.5 mm
- Small stand-off pips allow removal of solder flux etc. during cleaning of the printed-circuit board.

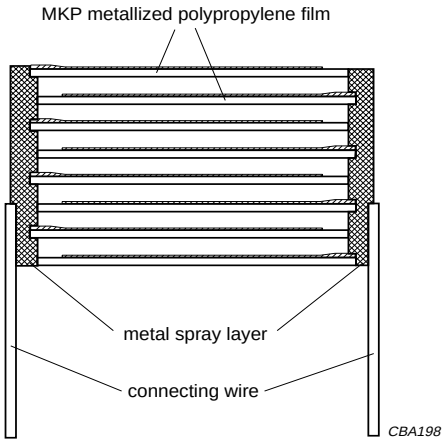


Fig.5 Construction.

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 this handbook, chapter *"Packaging information".*

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:

- For pitches ≤15 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.

SPACE REQUIREMENTS ON PRINTED-CIRCUIT BOARD

The maximum length and width of film capacitors is shown in Fig.6:

- Eccentricity as in Fig.6. 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 or $h_{max} \leq h' + 0.3$ mm.

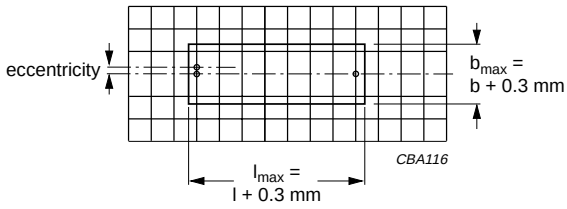


Fig.6 Lay-out.

Storage temperature

- Storage temperature: T_{stg} = –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 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

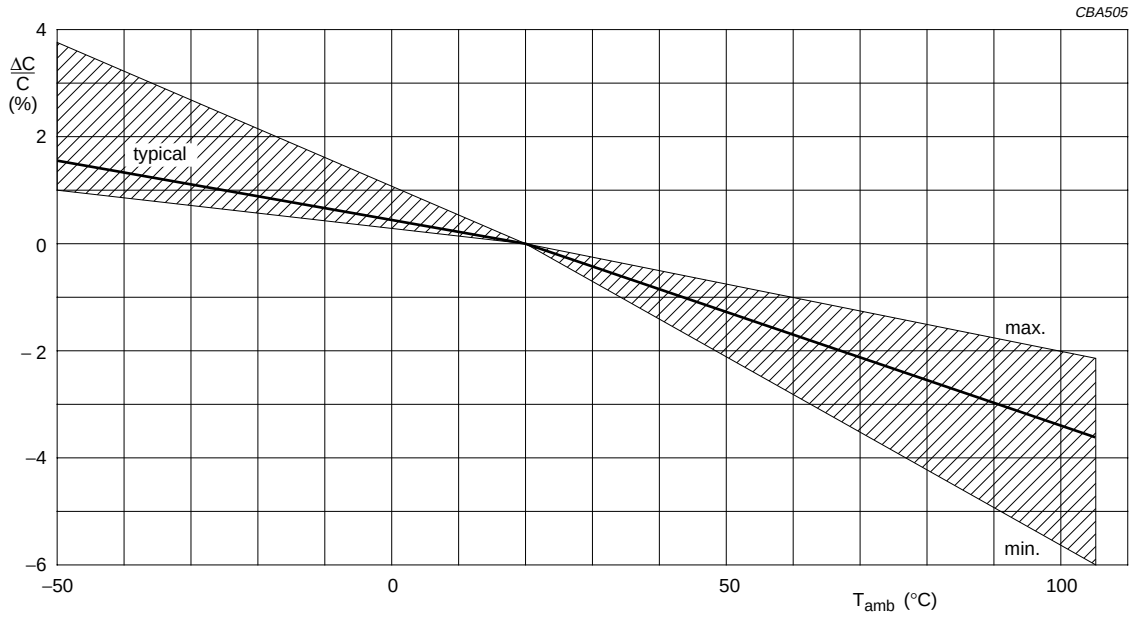


Fig.7 Capacitance change at 1 kHz as a function of temperature.

Tangent of loss angle

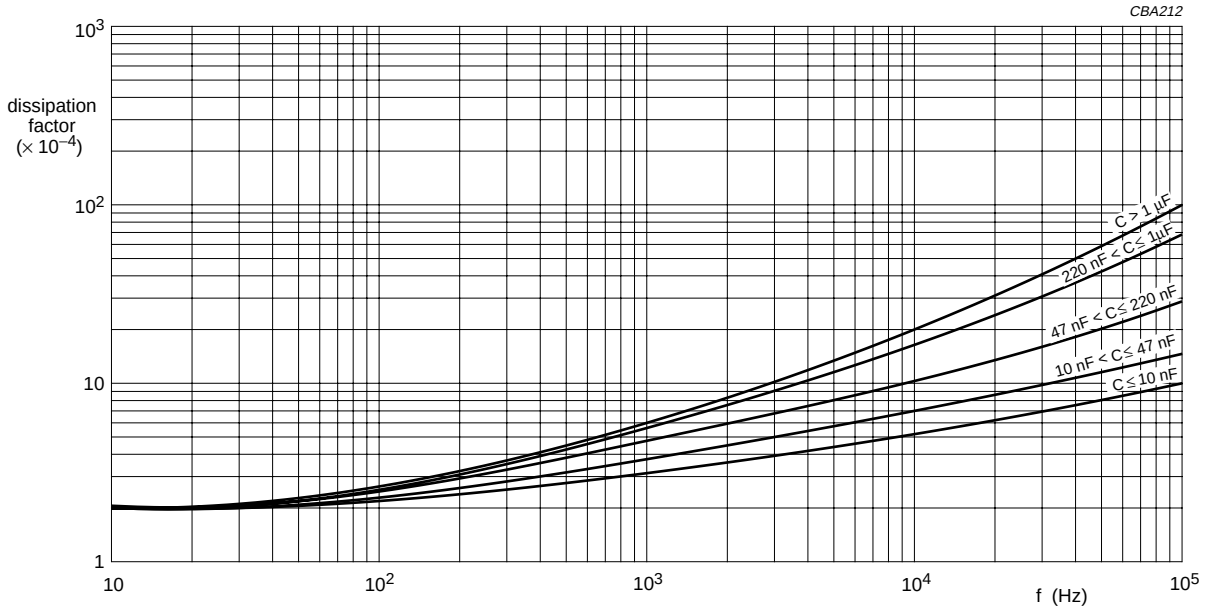


Fig.8 Tangent of loss angle as a function of frequency: typical curves.

Impedance

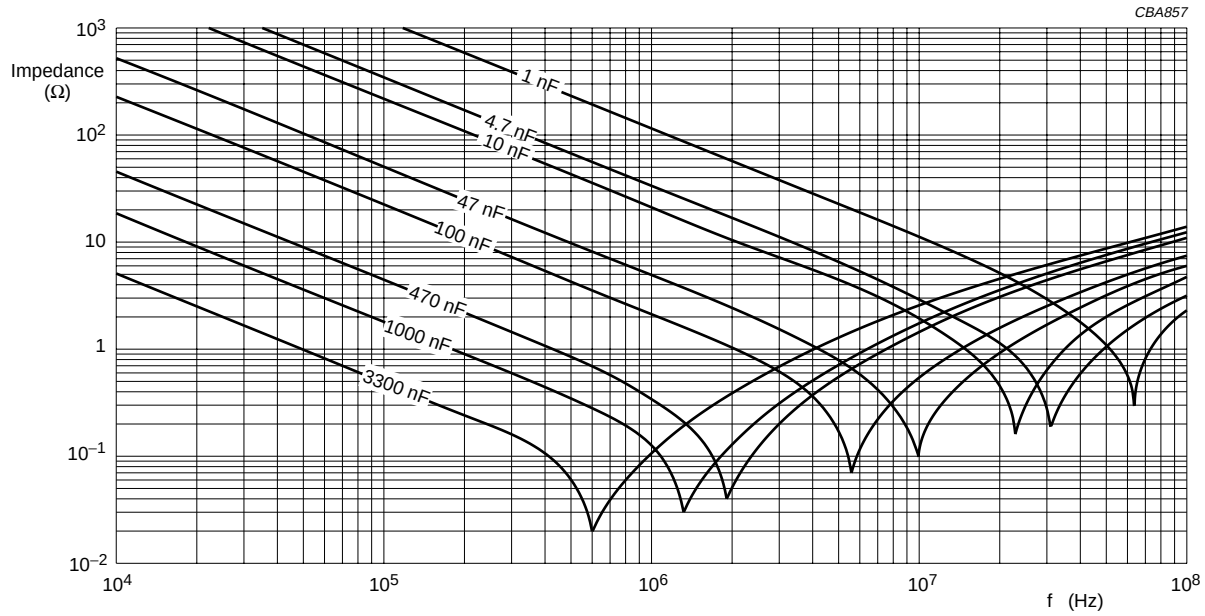


Fig.9 Impedance as a function of frequency: typical curves for 20% values.

Resonant frequency

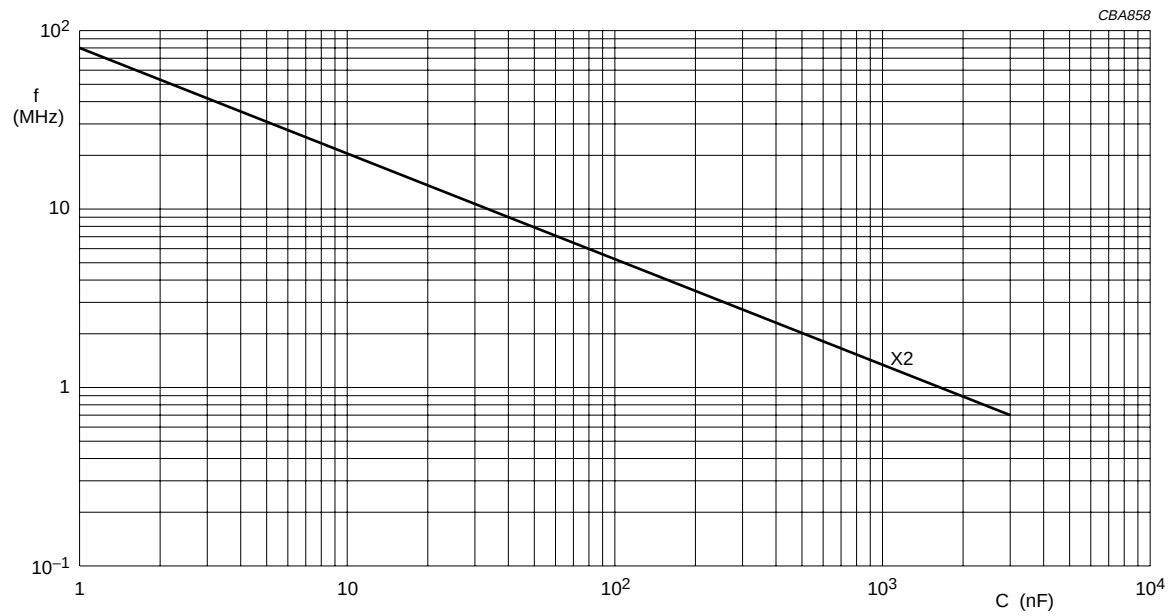


Fig.10 Resonant frequency as a function of capacitance: typical curves for 20% values.

Maximum RMS voltage and AC current (sinewave) as a function of frequency for $T_{amb} \leq 105$ °C

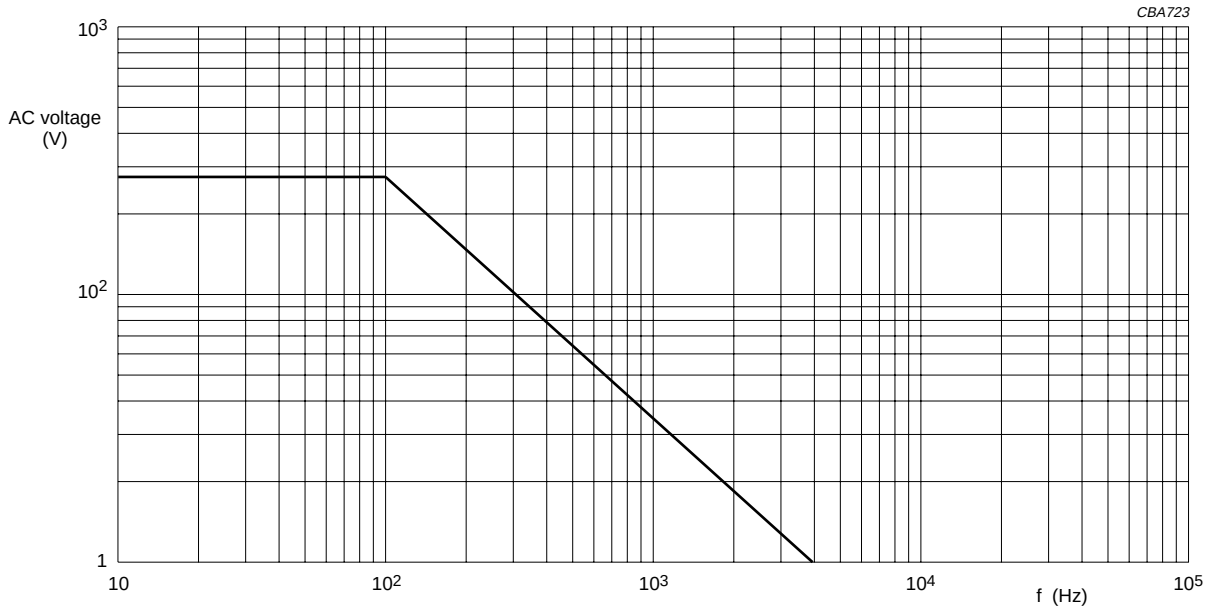


Fig.11 AC voltage (RMS value) as a function of frequency at $T_{amb} \leq 105$ °C.

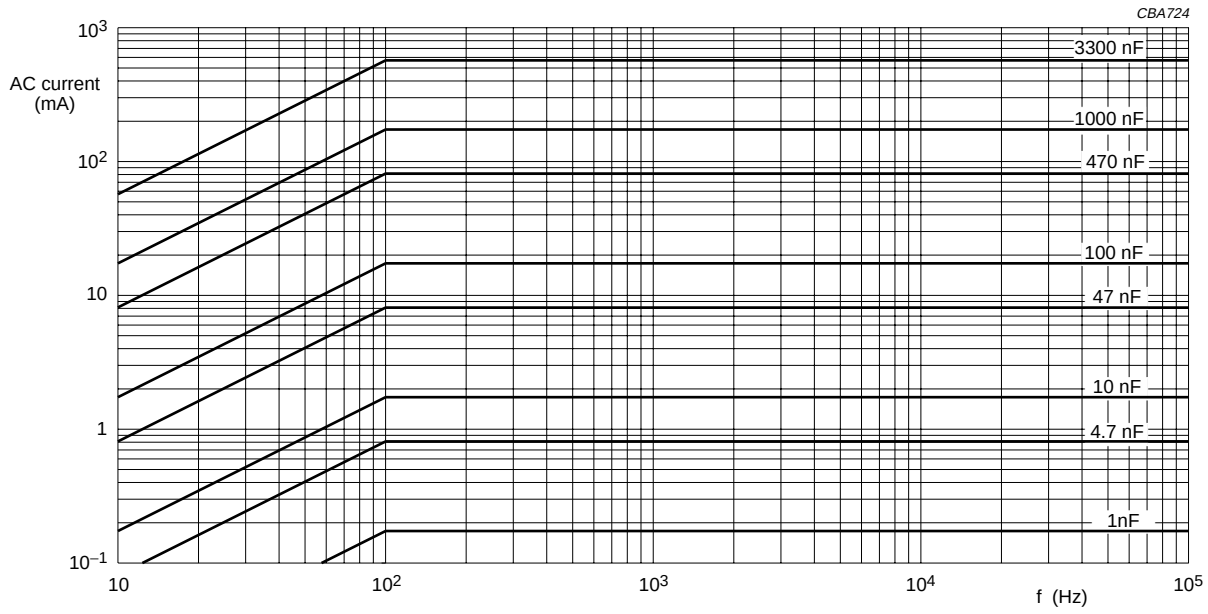


Fig.12 AC current (RMS value) as a function of frequency at $T_{amb} \leq 105$ °C.

Insulation resistance

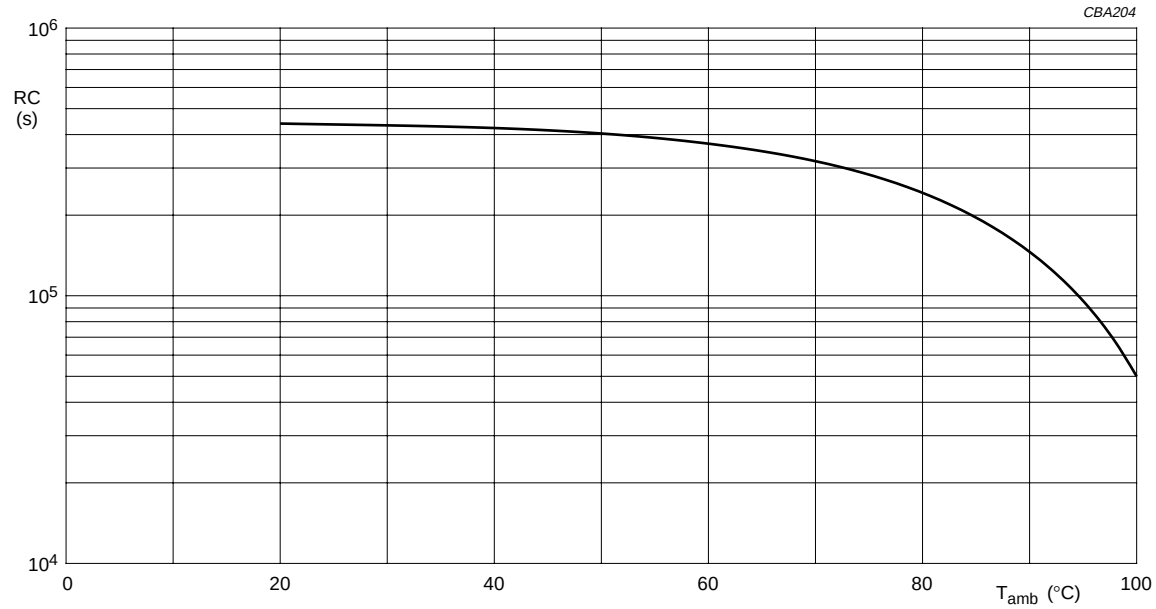


Fig.13 RC product as a function of ambient free air temperature: typical curve.

APPLICATION NOTES

- For X2 electromagnetic interference suppression in across the line applications (50 to 60 Hz) with a maximum mains voltage of 275 V (AC).
- These capacitors are not intended for continuous pulse applications. For these situations, capacitors of the AC and pulse program must be used, such as: 2222 375 .....; 2222 383 ..... or 2222 479 .....
- The maximum ambient temperature must not exceed 105 °C.
- Rated voltage pulse slope:
  - If the pulse voltage is lower than the rated voltage, the values of the specific reference data can be multiplied by 385 V (DC) and divided by the applied voltage.

MARKING

Product marking

The capacitors are marked by laser print (see Figs 14 to 16) with the following information:

1. Rated capacitance code in accordance with "*IEC 60062"*
2. Tolerance on rated capacitance; M = ±20%; K = ±10%; J = ±5%
3. Rated (AC) voltage (e.g. 275 V)
4. Sub-class (e.g. X2)
5. Manufacturer's type designation (e.g. 338 2)
6. Code for dielectric material (MKP) for capacitors with original pitch = 15, 22.5 and 27.5 mm
7. Manufacturer
8. Year and week of manufacture (e.g. 9801) for capacitors with original pitch = 15, 22.5 and 27.5 mm
9. Safety approvals: products will be marked with european approvals and with UL and CSA marks.

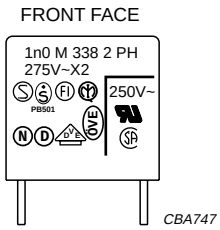


Fig.14 Example of marking for a capacitor with original pitch = 7.5 and 10 mm.

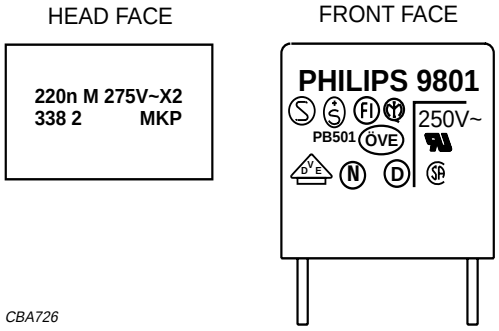


Fig.15 Example of marking for a capacitor with original pitch = 15 mm.

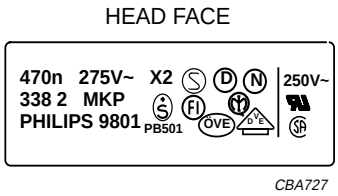
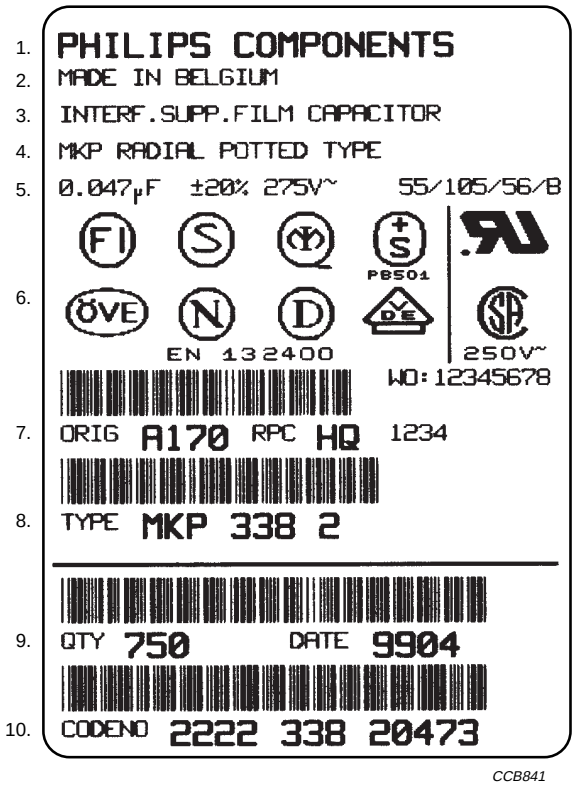


Fig.16 Example of marking for a capacitor with original pitch = 22.5 or 27.5 mm

Package marking

The package containing the capacitors is marked as shown Fig.17.

Please note:
In due time BC COMPONENTS
will replace PHILIPS COMPONENTS



Barcode label marking

LINE	MARKING EXPLANATION
1	Manufacturer’s name
2	Country of origin
3	Sub-family
4	Type description and sub class
5	Capacitance value, tolerance, voltage and climatic category (*“IEC 60068-1”*)
6	Safety approvals
7	Preference origin code: A Country of origin in code: 170 (Belgium) Responsible production centre: HQ Work order: WO Wage number of final inspection (only for capacitors with original pitch = 7.5 and 10 mm)
8	Product type description
9	Quantity and production period, year and week code
10	Product code (12NC)

Fig.17 Barcode label.

QUICK REFERENCE TEST REQUIREMENTS (see note 1)

TEST	PROCEDURE (quick reference)	REQUIREMENTS
Robustness of leads		
Tensile strength: *"IEC 60068-2-21"*	load 10 N; 10 s	no visible damage legible marking $\lvert\Delta C/C\rvert \leq 5\%$ $\Delta\tan\delta \leq 80 \times 10{-}4$ ($C \leq 1\ \mu F$); note 2 $\Delta\tan\delta \leq 50 \times 10{-}4$ ($C > 1\ \mu F$); note 2
Bending: *"IEC 60068-2-21"*	load 5 N; $4 \times 90°$	
Resistance to soldering heat: *"IEC 60068-2-20"*	solder bath: 260 °C; 10 s	
Component solvent resistance	isopropyl alcohol; 23 °C; 5 minutes	
Robustness of component		
Rapid change of temperature: *"IEC 60068-2-14"*	5 cycles; 1 cycle = 30 minutes at –55 °C and 30 minutes at 105 °C	$\lvert\Delta C/C\rvert \leq 5\%$ $\Delta\tan\delta \leq 80 \times 10{-}4$ ($C \leq 1\ \mu F$); note 2 $\Delta\tan\delta \leq 50 \times 10{-}4$ ($C > 1\ \mu F$); note 2
Vibration: *"IEC 60068-2-6"*	10 to 55 Hz; amplitude 0.75 mm; 6 hours	
Shock: *"IEC 60068-2-27"*	half sinewave; 490 m/s^2; 11 ms	
Climatic sequence		
Dry heat: *"IEC 60068-2-2"*	16 hours; 105 °C	$\lvert\Delta C/C\rvert \leq 5\%$ $\Delta\tan\delta \leq 80 \times 10{-}4$ ($C \leq 1\ \mu F$); note 2 $\Delta\tan\delta \leq 50 \times 10{-}4$ ($C > 1\ \mu F$); note 2 $R_{ins} \geq 50\%$ of specified value
Damp heat, cyclic, test Db, first cycle: *"IEC 60068-2-30"*		
Cold: *"IEC 60068-2-1"*	2 hours; –55 °C	
Damp heat, cyclic, test Db, remaining cycles: *"IEC 60068-2-30"*		
Voltage proof: *"IEC 60384-14"*	V_p = 1200 V (DC) ; 1 minute	
Other applicable tests		
Damp heat, steady state: *"IEC 60068-2-3"*	56 days; 40 °C; 90 to 95% RH no load V_p = 1200 V (DC); 1 minute	$\lvert\Delta C/C\rvert \leq 5\%$ $\Delta\tan\delta \leq 80 \times 10{-}4$ ($C \leq 1\ \mu F$); note 2 $\Delta\tan\delta \leq 50 \times 10{-}4$ ($C > 1\ \mu F$); note 2 $R_{ins} \geq 50\%$ of specified value
Endurance (AC): *"IEC 60384-14"*	3×2.5 kV pulse voltage for X2; 1000 hours; $1.25 \times U_{Rac}$ at 105 °C; once per hour; 0.1 s; 1000 V (RMS) via resistor of 47 Ω; V_p = 1200 V (DC); 1 minute	$\lvert\Delta C/C\rvert \leq 10\%$ $\Delta\tan\delta \leq 80 \times 10{-}4$ ($C \leq 1\ \mu F$); note 2 $\Delta\tan\delta \leq 50 \times 10{-}4$ ($C > 1\ \mu F$); note 2 $R_{ins} \geq 50\%$ of specified value

TEST	PROCEDURE (quick reference)	REQUIREMENTS
Charge and discharge: *"IEC 60384-14"*	10000 cycles; 5 ms; 1.5 × dV/dt	$\|\Delta C/C\| \leq 10\%$ $\Delta\tan\delta \leq 80 \times 10{-}4$ ($C \leq 1$ μF); note 2 $\Delta\tan\delta \leq 50 \times 10{-}4$ ($C > 1$ μF); note 2 $R_{ins} \geq 50\%$ of specified value
Passive flammability: *"IEC 60384-14"*	class B	no burning
Active flammability: *"IEC 60384-14"*	20 × 2.5 kV discharge	no burning
Heat storage: *"IEC 60384-14"*	1000 hours; 105 °C	$\|\Delta C/C\| \leq 5\%$ $\Delta\tan\delta \leq 80 \times 10{-}4$ ($C \leq 1$ μF); note 2 $\Delta\tan\delta \leq 50 \times 10{-}4$ ($C > 1$ μF); note 2
Resistance to soldering heat with preheating: *"IEC 60384-14"*	preheating: 105 °C; solder bath: 260 °C; 10 s	$\|\Delta C/C\| \leq 5\%$ $\Delta\tan\delta \leq 80 \times 10{-}4$ ($C \leq 1$ μF); note 2 $\Delta\tan\delta \leq 50 \times 10{-}4$ ($C > 1$ μF); note 2
Active flammability test	voltage proof up to 4 kV (DC) or until breakdown (100 V/sec, current limited 2 mA) failed capacitors connected to a 250 V (AC) power supply during 5 minutes.	no burning

Notes

1. For detailed information: see *"Type detail specification HQN-384-14/111"*.
2. Measuring frequency 10 kHz for $C \leq 1$ μF and 1 kHz for $C > 1$ μF.