DATA SHEET

MKP 338 4 X2
Interference suppression film capacitors

Product Specification
NEW
File under BCcomponents, BC05

2001 Jun 22

BC COMPONENTS

Interference suppression film capacitors MKP 338 4 X2

MKP RADIAL POTTED TYPE **PITCH 15/22.5/27.5/37.5/55 mm**

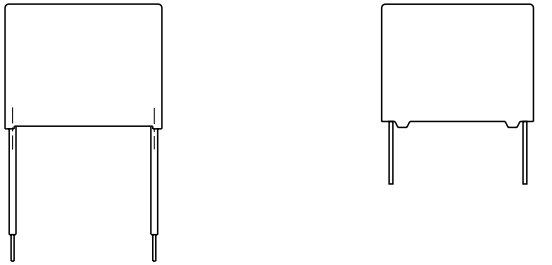


Fig.1 Simplified outlines.

FEATURES

- 15 to 55 mm lead pitch
- Supplied loose in box
- Consists of a low-inductive wound cell of metallized polypropylene film, potted in a flame-retardant case
- Fixed and insulated leads.

APPLICATIONS

- For X2 electromagnetic interference suppression
- Specially designed to meet the requirements of the "IEC 60384-14 2nd edition and EN 132400", requiring a 2.5 kV peak pulse voltage test, and the UL1283 specifications.

DETAIL SPECIFICATION

For more detailed data and test requirements see *"Type detail specification HQN-384-14/120"*.

QUICK REFERENCE DATA(1)

DESCRIPTION	VALUE
Capacitance range (E12 series)	0.01 to 10 μF
Capacitance tolerance	±20%; ±10%
Rated (AC) voltage, 50 to 60 Hz	300 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:	ENEC; UL1283 and CSA-C22.2 No.8
Materials	qualified in accordance with UL94V-O
Safety class	X2; across the line

Note

1. Under development.

Interference suppression film capacitors MKP 338 4 X2

SAFETY APPROVALS AND SAFETY TEST REPORT

Approvals

SAFETY APPROVALS (X2)		VOLTAGE	VALUE	FILE NUMBERS
cULus	UL1283 and CSA-C22.2 No.8	300 V (AC)	10 nF to 10 µF	pending
ENEC 02	EN132400	300 V (AC)	10 nF to 10 µF	pending

Safety test report

SAFETY TEST REPORT	VOLTAGE	VALUE	FILE NUMBERS
CB TEST CERTIFICATE	300 V (AC)	10 nF to 10 µF: 55/105/56/B	pending

The Enec-approval together with the CB-Certificate replace all national approval marks of the following countries (they have already signed the ENEC-Agreement): Austria; Belgium; Czech. Republic; Denmark; Finland; France; Germany; Greece; Hungary; Ireland; Italy; Luxembourg; Netherlands; Norway, Portugal; Slovenian; Spain; Sweden; Switzerland and United Kingdom.

Interference suppression film capacitors MKP 338 4 X2

COMPOSITION OF CATALOGUE NUMBER

TYPE AND PITCHES	
338 4 X2	7.5 mm (bent back)
	15.0 mm
	22.5 mm
	27.5 mm
	37.5 mm
	55.0 mm

CAPACITANCE (numerically)

MULTIPLIER (nF)	
1	3
10	4
100	5
1000	6

Example:
104 = 10 x 10 = 100 nF

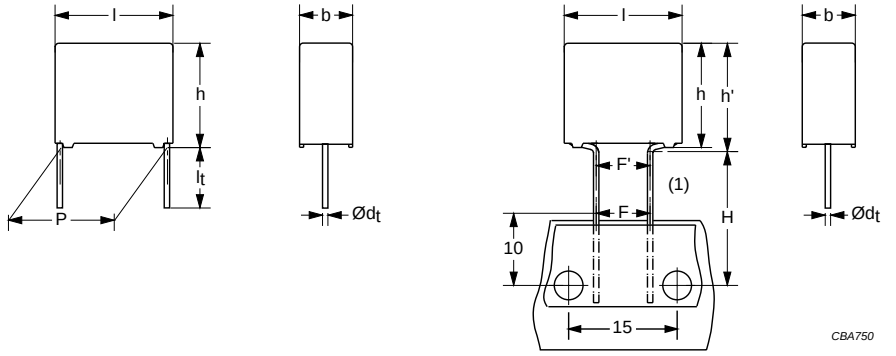
2222	338	4.	XX	X

TYPE	PACKAGING	LEAD CONFIGURATION	C-TOL	PREFERRED TYPES
338 4 X2	loose in box	lead length 3.5 mm	±20%	44
		lead length 5.0 mm		40
		lead length 25.0 mm		41
	taped	15.0 mm bent back to 7.5 mm		4.
				ON REQUEST
338 4 X2	loose in box	insulated leads stranded Cu-wire 0.5 mm^2 for 37.5 and 55 mm pitch	±20%	4.
		lead length 3.5 mm	±10%	45
		lead length 5.0 mm		42
		lead length 25.0 mm		43
		insulated leads stranded Cu-wire 0.5 mm^2 for 37.5 and 55 mm pitch		4.
	taped	15.0 mm bent back to 7.5 mm		4.

Interference suppression film capacitors MKP 338 4 X2

MKP 338 GENERAL DATA

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



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

Fig.3 Outline.

Specific reference data for the 300 V AC (X2) capacitors

DESCRIPTION	VALUE		
Tangent of loss angle:	at 1 kHz	at 10 kHz	at 100 kHz
$C \leq 470$ nF	$\leq 10 \times 10^{-4}$	$\leq 20 \times 10^{-4}$	$\leq 100 \times 10^{-4}$
470 nF < C ≤ 1 µF	$\leq 20 \times 10^{-4}$	$\leq 70 \times 10^{-4}$	–
1 µF < C ≤ 3.3 µF	$\leq 30 \times 10^{-4}$	–	–
Rated voltage pulse slope $(dU/dt)_R$ at 420 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 ≤ 1µF	2200 V; 1 minute		
1 µF < C ≤ 3.3 µF	1850 V; 1 minute		
Withstanding (AC) voltage between leads and case	2200 V; 1 minute		

Available 300 V AC (X2) versions

PACKAGING(1)	DIMENSIONS	C-tol	FIRST 9 DIGITS OF CATALOGUE NUMBER	ORDERING
Loose in box	lead length 3.5 mm	±20%	2222 338 44...	preferred
		±10%	2222 338 45...; note 2	on request
	lead length 5.0 mm	±20%	2222 338 40...	preferred
		±10%	2222 338 42...; note 2	on request
	lead length 25.0 mm	±20%	2222 338 41...	preferred
		±10%	2222 338 43...; note 2	on request
Taped	15.0 mm bent back to 7.5 mm	±20%	2222 338 4....	preferred
		±10%	2222 338 4....; note 2	on request

Notes

1. Taped on reel pitch = 27.5 mm is not available.
2. Other dimensions for ±10% tolerance values.

Interference suppression film capacitors MKP 338 4 X2

U_{Rac} = 300 V (X2); U_{Rdc} = 630 V **loose and taped**

C(1) (µF)	DIMENSIONS(2) b × h × l (mm)	MASS (g)	CATALOGUE NUMBER			
			LOOSE IN BOX			REEL
			l_t = 3.5 ±0.3mm	l_t = 5.0 ±0.3mm	l_t = 25.0 ±2.0mm	H = 16.0 mm; P_0 = 15.0 mm
			C-tol = ±20%			
			catalogue number	last 5 digits	last 5 digits	last 5 digits
Pitch = 15.0 ±0.4 mm; d_t = 0.60 ±0.06 mm						**pitch = 7.5 mm (bent back)**
0.01	5.0 × 11.0 (13.0) × 17.5	1.2	2222 338 44**103**	.. 40**103**	.. 41**103**	.. 48**001**
0.015			2222 338 44**153**	.. 40**153**	.. 41**153**	.. 48**002**
0.022			2222 338 44**223**	.. 40**223**	.. 41**223**	.. 48**003**
0.033			2222 338 44**333**	.. 40**333**	.. 41**333**	.. 48**004**
0.047			2222 338 44**473**	.. 40**473**	.. 41**473**	.. 48**005**
0.068			2222 338 44**683**	.. 40**683**	.. 41**683**	.. 48**006**
0.1	6.0 × 12.0 (14.0) × 17.5	1.4	2222 338 44**104**	.. 40**104**	.. 41**104**	.. 48**007**
Pitch = 15.0 ±0.4 mm; d_t = 0.80 ±0.08 mm						**pitch = 7.5 mm (bent back)**
0.15	7.0 × 13.5 (15.5) × 17.5	1.9	2222 338 44**154**	.. 40**154**	.. 41**154**	.. 48**008**
0.22	8.5 × 15.0 (17.0) × 17.5	2.6	2222 338 44**224**	.. 40**224**	.. 41**224**	.. 48**009**
0.33	10.0 × 16.5 (18.5) × 17.5	3.1	2222 338 44**334**	.. 40**334**	.. 41**334**	.. 48**011**
Pitch = 22.5 ±0.4 mm; d_t = 0.80 ±0.08 mm						**pitch = 7.5 mm (bent back)**
0.47	8.5 × 18.0 × 26.0	4.5	2222 338 44**474**	.. 40**474**	.. 41**474**	not available
0.68	10.0 × 19.5 × 26.0	5.5	2222 338 44**684**	.. 40**684**	.. 41**684**	
1.0	12.0 × 22.0 × 26.0	7.8	2222 338 44**105**	.. 40**105**	.. 41**105**	
Pitch = 27.5 ±0.4 mm; d_t = 0.80 ±0.08 mm						**pitch = 7.5 mm (bent back)**
1.5	15.0 × 25.0 × 31.0	12.8	2222 338 44**155**	.. 40**155**	.. 41**155**	not available
2.2	18.0 × 28.0 × 31.0	17.2	2222 338 44**225**	.. 40**225**	.. 41**225**	
3.3	21.0 × 31.0 × 31.0	20.4	2222 338 44**335**	.. 40**335**	.. 41**335**	

Notes

1. Under development.
2. Dimensions in brackets for bent back leads.

Interference suppression film capacitors MKP 338 4 X2

MKP GENERAL DATA **PITCH 37.5/55 mm**

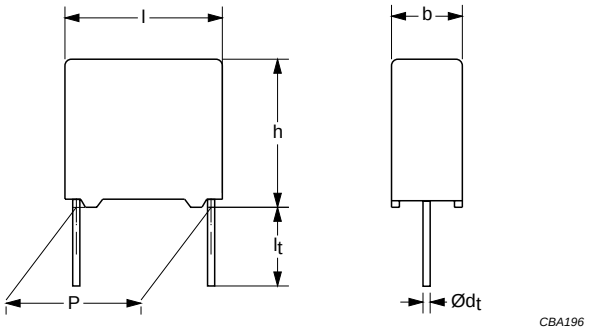


Fig.4 Outline.

Specific reference data for the 300 V AC (X2) capacitors

DESCRIPTION	VALUE
Tangent of loss angle	at 1 kHz
2.2 µF < C ≤ 4.7 µF	$\leq 50 \times 10^{-4}$
4.7 µF < C ≤ 10 µF	$\leq 100 \times 10^{-4}$
Rated voltage pulse slope $(dU/dt)_R$ at 420 V (DC)	100 V/µs
RC between leads 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	1400 V; 1 minute
Withstanding (AC) voltage between leads and case	2200 V; 1 minute

Available 300 V AC (X2) versions

PACKAGING	DIMENSIONS	C-tol	FIRST 9 DIGITS OF CATALOGUE NUMBER	ORDERING
Loose in box	lead length 5.0 mm; note 1	±20%	2222 338 40...	preferred
		±10%	2222 338 42...; note 2	on request
	lead length 25.0 mm; note 1	±20%	2222 338 41...	preferred
		±10%	2222 338 43...; note 2	on request
	insulated leads stranded Cu-wire 0.5 mm^2 for 37.5 and 55 mm pitch	±20%	2222 338 4....	on request
		±10%	2222 338 4....; note 2	on request

Notes

1. Lead length 3.5 mm for pitch = 37.5 and 55 mm is not availible.
2. Other dimensions for ±10% tolerance values.

Interference suppression film capacitors MKP 338 4 X2

U_{Rac} = 300 V (X2); U_{Rdc} = 630 V **loose**

C[1] (µF)	DIMENSIONS b × h × l (mm)	MASS (g)	CATALOGUE NUMBER	
			LOOSE IN BOX	
			l_t = 5.0 ±1.0 mm	l_t = 25.0 ±2.0 mm
			C-tol = ±20%	
			catalogue number	last 5 digits
Pitch = 37.5 ±0.7 mm; d_t = 1.0 ±0.1 mm				
4.7	18.0 × 35.0 × 42.0	30.0	2222 338 40**475**	... 41**475**
6.8	21.0 × 38.0 × 42.0	35.0	2222 338 40**685**	... 41**685**
Pitch = 55.0 ±1.0 mm; d_t = 1.0 ±0.1 mm				
10.0	21.0 × 38.0 × 59.5	50.0	2222 338 40**106**	... 41**106**

Note

1. Under development.

CONSTRUCTION

Description

- Low-inductive wound cell of metallized polypropylene (PP) film, potted with epoxy resin (for original pitch ≤ 27.5 mm) and polyurethane and epoxy resin (for pitch >27.5 mm) in a flame-retardant case
- Radial leads, solder-coated
- Small stand-off pips allow removal of solder flux etc. during cleaning of the printed-circuit board
- Radial insulated leads; stranded Cu-wire with PVC isolation for pitch >27.5 mm on request

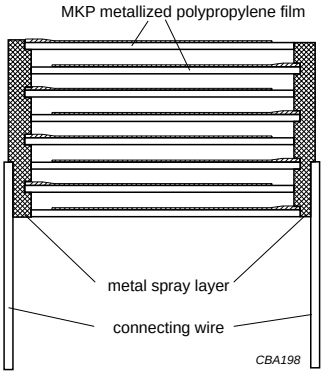


Fig.5 Construction.

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

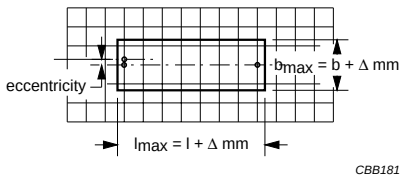
In order to withstand vibration and shock tests, it must be ensured that the stand-off pips are in good contact with the printed-circuit board:

- 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: $h_{max} \leq h + \Delta$ mm or $h_{max} \leq h' + \Delta$ mm.



(1) Δ = 0.3 mm for P ≤ 27.5 mm.
Δ = 1.0 mm for P > 27.5 mm.

Fig.6 Lay-out.

Storage temperature

- Storage temperature: Tstg = –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

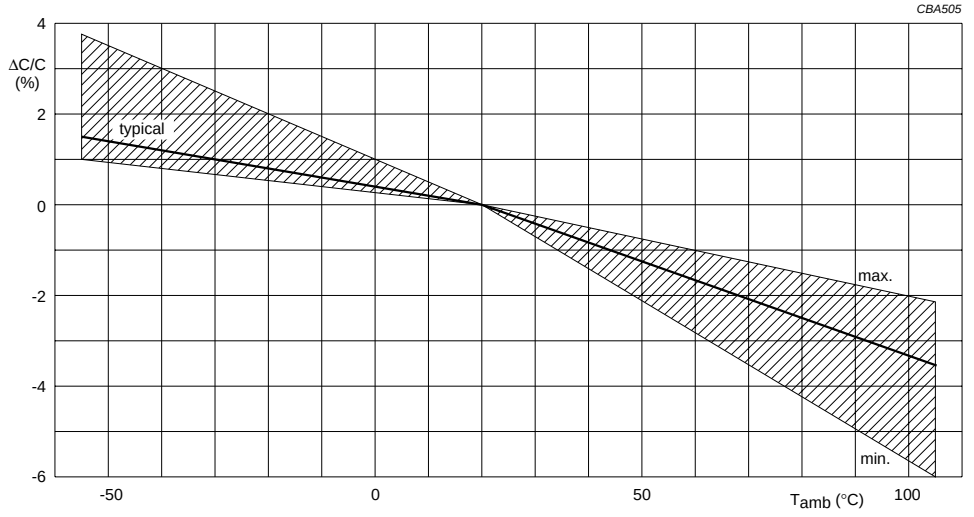


Fig.7 Capacitance change at 1 kHz as a function of temperature.

Tangent of loss angle

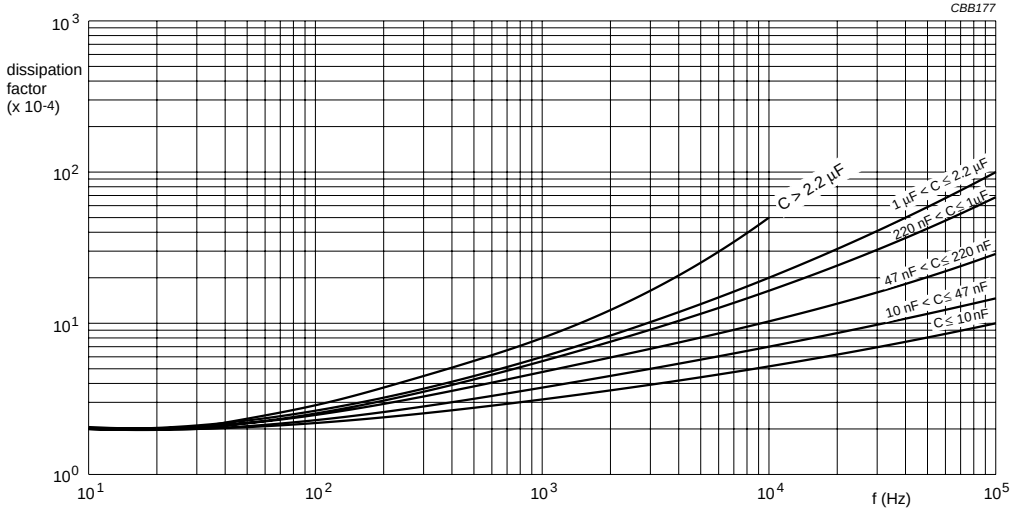


Fig.8 Tangent of loss angle as a function of frequency: typical curves.

Impedance

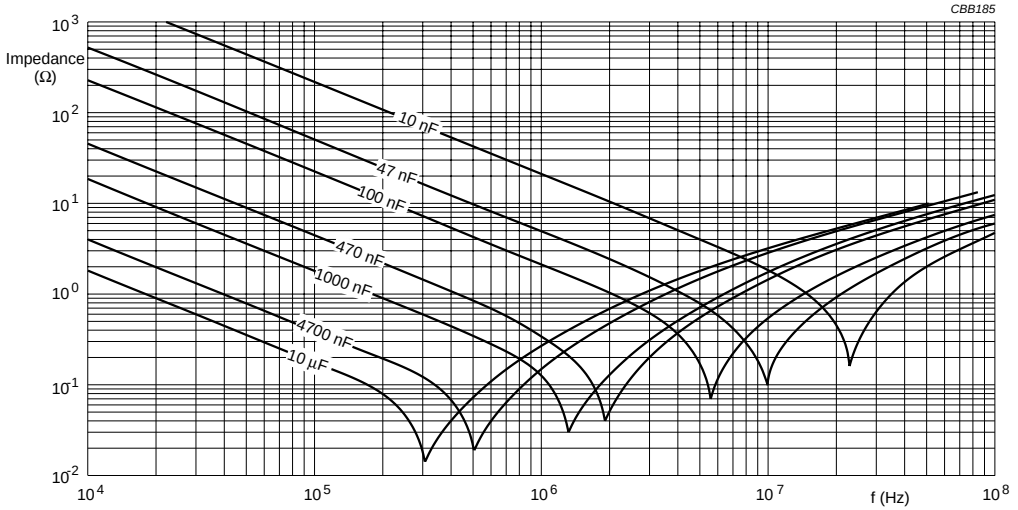


Fig.9 Impedance as a function of frequency: typical curves.

Resonant frequency

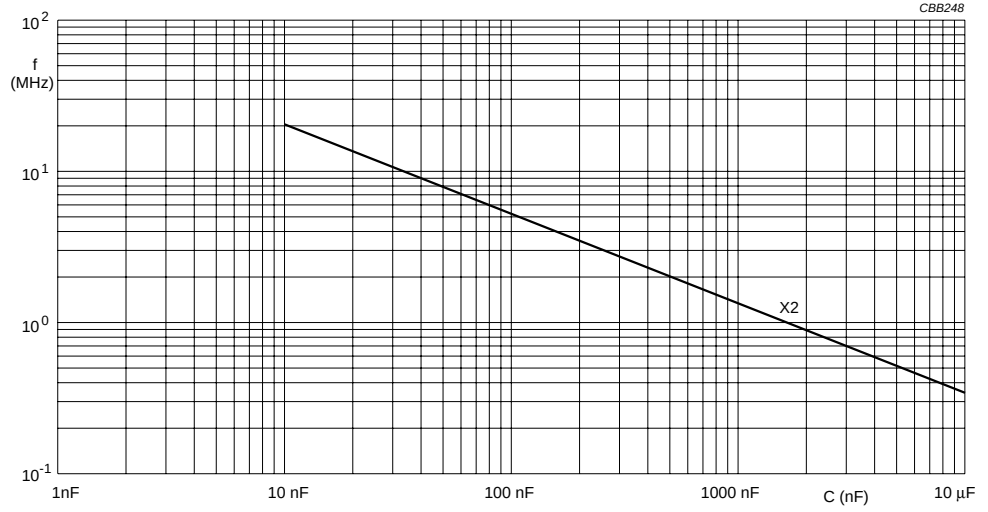


Fig.10 Resonant frequency as a function of capacitance: typical curve.

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

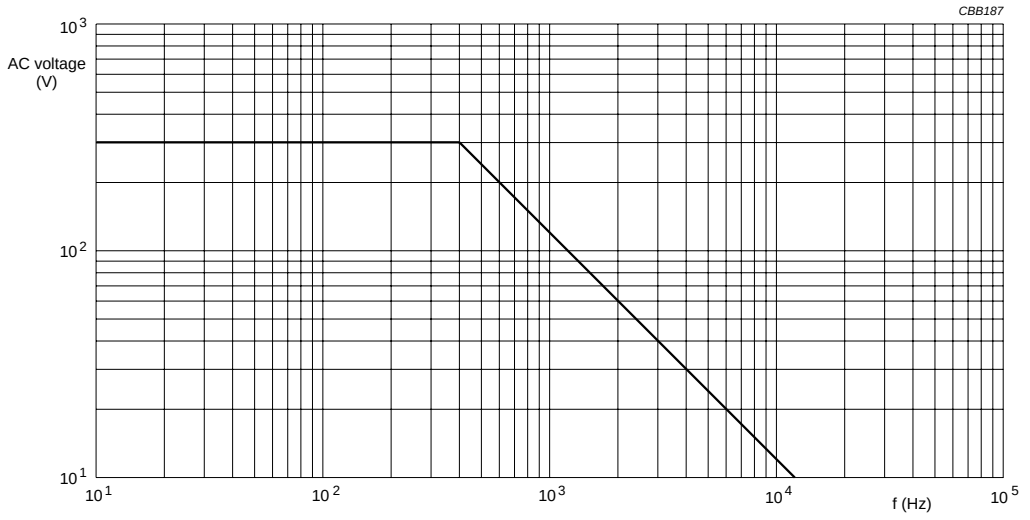


Fig.11 AC voltage (RMS value) as a function of frequency at $T_{amb} \leq 105$ °C.

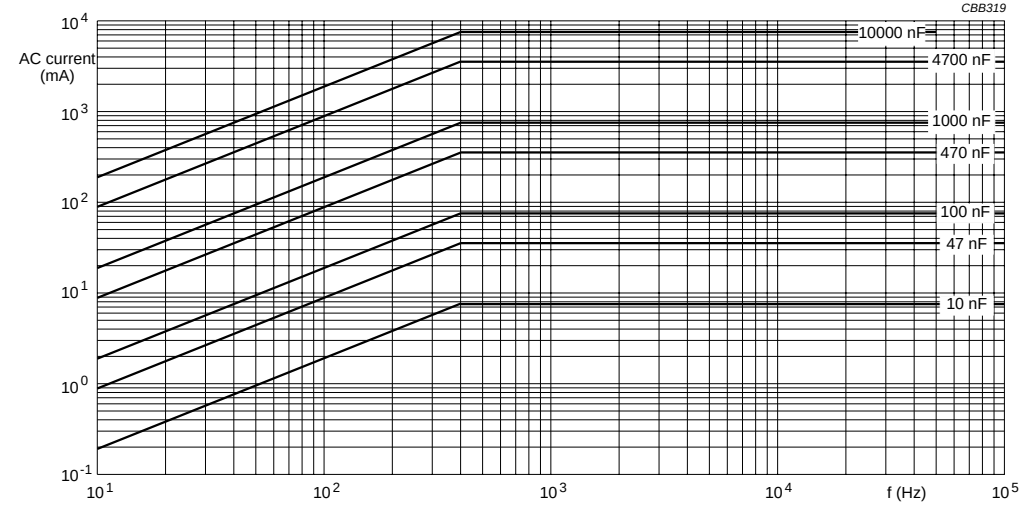


Fig.12 AC current (RMS value) as a function of frequency at $T_{amb} \leq 105$ °C.

Insulation resistance

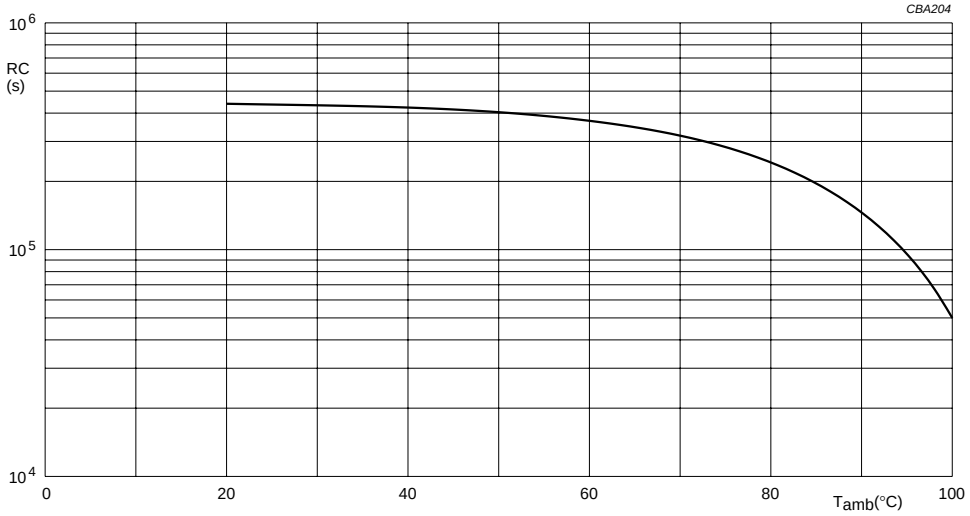


Fig.13 RC product as a function of ambient free air temperature: typical curve.

APPLICATION NOTES

- For X2 electromagnetic interference suppression in across the line applications (50/60 Hz) with a maximum mains voltage of 300 V (AC) ±10% instability.
- 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 420 V (DC) and divided by the applied voltage.

MARKING

Product marking

The capacitors are marked (see Figs 14 to 15) with the following information:

1. Rated capacitance code in accordance with "IEC 60062"
2. Tolerance on rated capacitance; M = ±20%; K = ±10%
3. Rated (AC) voltage (e.g. 300 V)
4. Sub-class (e.g. X2)
5. Manufacturer's type designation (e.g. 338 4)
6. Code for dielectric material (MKP)
7. Manufacturer and origin (" " Belgium; "PL" Poland)
8. Year and week of manufacture (e.g. 0133).

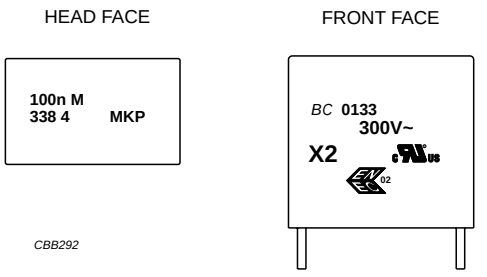


Fig.14 Example of marking for a capacitor with original pitch = 15 mm.

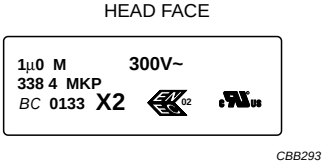


Fig.15 Example of marking for a capacitor with original pitch ≥ 22.5 mm.

Package marking

The package containing the capacitors is marked as shown Fig.16.

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: B Country of origin in code: 780 (Poland) Responsible production centre: PL Work order: WO
8	Product type description
9	Quantity and production period, year and week code
10	Product code (12NC)

Fig.16 Barcode label.

QUICK REFERENCE TEST REQUIREMENTS

TEST	PROCEDURE (quick reference)	REQUIREMENTS
Robustness of leads		
Tensile strength: "IEC 60068-2-21"	load 10 N; 10 s	no visible damage legible marking $\|\Delta C/C\| \leq 5\%$ $\Delta\tan\delta \leq 80 \times 10^{-4}$ ($C \leq 1\ \mu F$); note 1 $\Delta\tan\delta \leq 50 \times 10^{-4}$ ($C > 1\ \mu F$); note 1
Bending: "IEC 60068-2-21"	load 5 N; 4 × 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 (fixed leads only)		
Rapid change of temperature: "IEC 60068-2-14"	5 cycles 1 cycle = 30 minutes at –55 °C and 30 minutes at 105 °C	$\|\Delta C/C\| \leq 5\%$ $\Delta\tan\delta \leq 80 \times 10^{-4}$ ($C \leq 1\ \mu F$); note 1 $\Delta\tan\delta \leq 50 \times 10^{-4}$ ($C > 1\ \mu F$); note 1
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	$\|\Delta C/C\| \leq 5\%$ $\Delta\tan\delta \leq 80 \times 10^{-4}$ ($C \leq 1\ \mu F$); note 1 $\Delta\tan\delta \leq 50 \times 10^{-4}$ ($C > 1\ \mu F$); note 1 Rins ≥ 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 = 1290 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 = 1290 V (DC); 1 minute	$\|\Delta C/C\| \leq 5\%$ $\Delta\tan\delta \leq 80 \times 10^{-4}$ ($C \leq 1\ \mu F$); note 1 $\Delta\tan\delta \leq 50 \times 10^{-4}$ ($C > 1\ \mu F$); note 1 Rins ≥ 50% of specified value
Endurance (AC): "IEC 60384-14"	3 × 2.5 kV pulse voltage for X2; 1000 hours; 1.25 × U_{Rac} at 105 °C; once per hour; 0.1 s; 1000 V (RMS) via resistor of 47 Ω; V_p = 1290 V (DC); 1 minute	$\|\Delta C/C\| \leq 10\%$ $\Delta\tan\delta \leq 80 \times 10^{-4}$ ($C \leq 1\ \mu F$); note 1 $\Delta\tan\delta \leq 50 \times 10^{-4}$ ($C > 1\ \mu F$); note 1 Rins ≥ 50% of specified value

Interference suppression film capacitors MKP 338 4 X2

TEST	PROCEDURE (quick reference)	REQUIREMENTS
Charge and discharge: "IEC 60384-14"	10000 cycles; 5 ms; 1.5 × dV/dt	$\|\Delta C/C\| \leq 10\%$ $\Delta\tan\delta \leq 80 \times 10^{-4}$ ($C \leq 1\ \mu F$); note 1 $\Delta\tan\delta \leq 50 \times 10^{-4}$ ($C > 1\ \mu F$); note 1 Rins ≥ 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	$\|\Delta C/C\| \leq 5\%$ $\Delta\tan\delta \leq 80 \times 10^{-4}$ ($C \leq 1\ \mu F$); note 1 $\Delta\tan\delta \leq 50 \times 10^{-4}$ ($C > 1\ \mu F$); note 1
Resistance to soldering heat with preheating: "IEC 60384-14"	preheating: 105 °C; solder bath: 260 °C; 10 s	$\|\Delta C/C\| \leq 5\%$ $\Delta\tan\delta \leq 80 \times 10^{-4}$ ($C \leq 1\ \mu F$); note 1 $\Delta\tan\delta \leq 50 \times 10^{-4}$ ($C > 1\ \mu F$); note 1
Active flammability test	voltage proof up to 2 × peak impulse voltage of 4.13 or until breakdown (100 V/sec, current limited 2mA) failed capacitors connected to a 300 V (AC) power supply during 5 minutes.	no burning

Note

1. Measuring frequency 10 kHz for $C \leq 1\ \mu F$ and 1 kHz for $C > 1\ \mu F$.