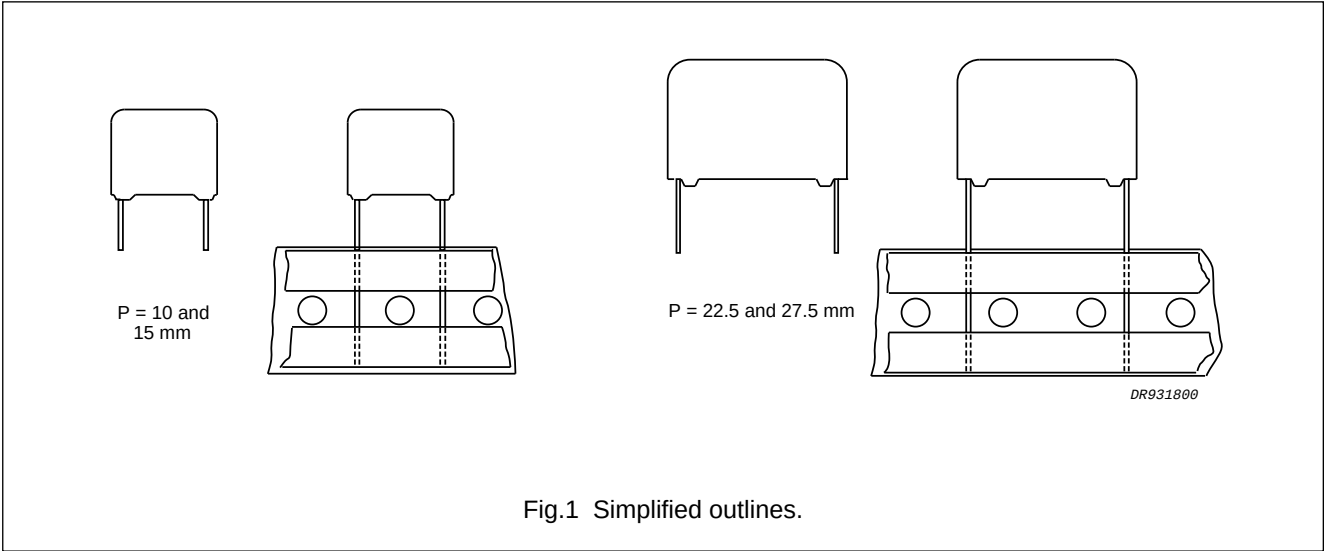


Interference suppression film capacitors

MKP 336 1/2

MKP RADIAL POTTED CAPACITORS

PITCH 10/15/22.5/27.5 mm



FEATURES

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

APPLICATIONS

- For X1 and X2 electromagnetic interference suppression
- Specially designed to meet the NEW REQUIREMENTS of the new "IEC 384-14 2nd edition, EN 132400", requiring for X1 a 4 kV and 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	
	MKP 336 1, X1	MKP 336 2, X2
Capacitance range (E12 series)	1 nF to 1 μF	1 nF to 2.2 μF
Capacitance tolerance	±20%; ±10%; ±5%	
Rated voltage (AC), 50 to 60 Hz	275 V	
Climatic category	55/100/21/C	
Rated temperature	100 °C	
Maximum application temperature	100 °C	
Reference specifications	IEC 384-14 2 nd edition, EN 132400; note 1	
Safety approvals	UL1414; CSA-C22.2 No 1 at (250 V); SEV; VDE; FI; N; D; S; IMQ; ÖVE	
Materials	qualified in accordance with UL94V-O	
Safety class	X1; X2	

Note

1. IEC 384-14 2nd edition = EN 132400.

Interference suppression film capacitors

MKP 336 1

MKP 336 1 GENERAL DATA

PITCH 10/15 mm

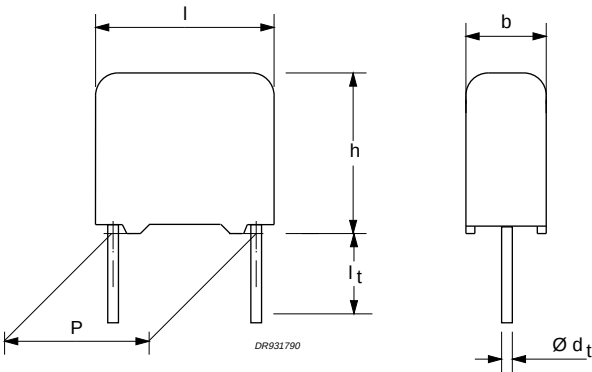


Fig.2 Outline.

Specific reference data for the 275 V AC (X1) capacitors

DESCRIPTION	VALUE	
	at 10 kHz	at 100 kHz
Tangent of loss angle: C ≤ 100 nF	≤10 × 10 ⁻⁴	≤50 × 10 ⁻⁴
Rated voltage pulse slope (dU/dt) _R	200 V/μs	
R between leads, for C ≤ 0.33 μF	>15000 MΩ	
Test voltage (DC) on line	3400 V; 1 s	

Available 275 V AC (X1) versions

PACKAGING	DIMENSIONS	C-tol	FIRST 9 DIGITS OF CATALOGUE NUMBER	ORDERING
Loose in box	l _t = 3.5 ±0.5 mm; note 1	±20%	2222 336 10...	preferred
		±10%	2222 336 11...	on request
	l _t = 25.0 ±2.0 mm	±20%	2222 336 16...	on request
		±10%	2222 336 17...	on request
Taped on reel	H = 18.5 mm; note 2	±20%	2222 336 13...	on request
		±10%	2222 336 14...	on request

Notes

- 1. l_t = 3.5 ±0.3 mm for pitch = 15 mm.
- 2. H = in-tape height; for detailed specifications refer to this handbook, Chapter “Packaging”.

Available 275 V AC (X1) versions on request

PACKAGING	DIMENSIONS	C-tol	VALUES	ORDERING
Ammopack	l _t = 3.2 to 35 mm	±5%	E12 series	on request

Interference suppression film capacitors

MKP 336 1/2

Safety approvals

SAFETY APPROVALS (X1)	FILE NUMBERS	SAFETY APPROVALS (X1)	FILE NUMBERS
UL1414	E 112471	NEMKO IEC 384 - 14 (2nd Ed.)	P94102557
CSA-C22.2 No.1-M90	LR 94054-6	DEMKO IEC 384 - 14 (2nd Ed.)	302086
SEV (EN132400)	96,770678	SEMKO IEC 384 - 14 (2nd Ed.)	9447024
VDE (EN132400)	CCA/DE 8926	IMQ (EN132400)	V 3731
FI IEC 384 - 14 (2nd Ed.)	178882-01	ÖVE	23137/R

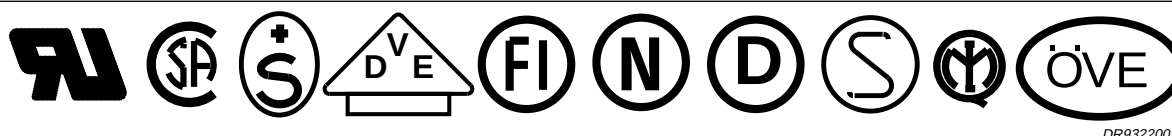


Fig.3 Safety approvals.

 $U_{Rac} = 275 \text{ V (AC) X1}$

loose and taped

C (μF)	DIMENSIONS b × h × l (mm)	MASS (g)	CATALOGUE NUMBER 2222 336 AND PACKAGING			
			LOOSE IN BOX			REEL
			l _t = 3.5 ±0.5 mm ⁽¹⁾		l _t = 25.0 ±2.0 mm	H = 18.5 mm
			last 5 digits of catalogue number ⁽²⁾	SPQ	SPQ	SPQ
			C-tol = ±20%			
Pitch = 10.0 ±0.4 mm; d _t = 0.60 ±0.06 mm						
0.001 0.0015 0.0022	4.0 × 10.0 × 12.5	0.6	10102	1000	1250	1400
			10152			
			10222			
0.0033 0.0047 0.0068	5.0 × 11.0 × 12.5	0.9	10332	1000	1000	1100
			10472			
			10682			
0.01	6.0 × 12.0 × 12.5	1.0	10103	750	750	900
Pitch = 15.0 ±0.4 mm; d _t = 0.80 ±0.08 mm						
0.01 0.01 0.015 0.022	5.0 × 11.0 × 17.5	1.2	note 3	1000	1000	1100
			19001			
			10153			
			10223			
0.022 0.033	6.0 × 12.0 × 17.5	1.4	note 3	1000	1000	900
			10333			
0.033 0.047	7.0 × 13.5 × 17.5	1.9	note 3	1000	500	800
			10473			
0.047 0.068	8.5 × 15.0 × 17.5	2.6	note 3	1000	500	650
			10683			
0.068 0.1	10.0 × 16.5 × 17.5	3.1	note 3	500	500	600
			10104			

Notes

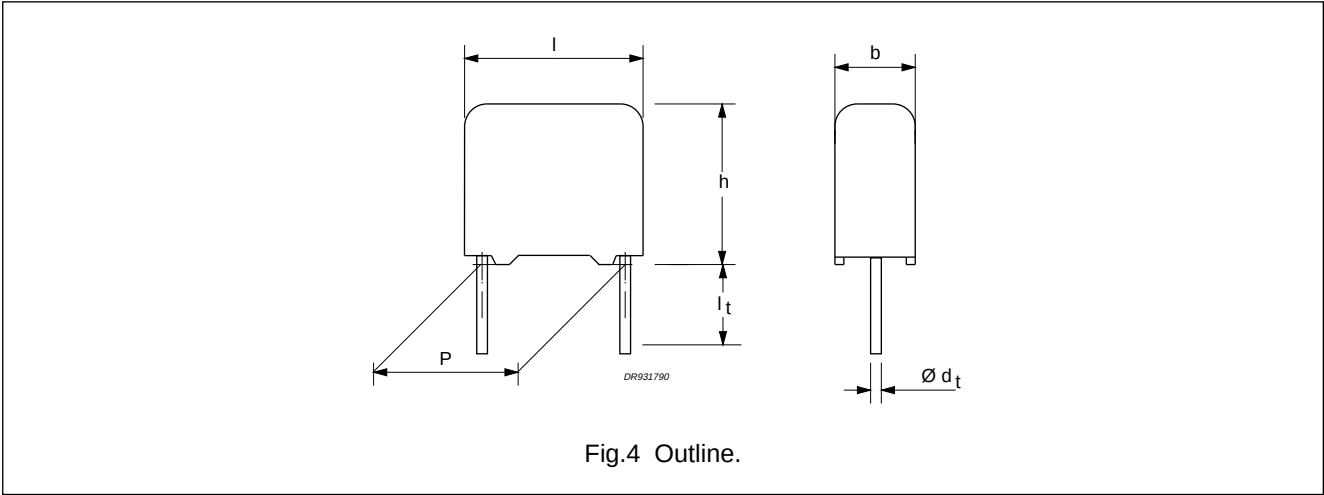
- $l_t = 3.5 \pm 0.3 \text{ mm}$ for pitch = 15 mm.
- The shading indicates preferred types.
- Other dimensions for 10% versions.

Interference suppression film capacitors

MKP 336 1

MKP 336 1 GENERAL DATA

PITCH 22.5/27.5 mm



Specific reference data for the 275 V AC (X1) capacitors

DESCRIPTION	VALUE	
	at 10 kHz	at 100 kHz
Tangent of loss angle: 100 nF < C ≤ 470 nF C > 470 nF	≤ 20 × 10 ⁻⁴ ≤ 70 × 10 ⁻⁴	≤ 100 × 10 ⁻⁴ —
Rated voltage pulse slope (dU/dt) _R	200 V/μs	
R between leads, for C ≤ 0.33 μF	> 15000 MΩ	
RC between leads, for C > 0.33 μF	> 5000 s	
Test voltage (DC) on line	3400 V; 1 s	

Available 275 V AC (X1) versions

PACKAGING	DIMENSIONS	C-tol	FIRST 9 DIGITS OF CATALOGUE NUMBER	ORDERING
Loose in box	l _t = 3.5 ± 0.3 mm	± 20%	2222 336 10...	preferred
		± 10%	2222 336 11...	on request
	l _t = 25.0 ± 2.0 mm	± 20%	2222 336 16...	on request
		± 10%	2222 336 17...	on request
Taped on reel	H = 18.5 mm; note 1	± 20%	2222 336 13...	on request
		± 10%	2222 336 14...	on request

Note

1. H = in-tape height; for detailed specifications refer to this handbook, Chapter “Packaging”.

Available 275 V AC (X1) versions on request

PACKAGING	DIMENSIONS	C-tol	VALUES	ORDERING
Ammopack	l _t = 3.2 to 35 mm	± 5%	E12 series	on request

Interference suppression film capacitors

MKP 336 1/2

Safety approvals

SAFETY APPROVALS (X1)	FILE NUMBERS	SAFETY APPROVALS (X1)	FILE NUMBERS
UL1414	E 112471	NEMKO IEC 384 - 14 (2nd Ed.)	P94102557
CSA-C22.2 No.1-M90	LR 94054-6	DEMKO IEC 384 - 14 (2nd Ed.)	302086
SEV (EN132400)	96,770678	SEMKO IEC 384 - 14 (2nd Ed.)	9447024
VDE (EN132400)	CCA/DE 8926	IMQ (EN132400)	V 3731
FI IEC 384 - 14 (2nd Ed.)	178882-01	ÖVE	23137/R

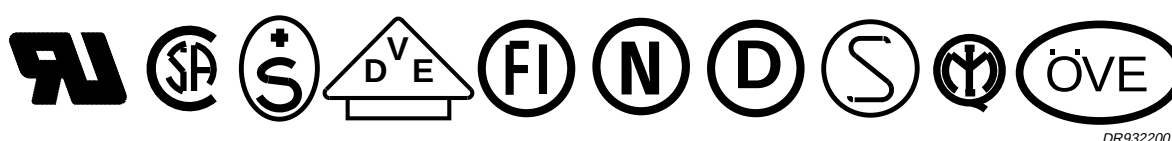


Fig.5 Safety approvals.

 $U_{Rac} = 275 \text{ V (AC) X1}$

loose and taped

C (μ F)	DIMENSIONS $b \times h \times l$ (mm)	MASS (g)	CATALOGUE NUMBER 2222 336 AND PACKAGING			
			LOOSE IN BOX			REEL
			$l_t = 3.5 \pm 0.3$ mm		$l_t = 25.0 \pm 2.0$ mm	$H = 18.5$ mm
			last 5 digits of catalogue number ⁽¹⁾	SPQ	SPQ	SPQ
			C-tol = $\pm 20\%$			
Pitch = 22.5 ± 0.4 mm; $d_t = 0.80 \pm 0.08$ mm						
0.1 0.1	$7.0 \times 16.5 \times 26.0$	3.2	note 2 19003	200	500	550
0.15	$8.5 \times 18.0 \times 26.0$	4.4	10154	200	500	450
0.22	$10.0 \times 19.5 \times 26.0$	5.5	10224	200	500	400
Pitch = 27.5 ± 0.4 mm; $d_t = 0.80 \pm 0.08$ mm						
0.22 0.22	$11.0 \times 21.0 \times 31.0$	7.8	note 2 19005	100	125	300
0.33	$13.0 \times 23.0 \times 31.0$	10.4	10334	100	125	250
0.47	$15.0 \times 25.0 \times 31.0$	12.8	10474	100	125	200
0.68	$18.0 \times 28.0 \times 31.0$	17.2	10684	100	125	150
1	$21.0 \times 31.0 \times 31.0$	20.4	10105	50	75	not available

Notes

1. The shading indicates preferred types.
2. Other dimensions for 10% versions.

Interference suppression film capacitors

MKP 336 2

MKP 336 2 GENERAL DATA

PITCH 10/15 mm

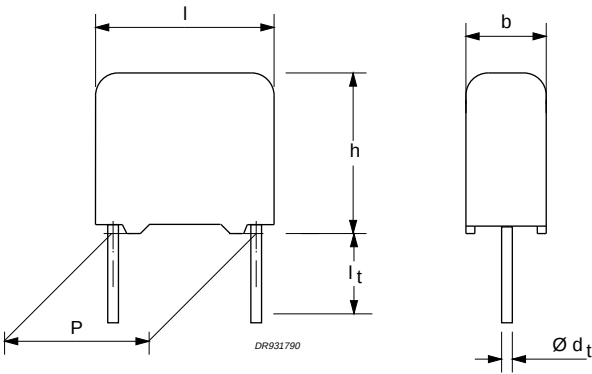


Fig.6 Outline.

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

DESCRIPTION	VALUE	
	at 10 kHz	at 100 kHz
Tangent of loss angle: C ≤ 100 nF 100 nF < C ≤ 220 nF	≤10 × 10 ⁻⁴ ≤20 × 10 ⁻⁴	≤50 × 10 ⁻⁴ ≤100 × 10 ⁻⁴
Rated voltage pulse slope (dU/dt) _R	100 V/μs	
R between leads, for C ≤ 0.33 μF	>15000 MΩ	
Test voltage (DC) on line: C ≤ 1μF	2200 V; 1 s	

Available 275 V (AC) X2 versions

PACKAGING	DIMENSIONS	C-tol	FIRST 9 DIGITS OF CATALOGUE NUMBER	ORDERING
Loose in box	l _t = 3.5 ±0.5 mm; note 1	±20%	2222 336 20...	preferred
		±10%	2222 336 21...	on request
	l _t = 25.0 ±2.0 mm	±20%	2222 336 26...	on request
		±10%	2222 336 27...	on request
Taped on reel	H = 18.5 mm; note 2	±20%	2222 336 23...	on request
		±10%	2222 336 24...	on request

Notes

- 1. l_t = 3.5 ±0.3 mm for pitch = 15 mm.
- 2. H = in-tape height; for detailed specifications refer to this handbook, Chapter “Packaging”.

Available 275 V AC (X2) versions on request

PACKAGING	DIMENSIONS	C-tol	VALUES	ORDERING
Ammopack	l _t = 3.2 to 35 mm	±5%	E12 series	on request

Interference suppression film capacitors

MKP 336 1/2

Safety approvals

SAFETY APPROVALS (X2)	FILE NUMBERS	SAFETY APPROVALS X2)	FILE NUMBERS
UL1414 ⁽¹⁾	E 112471	NEMKO IEC 384 - 14 (2nd Ed.)	P94101881
CSA-C22.2 No.1-M90 ⁽¹⁾	LR 94054-6	DEMKO IEC 384 - 14 (2nd Ed.)	302811
SEV (EN132400) ⁽¹⁾	96,770678	SEMKO IEC 384 - 14 (2nd Ed.)	9439096
VDE (EN132400)	CCA/DE 8926	IMQ (EN132400)	V 3732
FI IEC 384 - 14 (2nd Ed.)	176515.01	ÖVE	23136/R

Note

- Only for 1 nF up to and including 1 μ F.

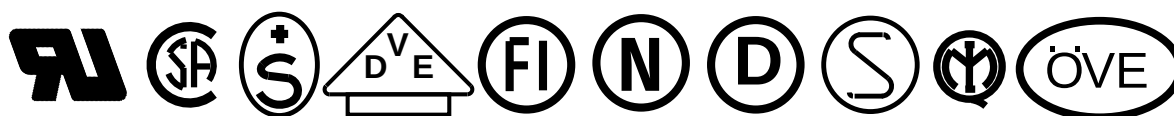


Fig.7 Safety approvals.

 $U_{Rac} = 275 \text{ V (AC) X2}$

loose and taped

C (μF)	DIMENSIONS b × h × l (mm)	MASS (g)	CATALOGUE NUMBER 2222 336 AND PACKAGING			
			LOOSE IN BOX			REEL
			l _t = 3.5 ±0.5 mm ⁽¹⁾		l _t = 25.0 ±2.0 mm	H = 18.5 mm
			last 5 digits of catalogue number ⁽²⁾	SPQ	SPQ	SPQ
			C-tol = ±20%			
Pitch = 10.0 ±0.4 mm; d _t = 0.60 ±0.06 mm						
0.001 0.0015 0.0022	4.0 × 10.0 × 12.5	0.6	20102 20152 20222	1000	1250	1400
0.0033 0.0047 0.0068 0.01 0.015 0.022	5.0 × 11.0 × 12.5	0.9	20332 20472 20682 20103 20153 20223	1000	1000	1100
0.033	6.0 × 12.0 × 12.5	1.0	20333	750	750	900
Pitch = 15.0 ±0.4 mm; d _t = 0.80 ±0.08 mm						
0.01 0.015 0.022 0.033 0.047 0.068	5.0 × 11.0 × 17.5	1.2	29001 29011 29021 29031 20473 20683	1000	1000	1100
0.068 0.1	6.0 × 12.0 × 17.5	1.4	note 3 20104	1000	1000	900
0.1	7.0 × 13.5 × 17.5	1.9	note 3	1000	500	800
0.15	8.5 × 15.0 × 17.5	2.6	20154	1000	500	650
0.22	10.0 × 16.5 × 17.5	3.1	20224	500	500	600

Notes

- $l_t = 3.5 \pm 0.3 \text{ mm}$ for pitch = 15 mm.
- The shading indicates preferred types.
- Other dimensions for 10% versions.

Interference suppression film capacitors

MKP 336 2

MKP 336 2 GENERAL DATA

PITCH 22.5/27.5 mm

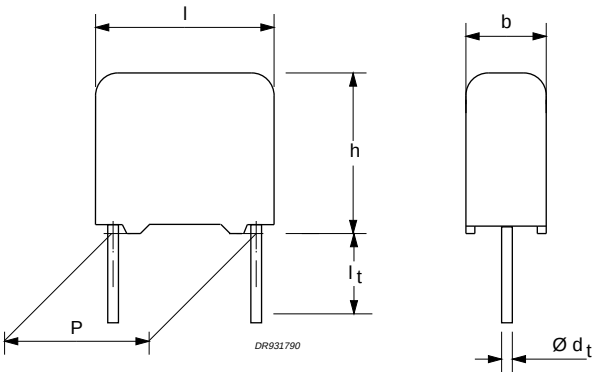


Fig.8 Outline.

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

DESCRIPTION	VALUE	
	at 10 kHz	at 100 kHz
Tangent of loss angle: 150 nF < C ≤ 470 nF C > 470 nF	≤20 × 10 ⁻⁴ ≤70 × 10 ⁻⁴	≤100 × 10 ⁻⁴ –
Rated voltage pulse slope (dU/dt) _R	100 V/μs	
R between leads, for C ≤ 0.33 μF	>15000 MΩ	
RC between leads, for C > 0.33 μF	>5000 s	
Test voltage (DC) on line: C ≤ 1μF C >1μF	2200 V; 1 s 2200 V/√C (C in μF); 1 s	

Available 275 V (AC) X2 versions

PACKAGING	DIMENSIONS	C-tol	FIRST 9 DIGITS OF CATALOGUE NUMBER	ORDERING
Loose in box	l _t = 3.5 ±0.3 mm	±20%	2222 336 20...	preferred
		±10%	2222 336 21...	on request
	l _t = 25.0 ±2.0 mm	±20%	2222 336 26...	on request
		±10%	2222 336 27...	on request
Taped on reel	H = 18.5 mm; note 1	±20%	2222 336 23...	on request
		±10%	2222 336 24...	on request

Note

1. H = in-tape height; for detailed specifications refer to this handbook, Chapter “Packaging”.

Available 275 V AC (X2) versions on request

PACKAGING	DIMENSIONS	C-tol	VALUES	ORDERING
Ammopack	l _t = 3.2 to 35 mm	±5%	E12 series	on request

Interference suppression film capacitors

MKP 336 1/2

Safety approvals

SAFETY APPROVALS (X2)	FILE NUMBERS	SAFETY APPROVALS (X2)	FILE NUMBERS
UL1414 ⁽¹⁾	E 112471	NEMKO IEC 384 - 14 (2nd Ed.)	P94101881
CSA-C22.2 No.1-M90 ⁽¹⁾	LR 94054-6	DEMKO IEC 384 - 14 (2nd Ed.)	302811
SEV (EN132400) ⁽¹⁾	96,770678	SEMKO IEC 384 - 14 (2nd Ed.)	9439096
VDE (EN132400)	CCA/DE 8926	IMQ (EN132400)	V 3732
FI IEC 384 - 14 (2nd Ed.)	176515.01	ÖVE	23136/R

Note

1. Only for 1 nF up to and including 1 μ F.

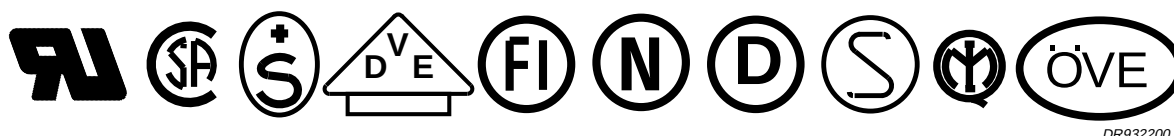


Fig.9 Safety approvals.

 $U_{Rac} = 275 \text{ V (AC) X2}$

loose and taped

C (μF)	DIMENSIONS b × h × l (mm)	MASS (g)	CATALOGUE NUMBER 2222 336 AND PACKAGING			
			LOOSE IN BOX			REEL
			l _t = 3.5 ±0.3 mm		l _t = 25.0 ±2.0 mm	H = 18.5 mm
			last 5 digits of catalogue number ⁽¹⁾	SPQ	SPQ	SPQ
			C-tol = ±20%			
Pitch = 22.5 ±0.4 mm; d _t = 0.80 ±0.08 mm						
0.15	6.0 × 15.5 × 26.0	2.9	29041	200	500	600
0.22	7.0 × 16.5 × 26.0	3.2	29051	200	500	550
0.33	8.5 × 18.0 × 26.0	4.4	20334	200	500	450
0.47	10.0 × 19.5 × 26.0	5.5	20474	200	500	400
Pitch = 27.5 ±0.4 mm; d _t = 0.80 ±0.08 mm						
0.47	9.0 × 19.0 × 31.0	5.5	29055	100	150	400
0.68	11.0 × 21.0 × 31.0	7.8	20684	100	125	300
1	13.0 × 23.0 × 31.0	10.4	20105	100	125	250
1	15.0 × 25.0 × 31.0	12.8	note 2	100	125	200
1.5	18.0 × 28.0 × 31.0	17.2	20155	100	125	150
2.2	21.0 × 31.0 × 31.0	20.4	20225	50	75	not available

Notes

1. The shading indicates preferred types.
2. Other dimensions for 10% versions.

Interference suppression film capacitors

MKP 336 1/2

CONSTRUCTION**Description**

- Low-inductive wound cell of metallized polypropylene (PP) film, potted with epoxy resin in a flame-retardant polypropylene case
- Radial leads, solder-coated:
 - Copper clad steel wire (pitch = 4e and 6e)
 - Copper wire (pitch = 9e and 11e)
- Small stand-off pips allow removal of solder flux etc. during cleaning of the printed-circuit board.

SPACE REQUIREMENTS ON PRINTED-CIRCUIT BOARD

The maximum length and width of film capacitors is shown in Fig.11:

- Eccentricity as in Fig.11. 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 717" as reference: $h_{\max} \leq h + 0.3 \text{ mm}$.

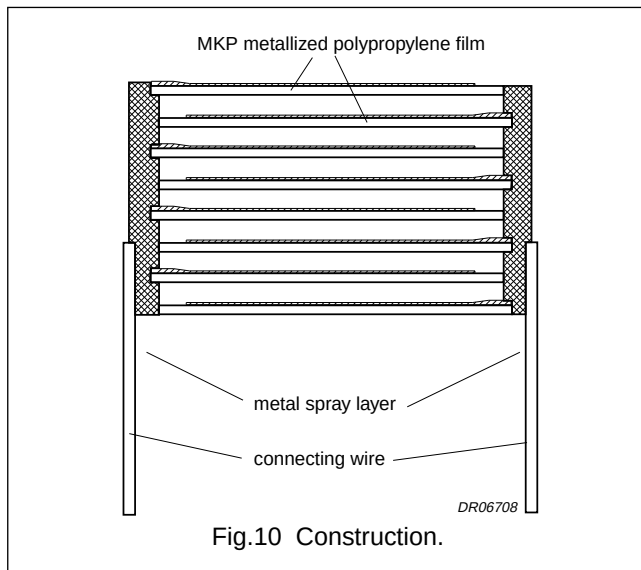


Fig.10 Construction.

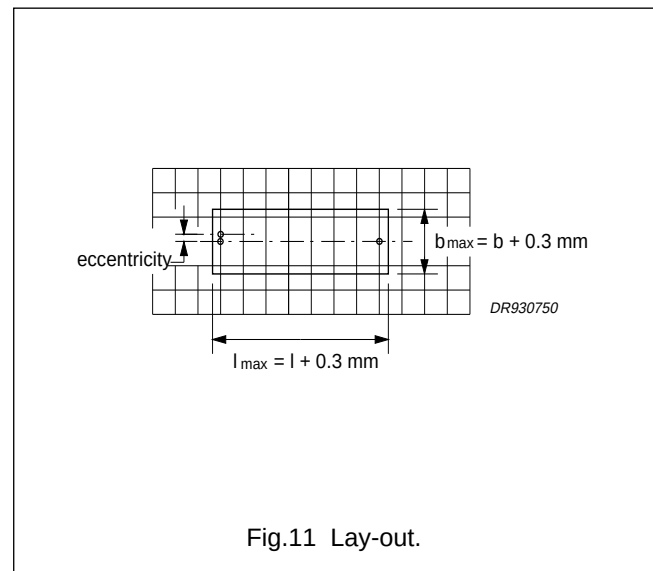


Fig.11 Lay-out.

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".

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 $\leq 15 \text{ mm}$ capacitors shall be mechanically fixed by the leads.
- For larger pitches the capacitors shall be mounted in the same way and the body clamped.

RATINGS AND CHARACTERISTICS

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

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

Interference suppression film capacitors

MKP 336 1/2

Capacitance

All capacitance values are specified at 1 kHz.

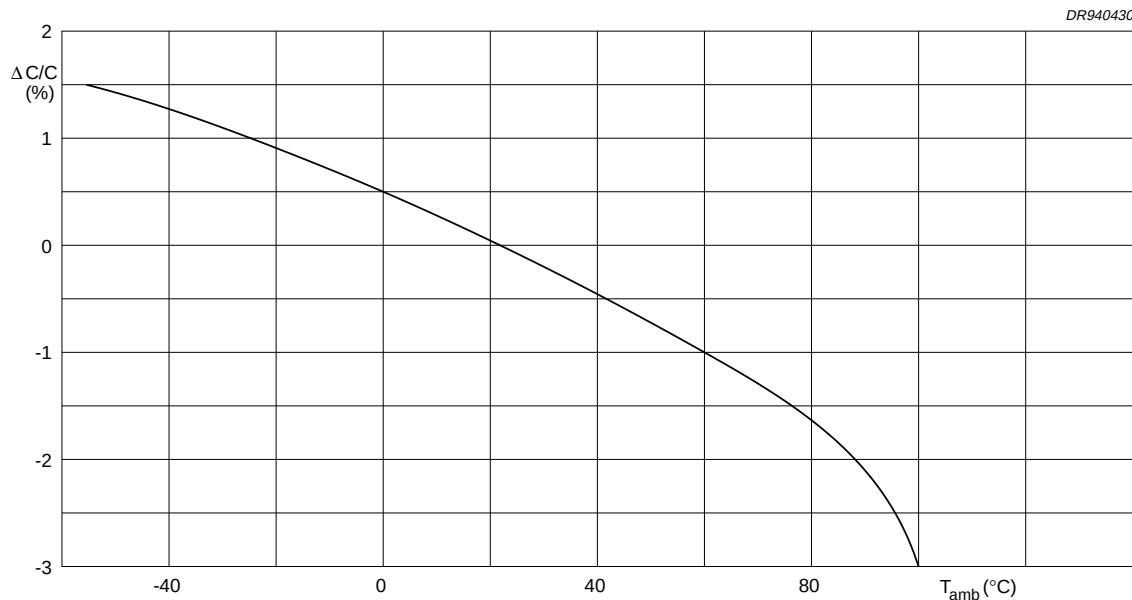


Fig.12 Capacitance change as a function of temperature; typical curve.

Impedance

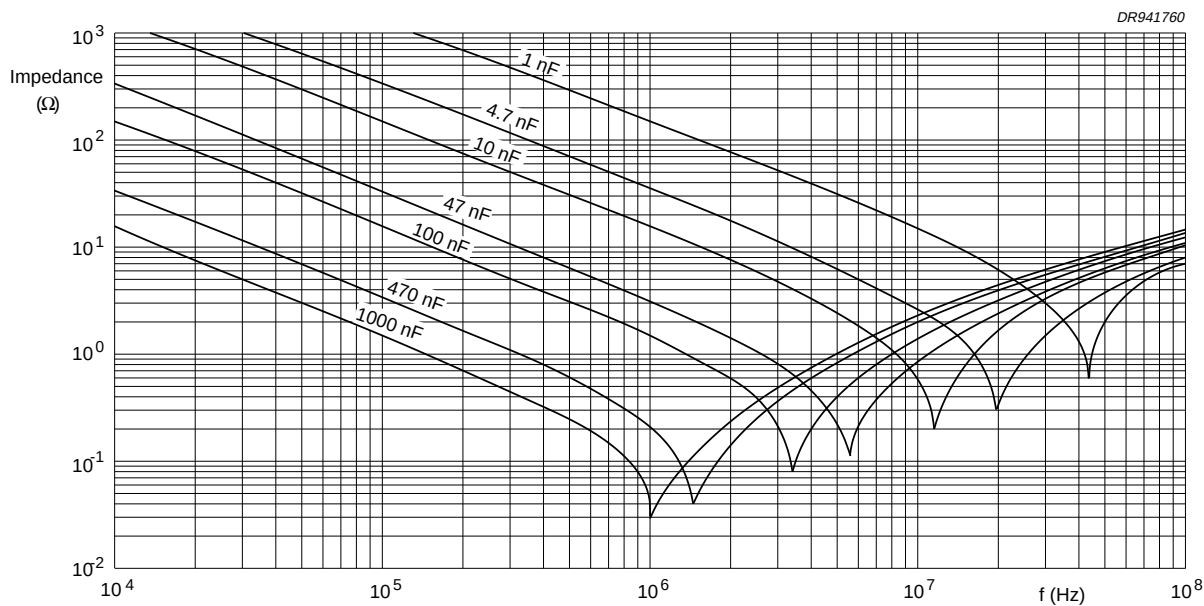


Fig.13 Impedance as a function of frequency; typical curves.

Interference suppression film capacitors

MKP 336 1/2

Resonant frequency

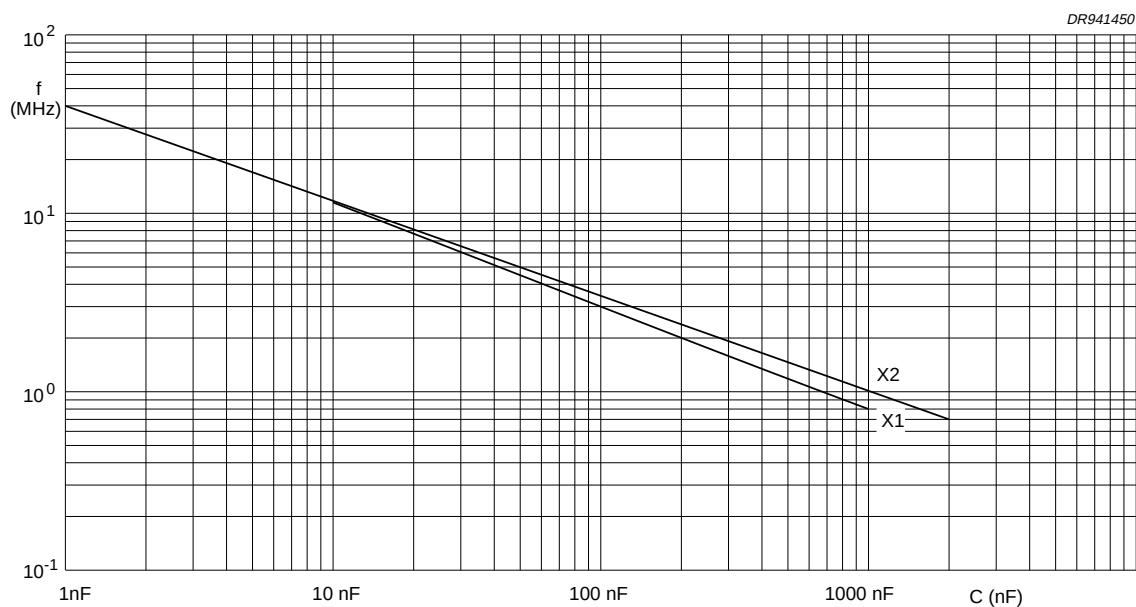


Fig.14 Resonant frequency as a function of capacitance; typical curves.

Temperature

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

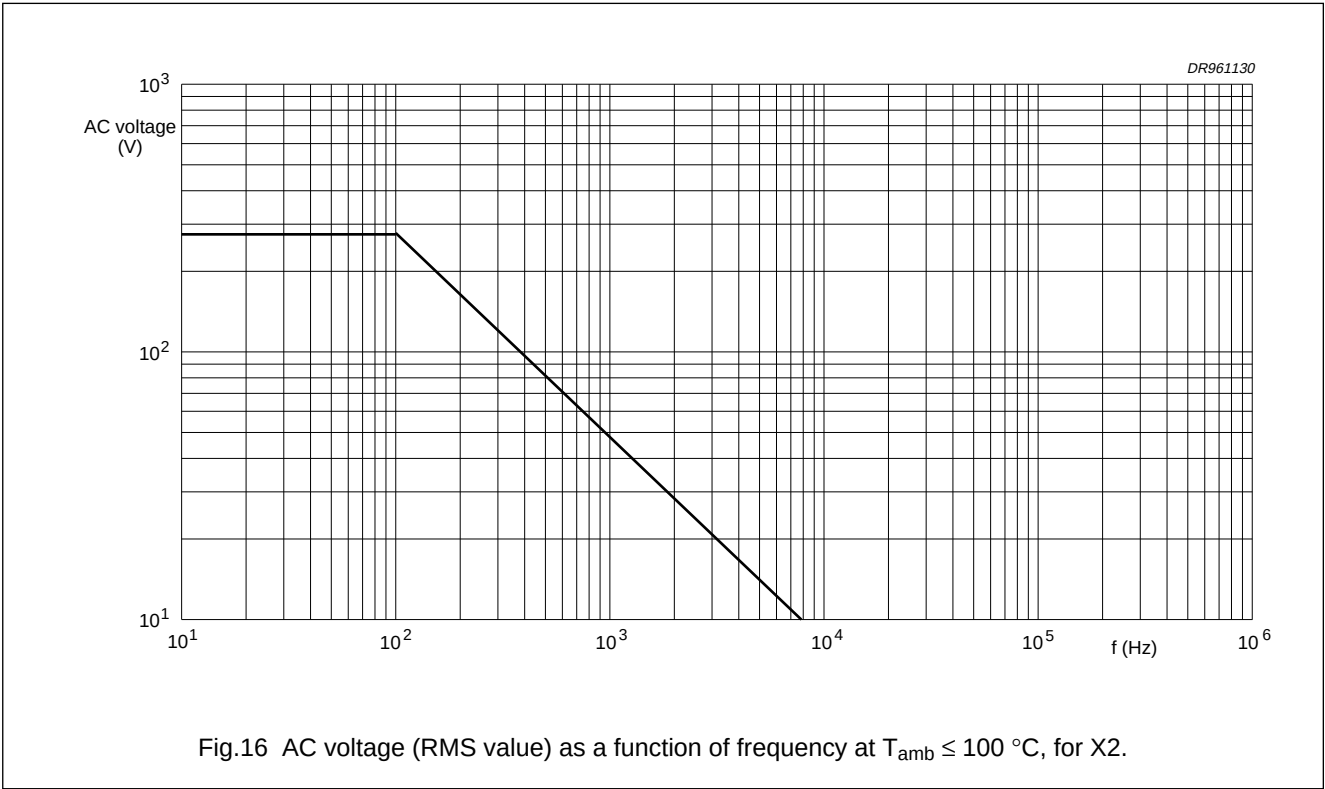
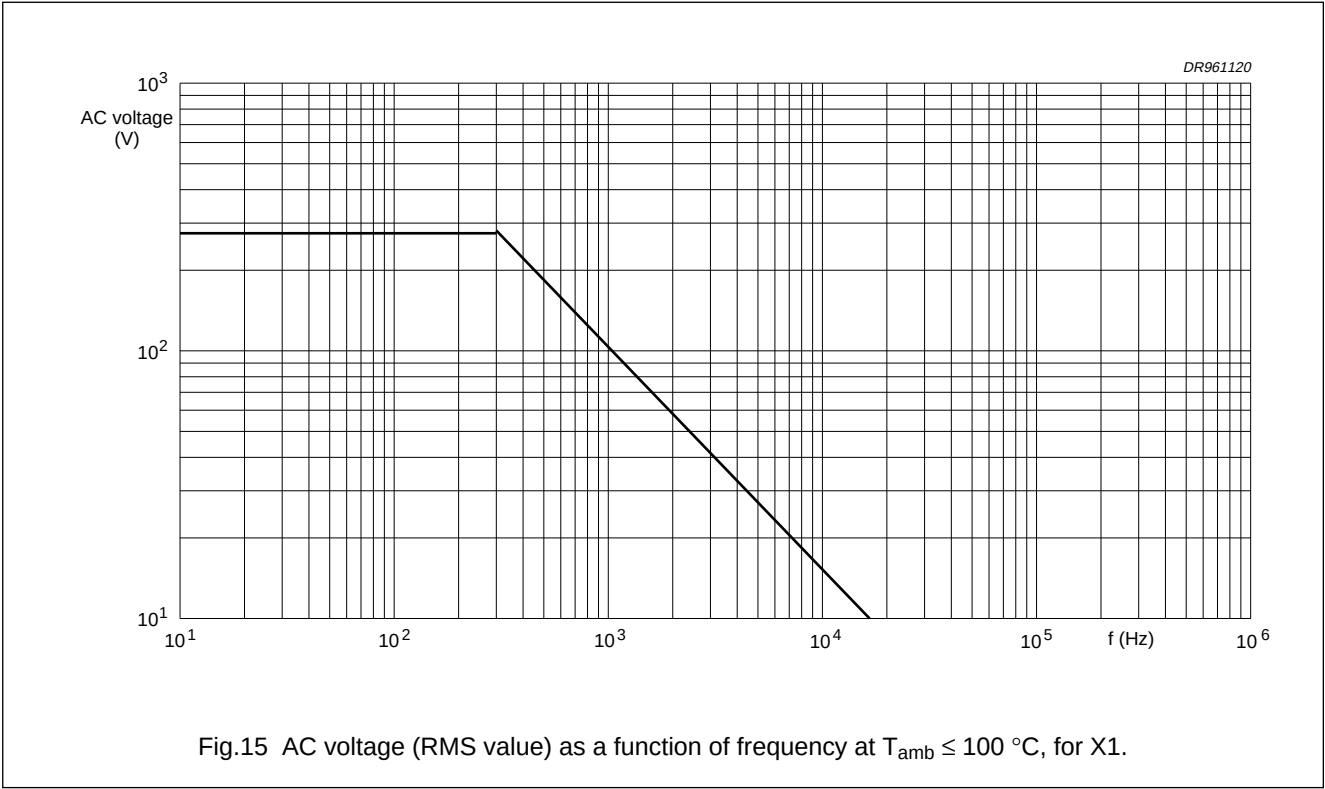
Voltage

- Test voltage (DC) between leads, 100% on line for 1 second:
 - for X1 capacitors: 3400 V
 - for X2 capacitors with $C \leq 1\mu\text{F}$: 2200 V and for $C > 1\mu\text{F}$: $\frac{2200 \text{ V}}{\sqrt{C}} \text{ (C in } \mu\text{F)}$
- Test voltage (AC) between interconnected leads and case (foil method): 2050 V.

Interference suppression film capacitors

MKP 336 1/2

Maximum RMS voltage (sinewave) as a function of frequency for $T_{amb} \leq 100\text{ }^{\circ}\text{C}$

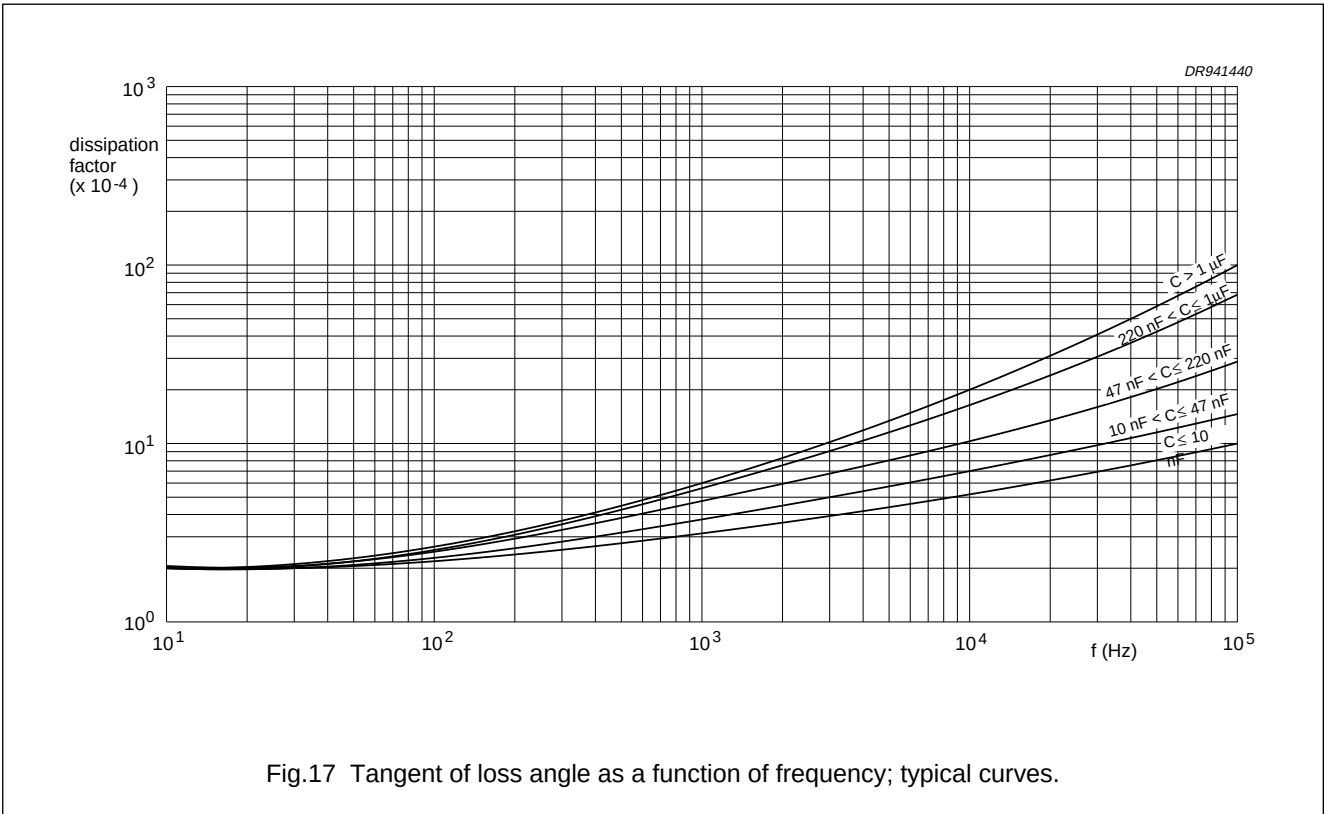


Interference suppression film capacitors

MKP 336 1/2

Tangent of loss angle

CAPACITANCE	TANGENT OF LOSS ANGLE	
	at 10 kHz	at 100 kHz
$C \leq 100\text{ nF}$	$\leq 10 \times 10^{-4}$	$\leq 50 \times 10^{-4}$
$100\text{ nF} < C \leq 470\text{ nF}$	$\leq 20 \times 10^{-4}$	$\leq 100 \times 10^{-4}$
$C > 470\text{ nF}$	$\leq 70 \times 10^{-4}$	—



Rated voltage pulse slope (dU/dt)_R

Maximum pulse load: 100 V/μs for X2; 200 V/μs for X1
If the pulse voltage is lower than the rated voltage, the values of the specific reference data can be multiplied by $\sqrt{2} \times U_{\text{Rac}}$ and divided by the applied voltage.

Interference suppression film capacitors

MKP 336 1/2

Insulation resistance

The insulation resistance is measured after a voltage of 100 ± 15 V has been applied for 1 minute ± 5 seconds, at $T_{\text{amb}} = 20$ °C:

- R between leads for $C \leq 0.33$ μF : >15000 $\text{M}\Omega$
- RC between leads for $C > 0.33$ μF : >5000 s
- R between interconnected leads and case (foil method): >30000 $\text{M}\Omega$.

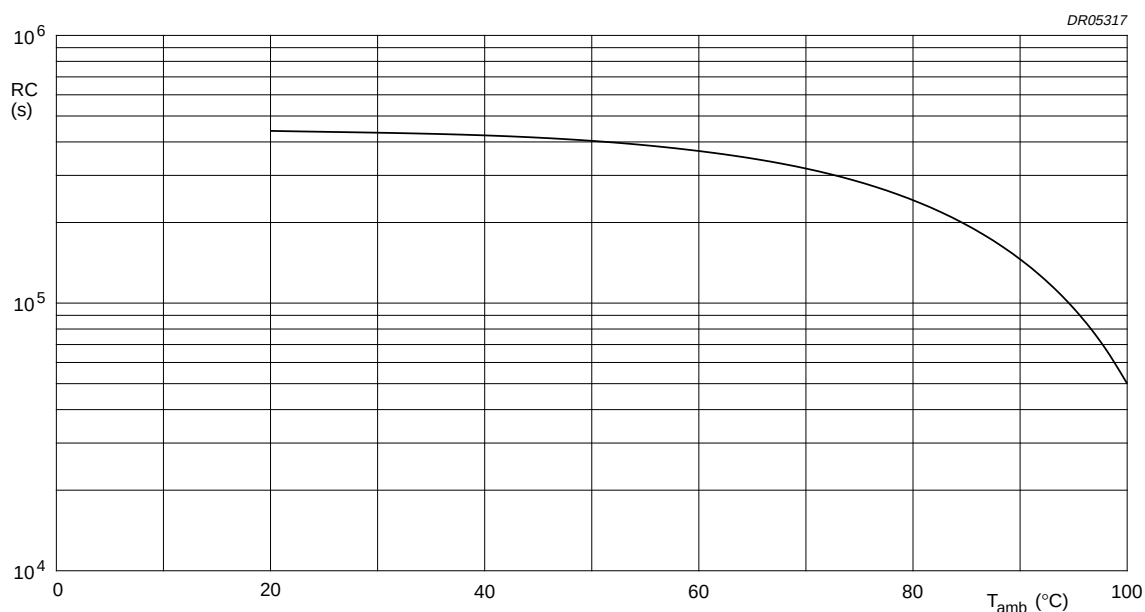


Fig.18 RC product as a function of ambient free air temperature; typical curve.

Application notes

- For X1 and X2 electromagnetic interference suppression in across the line applications (50/60 Hz)
- 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 376; 2222 378 or 2222 379

Interference suppression film capacitors

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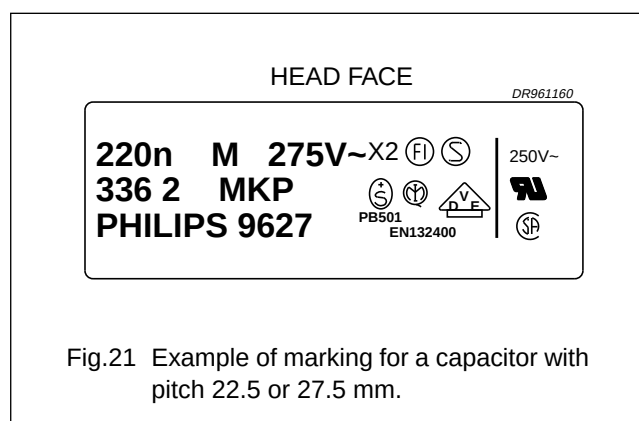
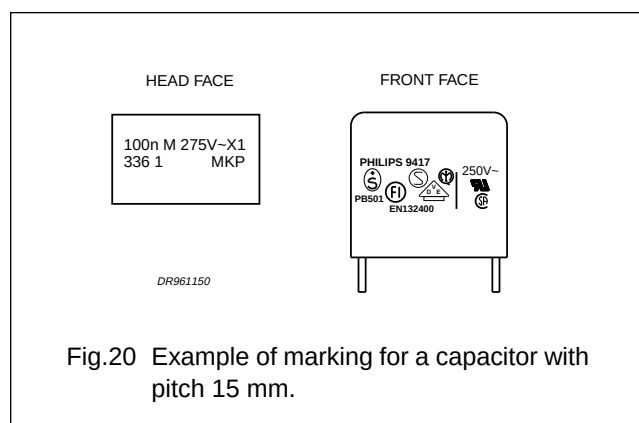
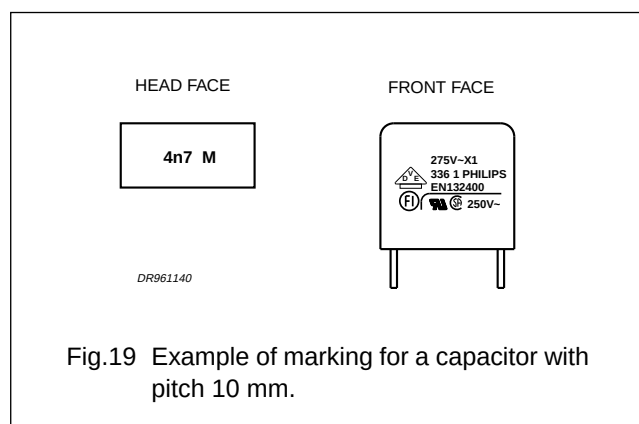
MARKING

Product marking

CAPACITORS WITH PITCH 10 TO 27.5 MM

The capacitors are marked by laser print; on the top (pitch ≥ 22.5 mm) or on the top and one side (pitch ≤ 15 mm) with the following information:

1. Rated capacitance code in accordance with "IEC 62"
2. Tolerance on rated capacitance; M = $\pm 20\%$; K = $\pm 10\%$; J = $\pm 5\%$
3. Rated (AC) voltage (275 V)
4. Sub-class (e.g. X1)
5. Manufacturer's type designation (e.g. 336 1)
6. Code for dielectric material (MKP) for pitch ≥ 15 mm
7. Manufacturer (PHILIPS)
8. Year and week of manufacture (e.g. 9401) for pitch ≥ 15 mm
9. Safety approvals: products will be marked with approvals depending on the available marking space per product.

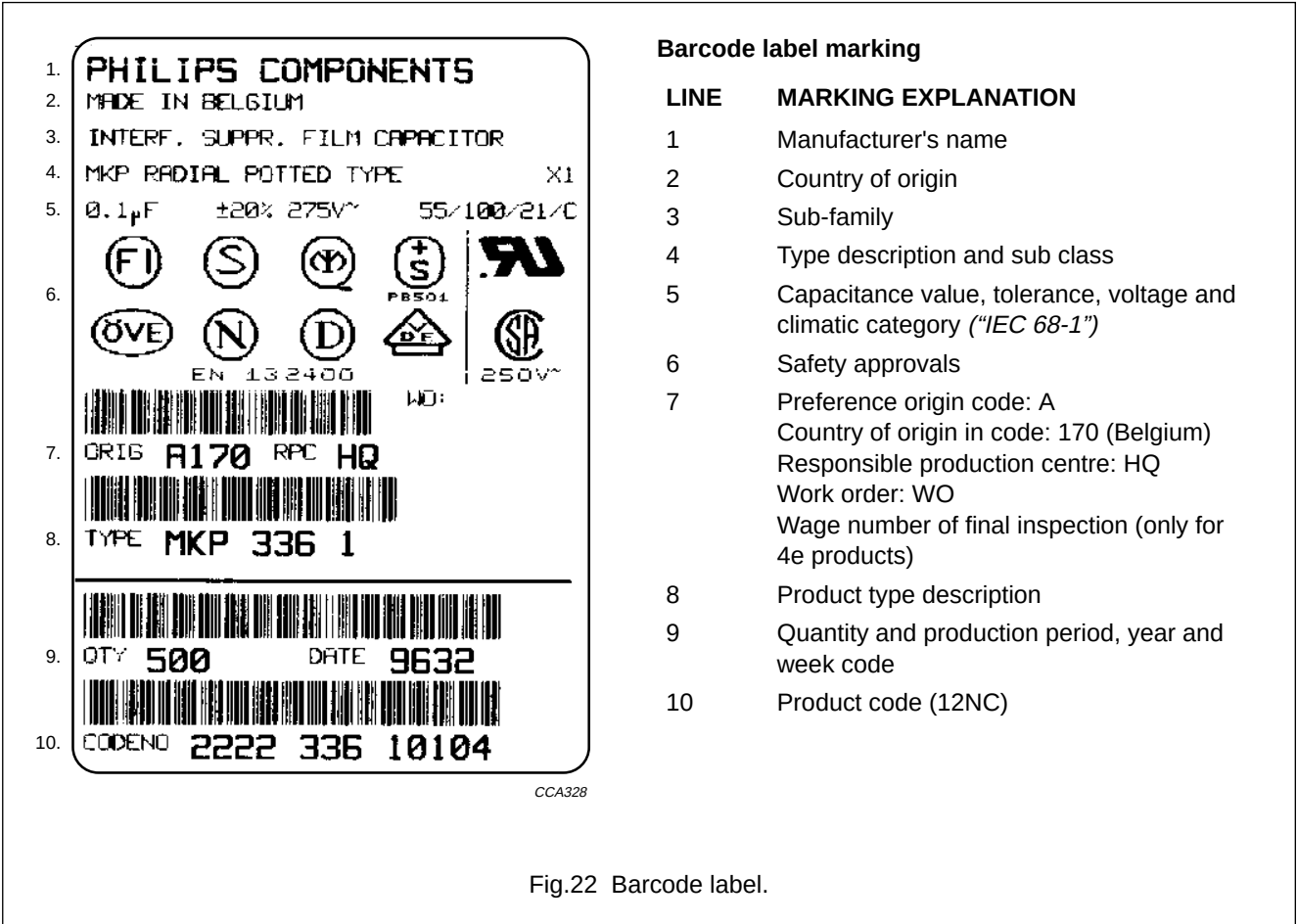


Interference suppression film capacitors

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Package marking

The package containing the capacitors is marked as shown Fig.22.



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QUICK REFERENCE TEST REQUIREMENTS (see note 1)

TEST	PROCEDURE (quick reference)	REQUIREMENTS
Robustness of leads		
Tensile and bending: "IEC 68-2-21"	solder bath: 260 °C; 10 s	no visible damage legible marking
Resistance to soldering heat: "IEC 68-2-20"		$ \Delta C/C \leq 5\%$
Component solvent resistance	isopropyl alcohol; 23 °C; 5 minutes	$\Delta \tan \delta \leq 100 \times 10^{-4}$ ($C \leq 100$ nF); note 2 $\Delta \tan \delta \leq 200 \times 10^{-4}$ (100 nF < $C \leq 470$ nF); note 2 $\Delta \tan \delta \leq 70 \times 10^{-4}$ ($C > 470$ nF); note 2
Robustness of component		
Rapid change of temperature: "IEC 68-2-14"	5 cycles 1 cycle = 30 minutes at -55 °C and 30 minutes at 100 °C	$ \Delta C/C \leq 5\%$ $\Delta \tan \delta \leq 100 \times 10^{-4}$ ($C \leq 100$ nF); note 2 $\Delta \tan \delta \leq 200 \times 10^{-4}$ (100 nF < $C \leq 470$ nF); note 2 $\Delta \tan \delta \leq 70 \times 10^{-4}$ ($C > 470$ nF); note 2
Vibration: "IEC 68-2-6"	10 to 55 Hz; amplitude 0.75 mm; 6 hours	
Shock: "IEC 68-2-27"	half sinewave; 490 m/s ² ; 11 ms	
Climatic sequence		
Dry heat: "IEC 68-2-2"	16 hours; 100 °C	$ \Delta C/C \leq 5\%$ $\Delta \tan \delta \leq 100 \times 10^{-4}$ ($C \leq 100$ nF); note 2 $\Delta \tan \delta \leq 200 \times 10^{-4}$ (100 nF < $C \leq 470$ nF); note 2 $\Delta \tan \delta \leq 70 \times 10^{-4}$ ($C > 470$ nF); note 2
Damp heat, cyclic, test Db, first cycle: "IEC 68-2-30"		
Cold: "IEC 68-2-1"	2 hours; -55 °C	$R_{ins} \geq 50\%$ of specified value
Damp heat, cyclic, test Db, remaining cycles: "IEC 68-2-30"		
Voltage proof: "IEC 384-14"	$V_p = 1200$ V (DC); 1 minute	

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TEST	PROCEDURE (quick reference)	REQUIREMENTS
Other applicable tests		
Damp heat, steady state: "IEC 68-2-3"	21 days; 40 °C; 95 to 98% RH no load $V_p = 1200$ V (DC); 1 minute.	$ \Delta C/C \leq 5\%$ $\Delta \tan \delta \leq 100 \times 10^{-4}$ ($C \leq 100$ nF); note 2 $\Delta \tan \delta \leq 200 \times 10^{-4}$ (100 nF < $C \leq 470$ nF); note 2 $\Delta \tan \delta \leq 70 \times 10^{-4}$ ($C > 470$ nF); note 2 $R_{ins} \geq 50\%$ of specified value
Endurance (AC): "IEC 384-14"	3×4.0 kV pulse voltage for X1; 3×2.5 kV pulse voltage for X2 1000 hours; $1.25 \times U_{Rac}$ at 100 °C; once per hour; 0.1 s; 1000 V (RMS) via resistor of 47 Ω ; $V_p = 1200$ V (DC); 1 minute.	$ \Delta C/C \leq 10\%$ $\Delta \tan \delta \leq 100 \times 10^{-4}$ ($C \leq 100$ nF); note 2 $\Delta \tan \delta \leq 200 \times 10^{-4}$ (100 nF < $C \leq 470$ nF); note 2 $\Delta \tan \delta \leq 70 \times 10^{-4}$ ($C > 470$ nF); note 2 $R_{ins} \geq 50\%$ of specified value
Charge and discharge: "IEC 384-14"	10000 cycles; 5 ms; $1.5 \times dV/dt$	$ \Delta C/C \leq 10\%$ $\Delta \tan \delta \leq 100 \times 10^{-4}$ ($C \leq 100$ nF); note 2 $\Delta \tan \delta \leq 200 \times 10^{-4}$ (100 nF < $C \leq 470$ nF); note 2 $\Delta \tan \delta \leq 70 \times 10^{-4}$ ($C > 470$ nF); note 2 $R_{ins} \geq 50\%$ of specified value
Passive flammability: "IEC 695-2-2"	class C	no burning
Active flammability: "IEC 384-14"	20×4 kV discharge for X1; 20×2.5 kV discharge for X2	no burning
Heat storage: "IEC 384-14"	1000 hours; 100 °C	$ \Delta C/C \leq 5\%$ $\Delta \tan \delta \leq 100 \times 10^{-4}$ ($C \leq 100$ nF); note 2 $\Delta \tan \delta \leq 200 \times 10^{-4}$ (100 nF < $C \leq 470$ nF); note 2 $\Delta \tan \delta \leq 70 \times 10^{-4}$ ($C > 470$ nF); note 2
Resistance to soldering heat with preheating: "IEC 384-14"	preheating: 100 °C; solder bath: 260 °C; 10 s	$ \Delta C/C \leq 5\%$ $\Delta \tan \delta \leq 100 \times 10^{-4}$ ($C \leq 100$ nF); note 2 $\Delta \tan \delta \leq 200 \times 10^{-4}$ (100 nF < $C \leq 470$ nF); note 2 $\Delta \tan \delta \leq 70 \times 10^{-4}$ ($C > 470$ nF); note 2

Notes

- For detailed information, see "Type specification".
- Measuring frequency 100 kHz for $C \leq 470$ nF and 10 kHz for $C > 470$ nF.