MKP 435

Interference suppression film capacitors, insulated leads

File under TPD sheet 190, HQN-384-14/117

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BCcomponents
Roeselare

TYPE DETAIL SPECIFICATION

Interference suppression film capacitors, insulated leads MKP 435

DOCUMENT SURVEY

DOCUMENT COMPOSITION	
PAGE	**DATE**
1 - 2	00-10-04
3 - 4	00-05-12
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MKP RADIAL POTTED TYPE **PITCH 15/22.5/27.5 mm**

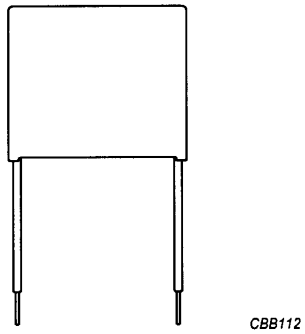

Fig.1 Simplified outlines.

FEATURES

- 15.0 to 27.5 mm lead pitch
- Insulated leads
- Supplied loose in box
- 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.

QUICK REFERENCE DATA

DESCRIPTION	VALUE
Capacitance range (E12 series)	10 nF to 1.0 µF
Capacitance tolerance	±20%, ±10%
Rated (AC) voltage , 50 to 60 Hz	275 V
Rated (DC) voltage	630 V
Climatic category	40/100/56/C (15 nF to 1.0 µF) 40/085/56/C (10 nF)
Rated temperature	100 °C
Maximum application temperature	100 °C
Reference specifications	IEC 60384-14 2nd edition and EN 132400
Safety approvals: 250 V 275 V	 UL1414; note 1 VDE; note 2
Safety class	X2

Notes

1. Pending.
2. Approved

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SAFETY APPROVALS

SAFETY APPROVALS (X2)		VOLTAGE	VALUE	FILE NUMBERS
cULus	UL1414	250 V (AC)	10 nF to 1.0 µF	
CB Test-Certificate		275 V (AC)	10 nF to 1.0 µF: 40/085/21/C	
VDE	VDE (EN132400)	275 V (AC)	15 nF to 1.0 µF: 40/100/56/C	128645

This approval together with the CB-Certificate replace all national approval marks of the following countries (they have already signed the CB-Agreement):

Austria	Belgium	Denmark	Finland	Sweden
France	Germany	Ireland	Italy	Switzerland
Netherlands	Israel	Portugal	Spain	Great Britain
Japan	Norway	China	Poland	Czech. Republic
Singapore	Rep. of Korea	Hungary	Iceland	Slovenian

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COMPOSITION OF CATALOGUE NUMBER

TYPE AND PITCHES	
435 X2	15.0 mm 22.5 mm 27.5 mm

MULTIPLIER (nF)	
1	3
10	4
100	5

CAPACITANCE (numerically)

Example:
104 = 10 x 10 = 100 nF

2222	435	XX	XX	X

TYPE	PACKAGING	LEAD CONFIGURATION	STANDARD DIMENSIONS(1)(2)(3)	C-TOL	PREFERRED TYPES
435 X2	loose in box	Solid Cu wire 0.8 mm	lead length 35.0 mm	±20%	2222 435 20...
			lead length 40.0 mm		2222 435 21...
			lead length 45.0 mm		2222 435 22...
		Stranded Cu wire 0.5 mm^2	lead length 35.0 mm	±20%	2222 435 23...
			lead length 40.0 mm		2222 435 24...
			lead length 45.0 mm		2222 435 25...
					ON REQUEST
435 X2	loose in box	Solid Cu wire 0.8 mm	lead length 35.0 mm	±10%	2222 435 30 ....
			lead length 40.0 mm		2222 435 31 ....
			lead length 45.0 mm		2222 435 32 ....
		Stranded Cu wire 0.5 mm^2	lead length 35.0 mm	±10%	2222 435 33 ....
			lead length 40.0 mm		2222 435 34 ...
			lead length 45.0 mm		2222 435 35 ...

Notes

1) Other lenght of wires on request.

2) Lead length: $l_t = \pm 5$ mm.

3) The parts without insulation are tinned.

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MKP 435 GENERAL DATA

PITCH 15/22.5/27.5 mm

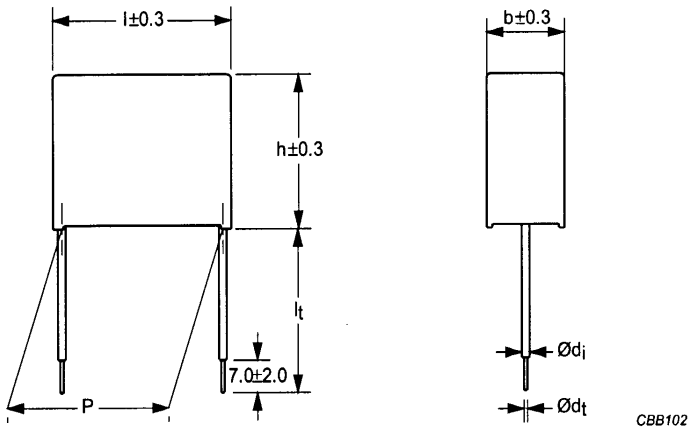

Fig.3 Outline.

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:			
100 nF < C ≤ 470 nF	≤10 × 10^{-4}	≤20 × 10^{-4}	≤100 × 10^{-4}
470 nF < C ≤ 1 µF	≤20 × 10^{-4}	≤70 × 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	>30000 MΩ		
RC between leads, for C > 0.33 µF at 100 V; 1 minute	>10000 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:	1200 V; 1 minute		
Withstanding (AC) voltage between leads and case	2050 V; 1 minute		

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Standard pitch sizes

U_{Rac} = 275 V (X2); U_{Rdc} = 630 V C-tol = ±20 %; loose; lead length = 35 mm

C (µF)	DIMENSIONS b × h × l (mm)	MASS (g)	CATALOGUE NUMBER 2222 435 ..... AND PACKAGING			
			LOOSE IN BOX			
			l_t = 35 ±5 mm			
			lead configuration = solid Cu wire = 0.8 mm[3]		lead configuration = stranded Cu wire = 0.5 mm²[4]	
			last 5 digits of catalogue number[1]	SPQ[2]	last 5 digits of catalogue number[1]	SPQ[2]
			C-tol = ±20%		C-tol = ±20%	
Reference pitch: P = 15 mm						
0.01	5.5 × 10.5 × 18.0	1.5	2222 435 20**103**	500	.. 23**103**	500
0.015			2222 435 20**153**		.. 23**153**	
0.022			2222 435 20**223**		.. 23**223**	
0.033			2222 435 20**333**		.. 23**333**	
0.047	6.5 × 12.5 × 18.0	2.0	2222 435 20**473**	400	.. 23**473**	400
0.068	7.5 × 13.5 × 18.0	2.5	2222 435 20**683**	400	.. 23**683**	400
0.10	8.5 × 14.5 × 18.0	3.0	2222 435 20**104**	400	.. 23**104**	400
Reference pitch: P = 22.5 mm						
0.15	7.5 × 15.5 × 26.5	4.0	2222 435 20**154**	200	.. 23**154**	200
0.22	8.5 × 16.5 × 26.5	5.0	2222 435 20**224**	200	.. 23**224**	200
0.33	10.5 × 18.5 × 26.5	6.5	2222 435 20**334**	150	.. 23**334**	150
Reference pitch: P = 27.5 mm						
0.47	11.5 × 20.5 × 31.5	10.0	2222 435 20**474**	100	.. 23**474**	100
0.68	13.5 × 23.5 × 31.5	13.0	2222 435 20**684**	100	.. 23**684**	100
1	15.0 × 24.5 × 31.5	15.0	2222 435 20**105**	75	.. 23**105**	75

Notes

1. The shading indicates preferred types.
2. For detailed packaging information refer to this specification chapter *"Packaging"*.
3. Ø di isolation = 2.4 mm for P = 15 mm and 2.8 mm for P > 15 mm.
4. Ø di isolation = 2.4 mm

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CONSTRUCTION

Description

- Low-inductive wound cell of metallized polypropylene (PP) film, potted with epoxy resin in a flame-retardant case
- Radial insulated leads:
  - Solid wire 0.8 mm with PVC insulation
  - Stranded tinned wire 0.5 mm^2 with PVC insulation

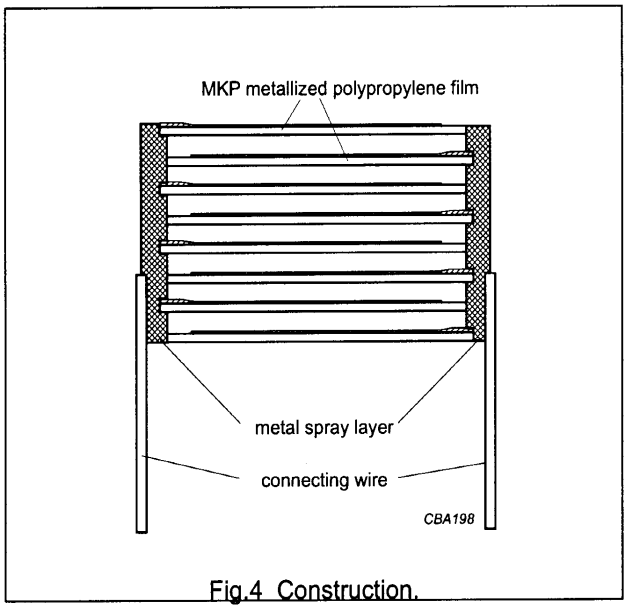

Fig.4 Construction.

Mounting

NORMAL USE

The capacitors are designed for snap-in, mounting and soldering.

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

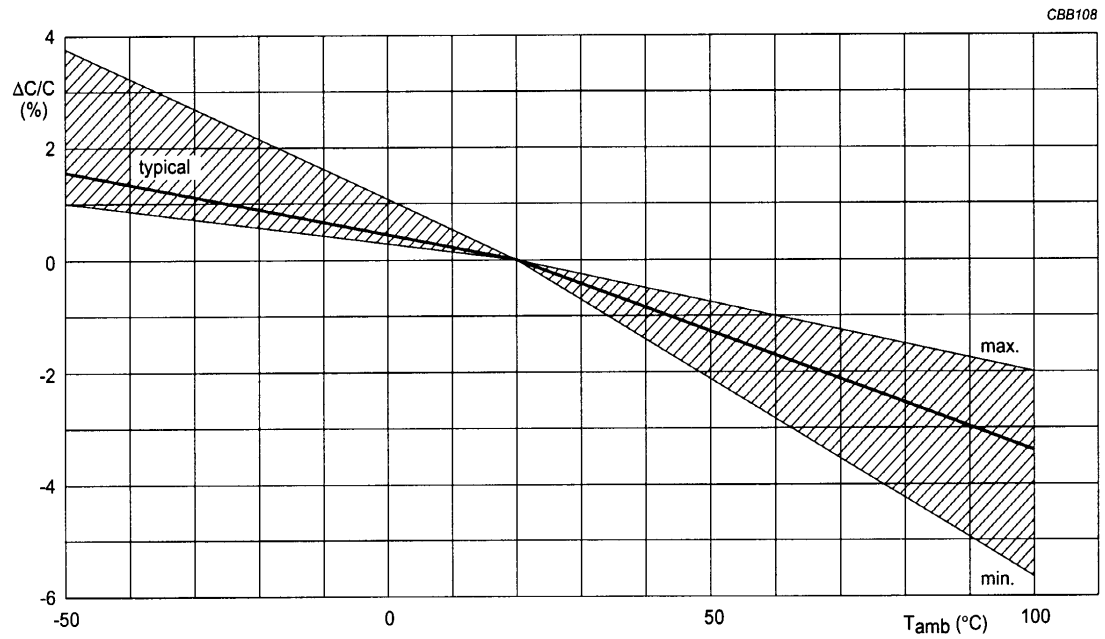

Fig.5 Capacitance change at 1 kHz as a function of temperature.

Tangent of loss angle

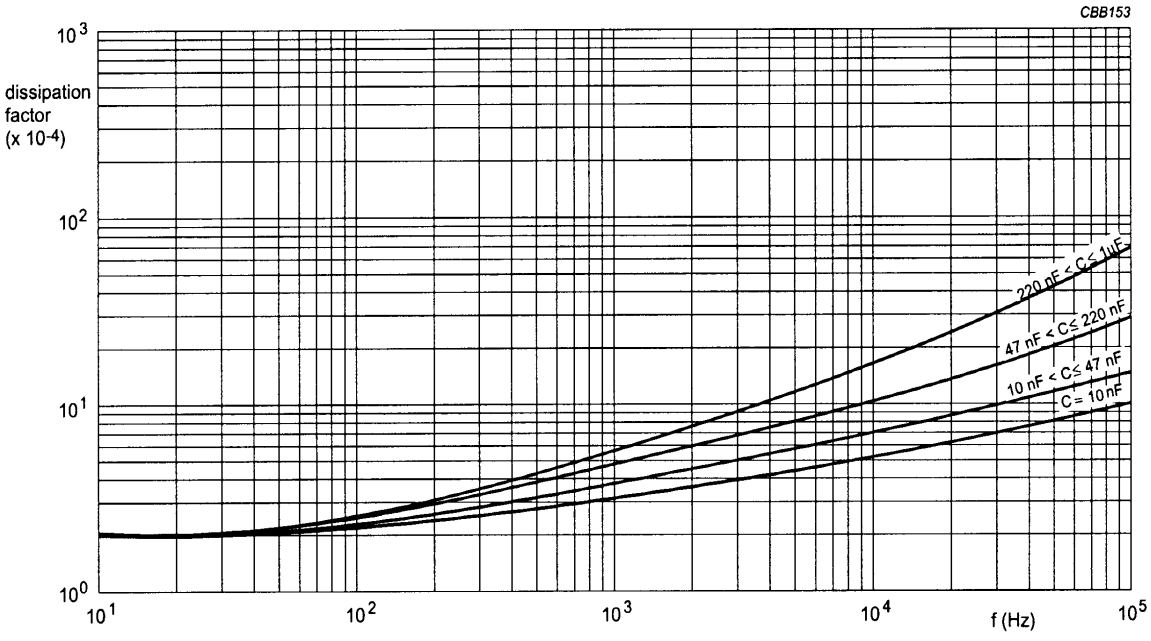

Fig.6 Tangent of loss angle as a function of frequency: typical curves.

Impedance

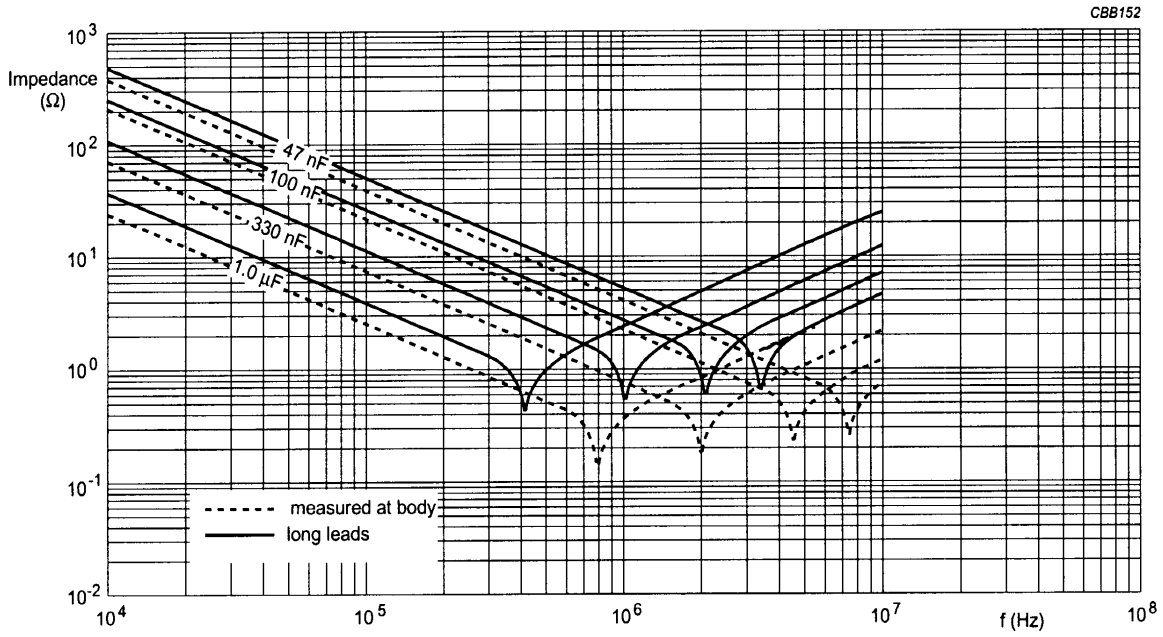

Fig.7 Impedance as a function of frequency: typical curves for 20% values measured with 35 mm lead length.

Resonant frequency

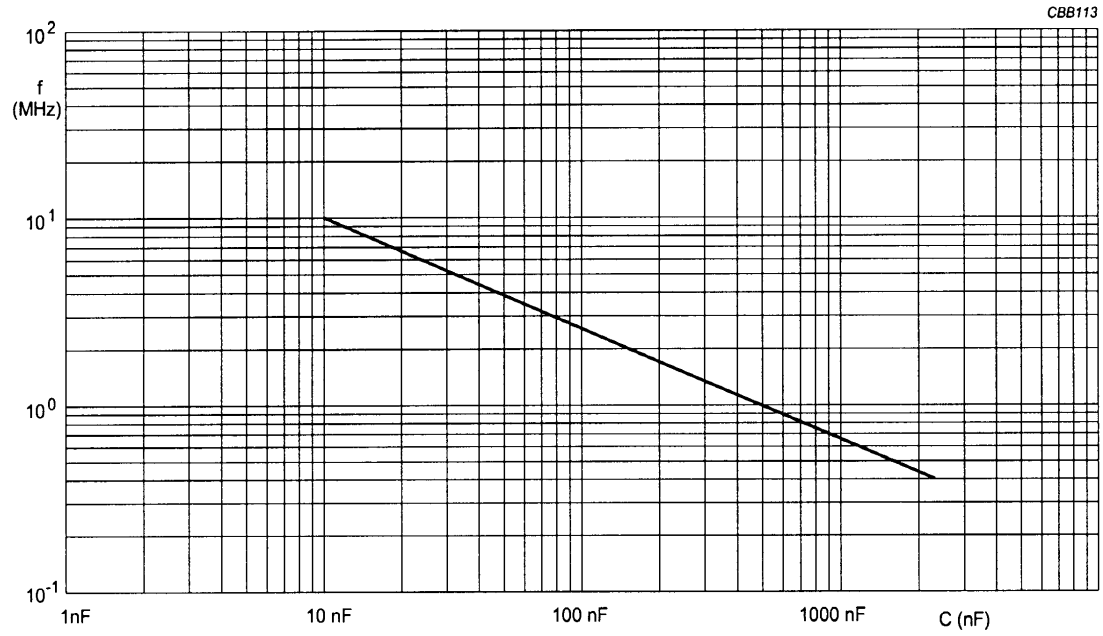

Fig.8 Resonant frequency as a function of capacitance: typical curves for 20% values.

Maximum RMS voltage and AC current (sinewave) as a function of frequency for $T_{amb} \leq 100$ °C

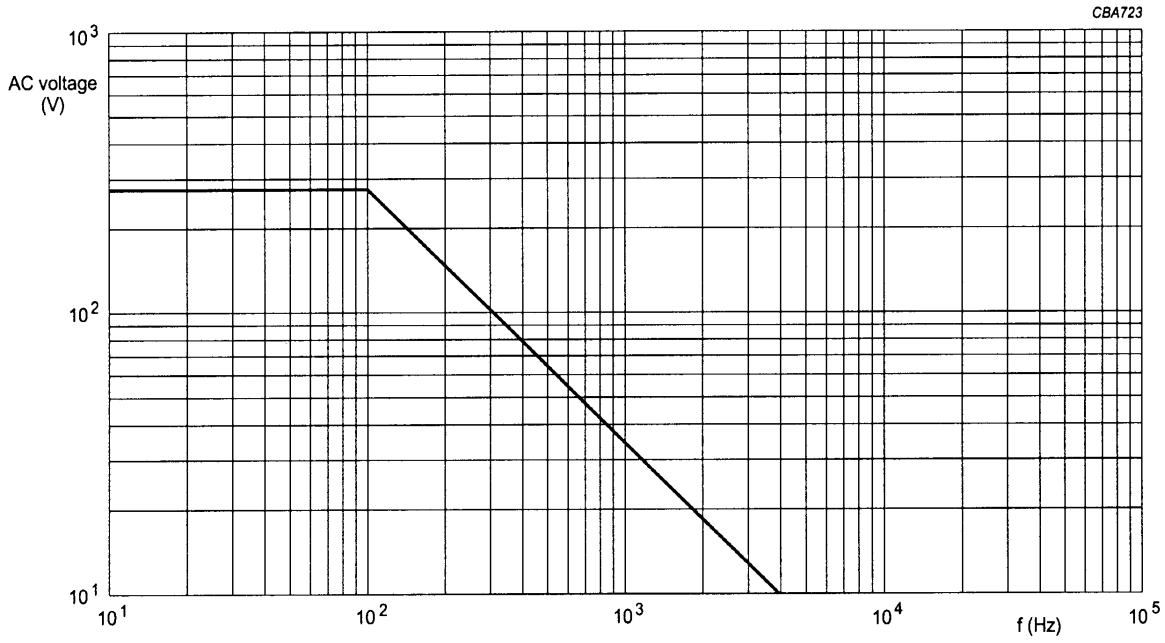

Fig.9 AC voltage (RMS value) as a function of frequency at $T_{amb} \leq 100$ °C.

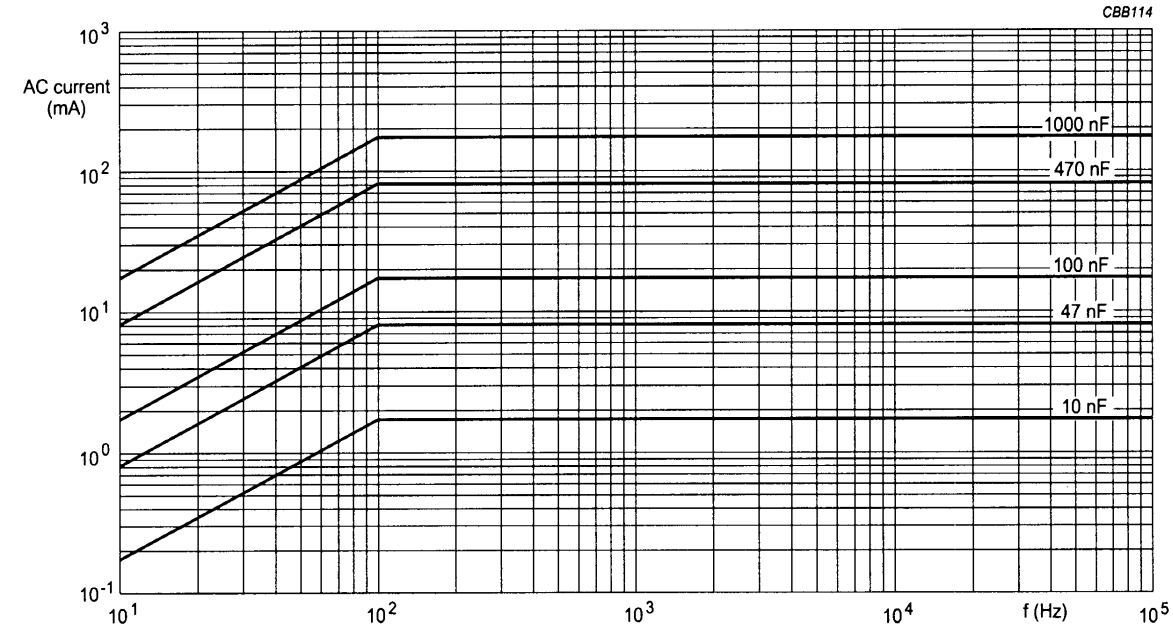

Fig.10 AC current (RMS value) as a function of frequency at $T_{amb} \leq 100$ °C.

Insulation resistance

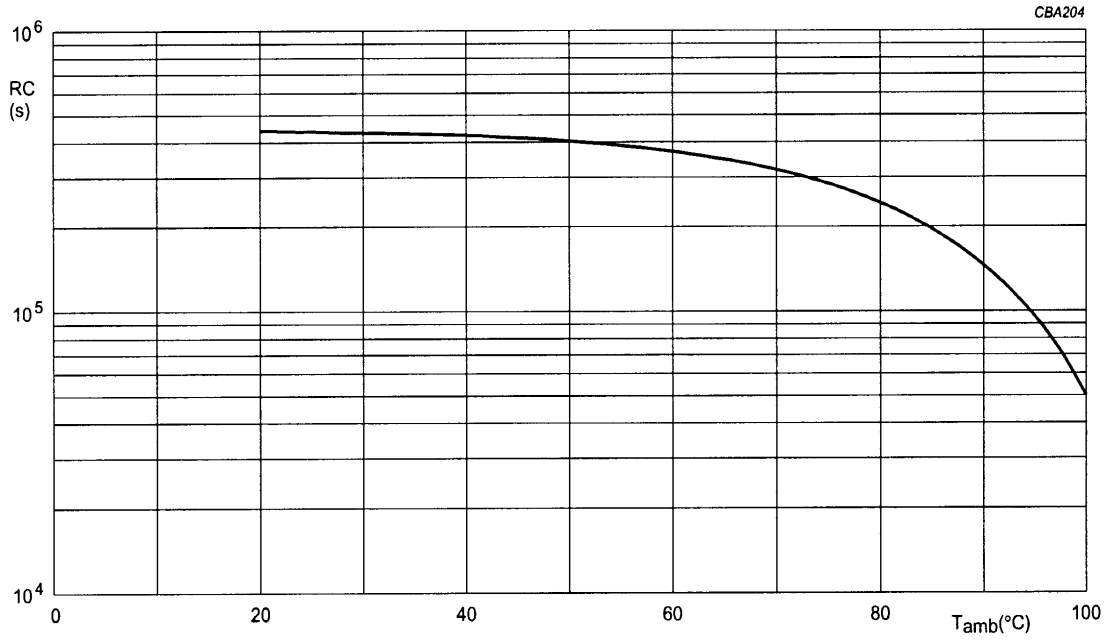

Fig.11 RC product as a function of ambient free air temperature: typical curve.

APPLICATION NOTES

- For X2 electromagnetic interference suppression in across the line applications (50/60 Hz) with a maximum mains voltage of 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 100 °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.

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MARKING

Product marking

The capacitors are marked by tampo print (see Fig.12) 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. 275 V)
4. Sub-class (e.g. X2)
5. Manufacturer's type designation (e.g. 435)
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. 0001) for capacitors with original pitch = 15, 22.5 and 27.5 mm
9. Safety approvals: products will be marked with european approval and with cUL marks.

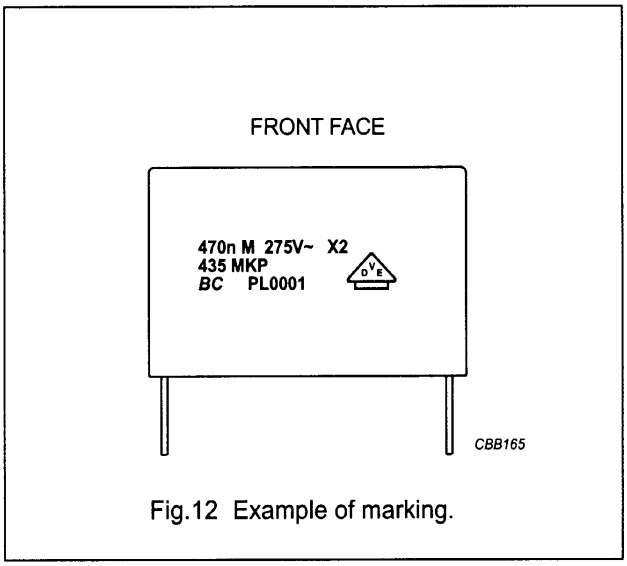
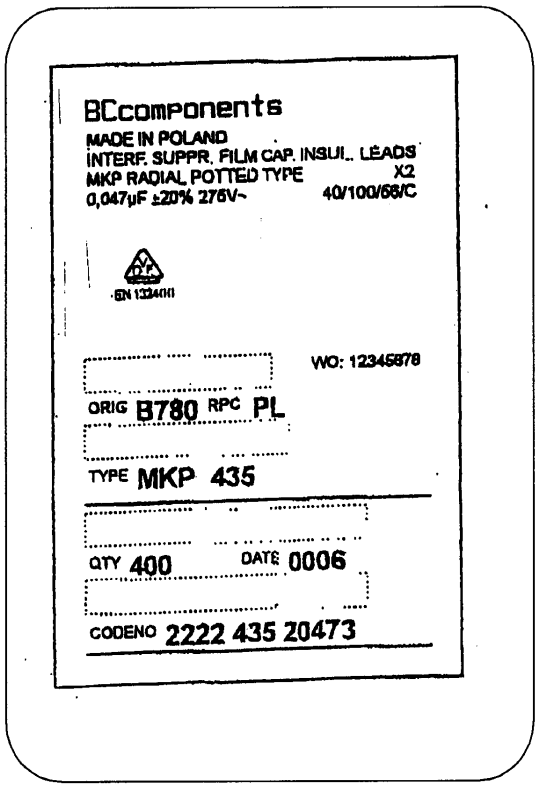


Fig.12 Example of marking.

Package marking

The package containing the capacitors is marked as shown Fig.13.



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.13 Barcode label.

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PACKAGING

- The products are packed in individual SPQ boxes. For quantities see "General data" of this specification.
- 10 individual cases are packed in a transport box.
- For dimensions see Fig. 14.

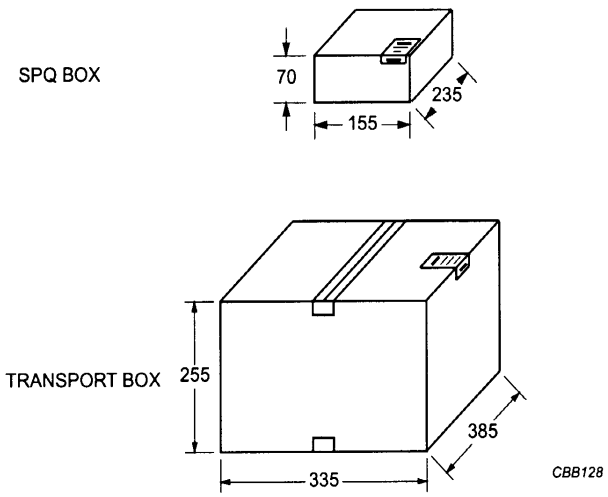

Fig.14 Packaging boxes.

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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 $\|\Delta C/C\| \leq 5\%$ $\Delta\tan\delta \leq 80 \times 10\text{–}4$ ($C \leq 1\ \mu F$); note 1
Bending: *"IEC 60068-2-21"*	load 5 N; 4 × 90 °	
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 –40 °C and 30 minutes at 100 °C	$\|\Delta C/C\| \leq 5\%$ $\Delta\tan\delta \leq 80 \times 10\text{–}4$ ($C \leq 1\ \mu F$); 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; 100 °C	$\|\Delta C/C\| \leq 5\%$ $\Delta\tan\delta \leq 80 \times 10\text{–}4$ ($C \leq 1\ \mu F$); note 1 $R_{ins} \geq 50\%$ of specified value
Damp heat, cyclic, test Db, first cycle: *"IEC 60068-2-30"*		
Cold: *"IEC 60068-2-1"*	2 hours; –40 °C	
Damp heat, cyclic, test Db, remaining cycles: *"IEC 60068-2-30"*		
Voltage proof: *"IEC 60384-14"*	Vp = 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 Vp = 1200 V (DC); 1 minute	$\|\Delta C/C\| \leq 5\%$ $\Delta\tan\delta \leq 80 \times 10\text{–}4$ ($C \leq 1\ \mu F$); note 1 $R_{ins} \geq 50\%$ of specified value
Endurance (AC): *"IEC 60384-14"*	3 × 2.5 kV pulse voltage for X2; 1000 hours; 1.25 × U_{Rac} at 100 °C; once per hour; 0.1 s; 1000 V (RMS) via resistor of 47 Ω; Vp = 1200 V (DC); 1 minute	$\|\Delta C/C\| \leq 10\%$ $\Delta\tan\delta \leq 80 \times 10\text{–}4$ ($C \leq 1\ \mu F$); note 1 $R_{ins} \geq 50\%$ of specified value
Charge and discharge: *"IEC 60384-14"*	10000 cycles; 5 ms; 1.5 × dV/dt	$\|\Delta C/C\| \leq 10\%$ $\Delta\tan\delta \leq 80 \times 10\text{–}4$ ($C \leq 1\ \mu F$); note 1 $R_{ins} \geq 50\%$ of specified value

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TEST	PROCEDURE (quick reference)	REQUIREMENTS
Passive flammability: *"IEC 60384-14"*	class C	no burning
Active flammability: *"IEC 60384-14"*	20 × 2.5 kV discharge	no burning
Heat storage: *"IEC 60384-14"*	1000 hours; 100 °C	$\|\Delta C/C\| \leq 5\%$ $\Delta \tan \delta \leq 80 \times 10\text{–}4$ ($C \leq 1$ µF); 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 250 V_{ac} power supply during 5 minutes.	no burning

Note

1. Measuring frequency 10 kHz for $C \leq 1$ µF.

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INSPECTION REQUIREMENTS

General notes:

1. Sub-clause numbers of tests and performance requirements refer to the *"Sectional Specification, IEC-publication EN 132400 (IEC 384-14) and Section One of this specification"*.
2. Inspection levels are selected from *"IEC-Publication 410; Sampling Plans and procedures for Inspection by Attributes"*.
3. For these capacitors, considered as a solid construction, the periodicity of the vibration and shock test is reduced from 6 months to 36 months.
4. In this table:
   a) p = periodicity in months
   b) n = sample size
   c) D = destructive
   d) ND = non-destructive
   e) IL = inspection level *"IEC 410"*
   f) AQL = acceptance quality level *"IEC 410"*
5. The test "Solvent resistance of the marking" is reduced from 6 months to 36 months for products with a lasered marking.

Group A inspection

CLAUSE NUMBER AND TEST	D OR ND	CONDITIONS	IL	n	PERFORMANCE REQUIREMENTS
Group A inspection (lot by lot)					
Sub-group A1	ND				
4.1 Visual examination			S4	note 1	No mechanical failures Legible marking and as specified in "General data" of this specification.
4.1 Dimensions		Gauging.	S3	note 1	As specified in "General data" of this specification.
Sub-group A2	ND				
4.2.2 Capacitance		at 1 kHz.			Within specified tolerance.
4.2.3 Tangent of loss angle		for $C \leq 1$ µF at 10 kHz			As specified in Section "Tangent of loss angle" of this specification.
4.2.1 Voltage proof (Test A)		2000 V (DC), for 2s			No permanent breakdown or flash-over Selfhealing allowed.
4.2.5 Insulation resistance (Test A)		at 100 V.			As specified in Section "Insulation resistance" of this specification.

Note:

1. Number to be tested: Sample size as directly allotted to the code letter for IL in Table 2A of *"IEC 410"* (Single sampling plan for normal inspection). The acceptance number complies with AQL value: 0.65 %.

Group C inspection requirements

SUB-CLAUSE NUMBER AND TEST		D OR ND	CONDITIONS	p	n	PERFORMANCE REQUIREMENTS
Group C inspection (periodic); see Section "General notes:"; **item** 3.						
SUB-GROUP C1A PART OF SAMPLE OF SUB-GROUP C1		D		6	6	
4.1	Dimensions (detail)					As specified in Chapters "General data" of this specfication.
	Initial measurements		Capacitance. Tangent of loss angle: for $C \leq 1$ µF at 10 kHz			
4.3	Robustness of terminations		Tensile: load 10 N; 10 s Bending: load 5 N; 4 × 90 °			No visible damage.
4.4.2	Final measurements		Visual examination.			No visible damage Legible marking.
			Capacitance.			$\lvert\Delta C/C\rvert \leq 5\%$ of the value measured initially.
			Tangent of loss angle.			Increase of tan δ: ≤0.008 for: $C \leq 1$ µF compared to the values measured initially.
			Insulation resistance.			As specified in Section "Insulation resistance" of this specification.
SUB-GROUP C1B OTHER PART OF SAMPLE OF SUB-GROUP C1		D		6	12	
	Initial measurements		Capacitance. Tangent of loss angle: for $C \leq 1$ µF at 10 kHz			
4.20	Solvent resistance of the marking: see Section "General notes:"; item 5.		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		θA = –40 °C θB = +100 °C 5 cycles Duration t = 30 min.			
4.6.1	Inspection		Visual examination.			No visible damage.

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SUB-CLAUSE NUMBER AND TEST		D OR ND	CONDITIONS	p	n	PERFORMANCE REQUIREMENTS
4.7	Vibration (see note 3.l		Mounting : see Section "Mounting" of this specification Procedure B4 Frequency range: 10 to 55 Hz. Amplitude: 0.75 mm or acceleration 98 m/s^2 (whichever is less severe) Total duration 6 hours.			
4.7.2	Final inspection		Visual examination.			No visible damage.
4.9	Shock (see note 3.)		Mounting : see Section "Mounting" for more information Pulse shape: half sine Acceleration: 490 m/s^2 Duration of pulse: 11 ms.			
4.9.2	Final measurements		Visual examination. Capacitance. Tangent of loss angle. Insulation resistance.			No visible damage. $\|\Delta C/C\| \leq 5\%$ of the value measured initially. Increase of tan δ: ≤ 0.008 for: $C \leq 1\ \mu F$ compared to the values measured initially. As specified in Section "Insulation resistance" of this specification.
SUB-GROUP C1 COMBINED SAMPLE OF SPECIMENS OF SUB-GROUPS C1A AND C1B		D		6	18	
4.11	Climatic sequence					
4.11.1	Initial measurements		Capacitance: measured in 4.4.2 and 4.9.2. Tangent of loss angle: measured initially in C1A and C1B.			
4.11.2	Dry heat		Temperature: 100 °C Duration: 16 hours.			
4.11.3	Damp heat cyclic Test Db First cycle					
4.11.4	Cold		Temperature: –40 °C Duration: 2 hours.			

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SUB-CLAUSE NUMBER AND TEST	D OR ND	CONDITIONS	p	n	PERFORMANCE REQUIREMENTS
4.11.5 Damp heat cyclic Test Db remaining cycles					
4.11.6 Final measurements		Visual examination.			No visible damage Legible marking.
		Capacitance.			$\|\Delta C/C\| \leq 5\%$ of the value measured in 4.11.1.
		Tangent of loss angle.			Increase of tan δ: ≤ 0.008 for: $C \leq 1\ \mu F$ compared to the values measured in 4.11.1.
		Voltage proof 1200 V (DC), 1 min. between term.			No permanent breakdown or flashover.
		Insulation resistance.			$\geq 50\%$ of values specified in Section "Insulation resistance" of this specification.
SUB-GROUP C2	D		6	10	
4.12 Damp heat steady state		56 days; 40 °C; 95 to 98% RH no load			
4.12.1 Initial measurements		Capacitance. Tangent of loss angle: for $C \leq 1\ \mu F$ at 10 kHz			
4.12.3 Final measurements		Visual examination.			No visible damage Legible marking.
		Capacitance.			$\|\Delta C/C\| \leq 5\%$ of the value measured in 4.12.1.
		Tangent of loss angle.			Increase of tan δ: ≤ 0.008 for: $C \leq 1\ \mu F$ compared to values measured in 4.12.1.
		Voltage proof 1200 V (DC), 1 min. between term.			No permanent breakdown or flashover.
		Insulation resistance.			$\geq 50\%$ of values specified in Section "Insulation resistance" of this specification.

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SUB-CLAUSE NUMBER AND TEST	D OR ND	CONDITIONS	p	n	PERFORMANCE REQUIREMENTS
SUB-GROUP C3	D		3	12	
4.13.1 Initial measurements		Capacitance. Tangent of loss angle: for $C \leq 1\ \mu F$ at 10 kHz			
4.13 Impulse voltage		3 successive impulses, full wave, peak voltage: X2: 2.5 kV for $C \leq 1\mu F$ Max. 24 pulses.			No selfhealing breakdowns or flashover.
4.14 Endurance		Duration: 1000 hours $1.25 \times U_{Rac}$ at 100 °C Once in every hour the voltage is increased to 1000 V (RMS) for 0.1 s via a resistor of 47 Ω ± 5%.			
4.14.7 Final measurements		Visual examination.			No visible damage Legible marking.
		Capacitance.			$\lvert\Delta C/C\rvert \leq 10\%$ compared to values measured in 4.13.1.
		Tangent of loss angle.			Increase of tan δ: ≤0.008 for: $C \leq 1\ \mu F$ compared to values measured in 4.13.1.
		Voltage proof 1200 V (DC), 1 min. between terminations 2050 V (AC), 1 min. between terminations and case			No permanent breakdown or flashover.
		Insulation resistance.			≥50% of values specified in Section "Insulation resistance" of this specification.
SUB-GROUP C4	D		6	6	
4.15 Charge and discharge		10000 cycles (50 c/s) charge to U_R half sinewave Duration: 5 ms Discharge resistance: $R = \frac{385Vdc}{1.5 \times C(dU/dt)}$ $R_{min} = 2.2\Omega$			

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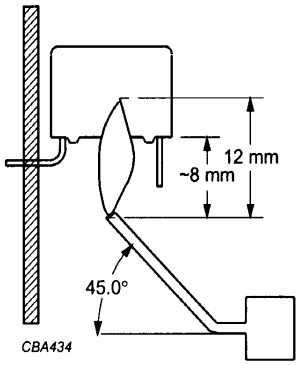
SUB-CLAUSE NUMBER AND TEST	D OR ND	CONDITIONS	p	n	PERFORMANCE REQUIREMENTS
4.15.1 Initial measurements		Capacitance. Tangent of loss angle: for C ≤ 1 µF at 10 kHz			
4.15.3 Final measurements		Capacitance. Tangent of loss angle. Insulation resistance.			|ΔC/C| ≤ 10% of the value measured in 4.15.1. Increase of tan δ: ≤0.008 for: C ≤ 1 µF compared to values measured in 4.15.1. ≥50% of values specified in Section "Insulation resistance" of this specification.
SUB-GROUP C5	D		12	4	
4.16 Radio frequency characteristic.		Resonance frequency.			As specified in Section "Resonant frequency" of this specification. ± 10%.
SUB-GROUP C6	D		12	18	
4.17 Passive flammability Class C		Bore of gas jet: ∅ 0.5 mm Fuel: butane Test duration for actual volume V in mm^3: V ≤ 250: 5 s 250 < V ≤ 500: 10 s 500 < V ≤ 1750: 20 s V > 1750: 30 s One flame application  			After removing test flame from capacitor, the capacitor must not continue to burn for more than 10 s. No burning particle must drop from the sample.

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SUB-CLAUSE NUMBER AND TEST	D OR ND	CONDITIONS	p	n	PERFORMANCE REQUIREMENTS
SUB-GROUP C7	D		12	24	
4.18 Active flammability		20 × 2.5 kV discharges on the test capacitor connected to $U_{Rac.}$			The cheese cloth around the capacitors shall not burn with a flame No electrical measurements are required.

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Group additional inspection

ADDITIONAL TESTS	D OR ND	CONDITIONS	p	n	PERFORMANCE REQUIREMENTS
SUB-GROUP ADD1	D		3	10	
A.1 Solderability		Without ageing Method: 1 Non-activated colophony flux 501 Solder bath: 235 °C Dwell time: 2 s.			Good tinning as evidenced by free flowing of the solder with wetting of the terminations (>95 %)
SUB-GROUP ADD2	D		3	12	
A.2 Heat storage		Duration: 1000 hours Temperature: 100 °C			
A.2.1 Initial measurements		Capacitance. Tangent of loss angle: for $C \leq 1$ µF at 10 kHz			
A.2.2 Final measurements		Visual examination.			No visible damage.
		Capacitance.			$\lvert\Delta C/C\rvert \leq 5\%$ of the value measured in A.2.1.
		Tangent of loss angle.			Increase of tan δ: ≤0.008 for: $C \leq 1$ µF compared to values measured in A.2.1.
		Insulation resistance.			As specified in Section "Insulation resistance" of this specification.
SUB-GROUP ADD3	D		3	9	
A.3 Endurance					
A.3.1 Endurance test		Duration: 1000 hours Temperature: 100 °C Voltage: $1.25 \times U_{Rdc}$ at 100 °C.			
A.3.2 Initial measurements		Capacitance. Tangent of loss angle: for $C \leq 1$ µF at 10 kHz			
A.3.3 Final measurements		Visual examination.			No visible damage.
		Capacitance.			$\lvert\Delta C/C\rvert \leq 5\%$ of the value measured in A.3.2.
		Tangent of loss angle.			Increase of tan-delta: Increase of tan-delta ≤0.008 for: $C \leq 1$ µF compared to values measured in A.3.2.

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ADDITIONAL TESTS	D OR ND	CONDITIONS	p	n	PERFORMANCE REQUIREMENTS
		Insulation resistance.			≥50% of values specified in Section "Insulation resistance" of this specification.
SUB-GROUP ADD4	D		6	15	
A.4.1 Active flammability		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 250 V (AC) power supply during 5 minutes.			The capacitor shall not ignite a cheese cloth.

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AMENDMENT RECORD

DATE	CHANGE DESCRIPTION
00-03-07	First issue (provisionally released to 1 µF)
00-03-31	Several adjustments
00-04-20	Several adjustments
00-05-12	VDE approved
00-10-04	p.13 and 14: UL approval is cancelled (given by Marketing)