

BCcomponents	METALLIZED POLYPROPYLENE FILM	HQN-384-17/102
MISD	AC AND PULSE CAPACITOR	010 Pages: 48
ROESELARE	MKP 378 MKP/MKP 378	03-02-18
	MKP AND MKP/MKP RADIAL POTTED TYPE	03-02-18
Modification:	Supersedes:	01-12-11
See amendment record		

MKP 378 MKP/MKP 378
AC and Pulse metallized
polypropylene film capacitor

File under TPD sheet 190, HQN-384-17/102

Print date: 10 Feb 2003

BCcomponents
Roeselare



TYPE DETAIL SPECIFICATION

AC and Pulse metallized polypropylene film capacitor

MKP 378
MKP/MKP 378**RELATED DOCUMENTS**

- HQN-384-01/102: Packaging information.

DOCUMENT SURVEY

DOCUMENT COMPOSITION	
PAGE	DATE
1 - 2	03-02-18
3 - 12	00-12-05
13 - 21	03-02-18
22 - 34	00-12-05
35 - 37	01-10-23
38 - 45	00-12-05
46 - 48	01-12-11

AC and Pulse metallized polypropylene film capacitor

MKP 378
MKP/MKP 378

MKP AND MKP/MKP RADIAL POTTED TYPE

PITCH 15/22.5/27.5 mm

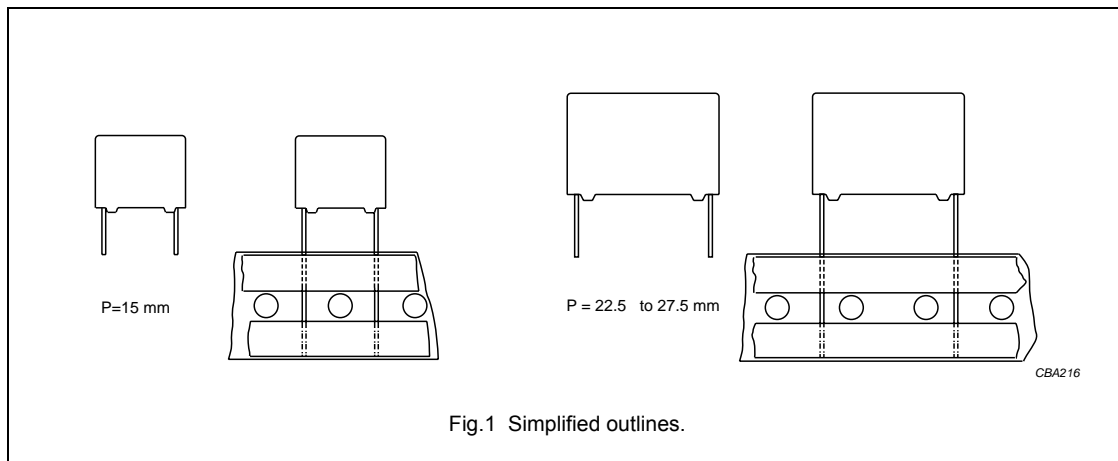


Fig.1 Simplified outlines.

FEATURES

- 15 to 27.5 mm lead pitch
- Low contact resistance
- Low loss dielectric
- Small dimensions for high density packaging
- Supplied loose in box and taped on reel.

APPLICATIONS⁽¹⁾

- Where steep pulses occur e.g. SMPS (switch mode power supplies)
- Motor control circuits
- S-correction.

(1) It is not advised to use these products as resonance capacitors in fly-back applications.

QUICK REFERENCE DATA

DESCRIPTION	VALUE
Capacitance range (E24 series)	0.003 to 3.3 μ F
Capacitance tolerance	\pm 5%
Rated voltage (DC)	250 V 400 V 630 V 1000 V 1600 V 2000 V
Rated voltage (AC)	160 V 200 V 300 V 400 V 500 V 600 V
Rated peak-to-peak voltage	450 V 560 V 850 V 1130 V 1400 V 1700 V
Climatic category	55/085/56
Rated temperature (DC)	85 °C
Rated temperature (AC)	70 °C
Maximum application temperature	85 °C
Reference specification	IEC 384-17
Performance grade	grade 1 (long life)
Stability grade:	
pitch 15 mm	grade 2
pitch 22.5 and 27.5 mm	grade 1

AC and Pulse metallized polypropylene film capacitor

MKP 378
MKP/MKP 378

COMPOSITION OF CATALOGUE NUMBER

TYPE AND PITCHES	
378	15.0 mm
	22.5 mm
	27.5 mm

MULTIPLIER (nF)	
0.1	2
1	3
10	4

CAPACITANCE (numerically)

Example:
104 = 10 x 10 = 100 nF

2222 378 XX XX X

TYPE	PACKAGING	LEAD CONFIGURATION	C-TOL	630 V	1000 V	1600 V	2000 V
378	loose in box	lead length 3.5 mm	±5%	64	74	84	94
		lead length 5.0 mm	±5%	62	72	82	92
	taped on reel	H = 18.5 mm; P ₀ = 12.7 mm	±5%	65	75	85	95

AC and Pulse metallized polypropylene film capacitor

MKP 378
MKP/MKP 378



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AC and Pulse metallized polypropylene film capacitor

MKP 378

MKP 378 GENERAL DATA

PITCH 22.5/27.5 mm

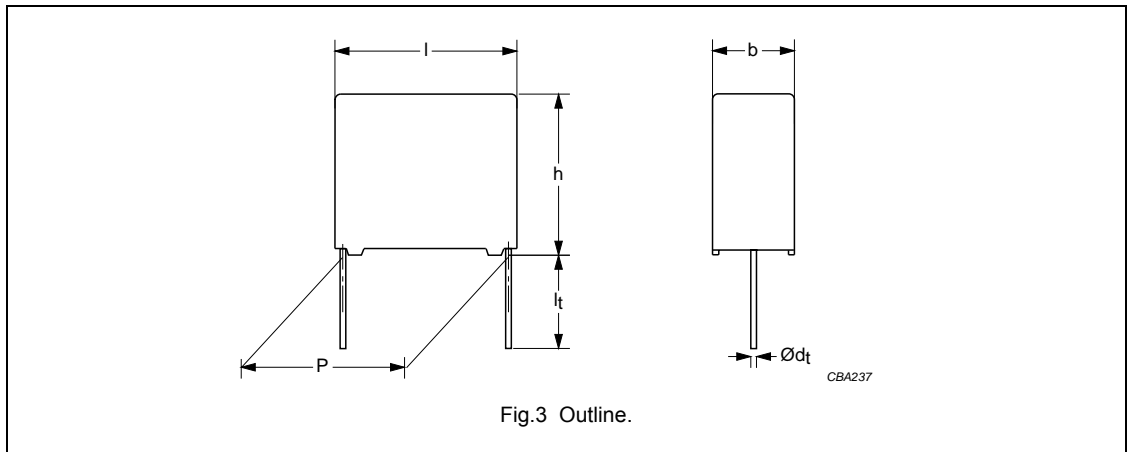


Fig.3 Outline.

Specific reference data for the 250 V DC capacitors

DESCRIPTION	VALUE	
	at 10 kHz	at 100 kHz
Tangent of loss angle: $C \leq 0.43 \mu\text{F}$ $0.47 \mu\text{F} \leq C \leq 0.62 \mu\text{F}$ $0.68 \mu\text{F} \leq C \leq 0.82 \mu\text{F}$ $0.91 \mu\text{F} \leq C \leq 1.0 \mu\text{F}$ $1.1 \mu\text{F} \leq C \leq 3.3 \mu\text{F}$	$\leq 15 \times 10^{-4}$	$\leq 45 \times 10^{-4}$ $\leq 55 \times 10^{-4}$ $\leq 60 \times 10^{-4}$ $\leq 90 \times 10^{-4}$ $\leq 200 \times 10^{-4}$
Rated voltage pulse slope $(dU/dt)_R$ at 250 V (DC): P = 22.5 mm P = 27.5 mm P = 27.5 mm	90 V/ μs 60 V/ μs (b < 15 mm) 30 V/ μs (b \geq 15 mm)	
R between leads, for $C \leq 1 \mu\text{F}$; 500 V; 1 minute	>100000 M Ω	
RC between leads, for $C > 1 \mu\text{F}$; 500 V; 1 minute	>100000 s	
Ionization voltage (typical value) at 50 pC peak discharge	>220 V (AC)	
Withstanding (DC) voltage (cut off current 10 mA); rise time 100 V/s	1008 V; 1 minute	
Withstanding (DC) voltage between leads and case	2840 V; 1 minute	

Available 250 V DC versions

PACKAGING ⁽¹⁾	DIMENSIONS	C-tol	FIRST 9 DIGITS OF CATALOGUE NUMBER	ORDERING
Loose in box	$l_t = 5.0 \pm 1.0 \text{ mm}$	$\pm 5\%$	2222 378 42...	on request
	$l_t = 3.5 \pm 0.3 \text{ mm}$	$\pm 5\%$	2222 378 44...	on request
Taped on reel	H = 18.5 mm; note 2	$\pm 5\%$	2222 378 45...	on request

Notes

1. Taped on reel pitch = 27.5 mm is not available.
2. H = in-tape height; for detailed specifications refer to Type detail specification "HQN-384-01/102, Packaging information".

AC and Pulse metallized polypropylene film capacitor

MKP 378

 $U_{Rdc} = 250 \text{ V}$; $U_{Rac} = 160 \text{ V}$ / $U_{p-p} = 450 \text{ V}$

loose and taped

C (μF)	DIMENSIONS $b \times h \times l$ (mm)	MASS (g)	CATALOGUE NUMBER AND PACKAGING		
			LOOSE IN BOX		REEL
			$l_t = 5.0 \pm 1.0 \text{ mm}$	short leads	H = 18.5 mm
			C-tol = $\pm 5\%$	SPQ	SPQ
catalogue number					
Pitch = $22.5 \pm 0.4 \text{ mm}$; $d_t = 0.80 \pm 0.08 \text{ mm}$					
0.33	7.0 × 16.5 × 26.0	3.2	2222 378 42334	200	550
0.36			2222 378 42364		
0.39			2222 378 42394		
0.43	8.5 × 18.0 × 26.0	4.4	2222 378 42434	200	450
0.47			2222 378 42474		
0.51			2222 378 42514		
0.56			2222 378 42564		
0.62			2222 378 42624		
0.68	10.0 × 19.5 × 26.0	5.5	2222 378 42684	200	350
0.75			2222 378 42754		
0.82			2222 378 42824		
Pitch = $27.5 \pm 0.4 \text{ mm}$; $d_t = 0.80 \pm 0.08 \text{ mm}$					
0.91	11.0 × 21.0 × 31.0	7.8	2222 378 42914	100	not available
1			2222 378 42105		
1.1			2222 378 42115		
1.2			2222 378 42125		
1.3			2222 378 42135		
1.5	13.0 × 23.0 × 31.0	10.4	2222 378 42155	100	
1.6			2222 378 42165		
1.8			2222 378 42185		
2	15.0 × 25.0 × 31.0	12.8	2222 378 42205	100	
2.2			2222 378 42225		
2.4	18.0 × 28.0 × 31.0	17.2	2222 378 42245	100	
2.7			2222 378 42275		
3			2222 378 42305		
3.3			2222 378 42335		

AC and Pulse metallized polypropylene film capacitor

MKP 378

MKP 378 GENERAL DATA

PITCH 22.5/27.5 mm

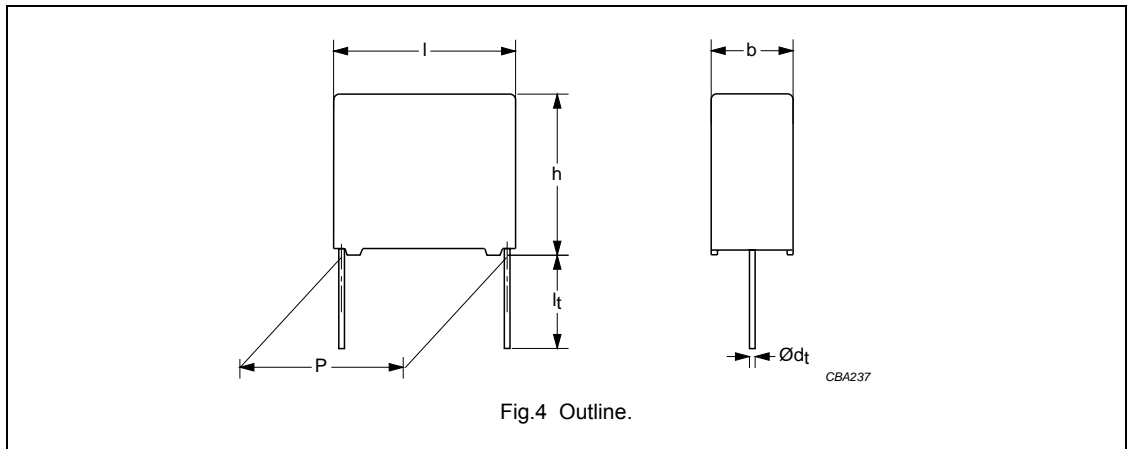


Fig.4 Outline.

Specific reference data for the 400 V DC capacitors

DESCRIPTION	VALUE	
	at 10 kHz	at 100 kHz
Tangent of loss angle: $C \leq 0.24 \mu\text{F}$ $0.27 \mu\text{F} \leq C \leq 0.36 \mu\text{F}$ $0.39 \mu\text{F} \leq C \leq 0.51 \mu\text{F}$ $0.56 \mu\text{F} \leq C \leq 0.68 \mu\text{F}$ $0.75 \mu\text{F} \leq C \leq 1.0 \mu\text{F}$ $1.1 \mu\text{F} \leq C \leq 2.0 \mu\text{F}$	$\leq 10 \times 10^{-4}$	$\leq 30 \times 10^{-4}$
Rated voltage pulse slope $(dU/dt)_R$ at 400 V (DC): $P = 22.5 \text{ mm}$ $P = 27.5 \text{ mm}$ $P = 27.5 \text{ mm}$	100 V/ μs	$70 \text{ V}/\mu\text{s}$ ($b < 15 \text{ mm}$) $35 \text{ V}/\mu\text{s}$ ($b \geq 15 \text{ mm}$)
R between leads, for $C \leq 1 \mu\text{F}$	$> 100000 \text{ M}\Omega$	
RC between leads, for $C > 1 \mu\text{F}$	$> 100000 \text{ s}$	
Ionization voltage (typical value) at 50 pC peak discharge	$> 250 \text{ V (AC)}$	
Withstanding (DC) voltage (cut off current 10 mA); rise time 100 V/s	1008 V; 1 minute	
Withstanding (DC) voltage between leads and case	2840 V; 1 minute	

Available 400 V DC versions

PACKAGING ⁽¹⁾	DIMENSIONS	C-tol	FIRST 9 DIGITS OF CATALOGUE NUMBER	ORDERING
Loose in box	$l_t = 5.0 \pm 1.0 \text{ mm}$	$\pm 5\%$	2222 378 52...	on request
	$l_t = 3.5 \pm 0.3 \text{ mm}$	$\pm 5\%$	2222 378 54...	on request
Taped on reel	H = 18.5 mm; note 2	$\pm 5\%$	2222 378 55...	on request

Notes

1. Taped on reel pitch = 27.5 mm is not available.
2. H = in-tape height; for detailed specifications refer to Type detail specification "HQN-384-01/102, Packaging information".

AC and Pulse metallized polypropylene film capacitor

MKP 378

 $U_{Rdc} = 400 \text{ V}$; $U_{Rac} = 200 \text{ V}$ / $U_{p-p} = 560 \text{ V}$

loose and taped

C (μF)	DIMENSIONS $b \times h \times l$ (mm)	MASS (g)	CATALOGUE NUMBER AND PACKAGING		
			LOOSE IN BOX		REEL
			$l_t = 5.0 \pm 1.0 \text{ mm}$	short leads	H = 18.5 mm
			C-tol = $\pm 5\%$	SPQ	SPQ
catalogue number					
Pitch = $22.5 \pm 0.4 \text{ mm}$; $d_t = 0.80 \pm 0.08 \text{ mm}$					
0.18	7.0 × 16.5 × 26.0	3.2	2222 378 52184	200	550
0.2			2222 378 52204		
0.22			2222 378 52224		
0.24	8.5 × 18.0 × 26.0	4.4	2222 378 52244	200	450
0.27			2222 378 52274		
0.3			2222 378 52304		
0.33			2222 378 52334		
0.36	10.0 × 19.5 × 26.0	5.5	2222 378 52364	200	350
0.39			2222 378 52394		
0.43			2222 378 52434		
0.47			2222 378 52474		
Pitch = $27.5 \pm 0.4 \text{ mm}$; $d_t = 0.80 \pm 0.08 \text{ mm}$					
0.51	11.0 × 21.0 × 31.0	7.8	2222 378 52514	100	not available
0.56			2222 378 52564		
0.62			2222 378 52624		
0.68			2222 378 52684		
0.75	13.0 × 23.0 × 31.0	10.4	2222 378 52754	100	
0.82			2222 378 52824		
0.91			2222 378 52914		
1			2222 378 52105		
1.1	15.0 × 25.0 × 31.0	12.8	2222 378 52115	100	
1.2			2222 378 52125		
1.3			2222 378 52135		
1.5	18.0 × 28.0 × 31.0	17.2	2222 378 52155	100	
1.6			2222 378 52165		
1.8			2222 378 52185		
2			2222 378 52205		

AC and Pulse metallized polypropylene film capacitor

MKP/MKP 378

MKP/MKP 378 GENERAL DATA

PITCH 15 mm

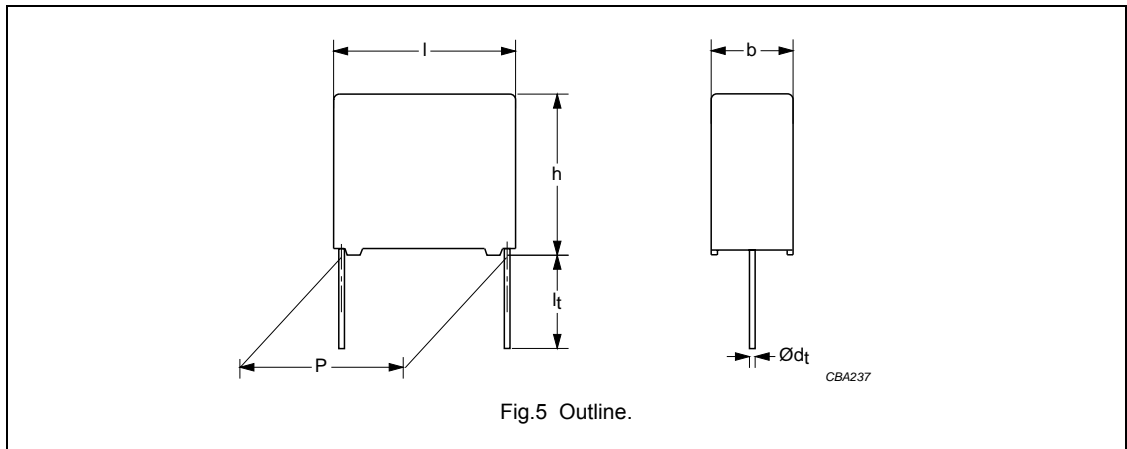


Fig.5 Outline.

Specific reference data for the 630 V DC capacitors

DESCRIPTION	VALUE	
	at 10 kHz	at 100 kHz
Tangent of loss angle: $C \leq 0.051 \mu\text{F}$	$\leq 8 \times 10^{-4}$	$\leq 15 \times 10^{-4}$
Rated voltage pulse slope $(dU/dt)_R$ at 630 V (DC)	500 V/ μs	
R between leads, for $C \leq 1 \mu\text{F}$; 500 V; 1 minute	$>100\,000 \text{ M}\Omega$	
R between leads and case; 500 V; 1 minute	$>100\,000 \text{ M}\Omega$	
Ionization (AC)voltage (typical value) at 50 pC peak discharge	$>400 \text{ V}$	
Withstanding (DC) voltage (cut off current 10 mA); rise time 100 V/s	1 008 V; 1 minute	
Withstanding (DC) voltage between leads and case	2840 V; 1 minute	

Available 630 V DC versions

PACKAGING	DIMENSIONS	C-tol	FIRST 9 DIGITS OF CATALOGUE NUMBER	ORDERING
Loose in box	$l_t = 3.5 \pm 0.3 \text{ mm}$	$\pm 5\%$	2222 378 64...	preferred
	$l_t = 5.0 \pm 1.0 \text{ mm}$	$\pm 5\%$	2222 378 62...	on request
Taped on reel	$H = 18.5 \text{ mm}$; note 1	$\pm 5\%$	2222 378 65...	on request

Available 630 V DC versions on request

C (μF)	Pitch = $15.0 \pm 0.4 \text{ mm}$; $b \times h \times l = 8.5 \text{ mm} \times 15.0 \text{ mm} \times 17.5 \text{ mm}$		
	LOOSE IN BOX; SPQ = 1000		REEL; SPQ = 650
	$l_t = 3.5 \pm 0.3 \text{ mm}$	$l_t = 5.0 \pm 1.0 \text{ mm}$	$H = 18.5 \text{ mm}^{(1)}$
0.056	2222 378 90042	2222 378 90043	2222 378 90044
0.062	2222 378 90046	2222 378 90047	2222 378 90048

Note

- H = in-tape height; for detailed specifications refer to Type detail specification "HQN-384-01/102, Packaging information".

AC and Pulse metallized polypropylene film capacitor

MKP/MKP 378

 $U_{Rdc} = 630 \text{ V}$; $U_{Rac} = 300 \text{ V}$ / $U_{p-p} = 850 \text{ V}$

C (μF)	DIMENSIONS $b \times h \times l$ (mm)	MASS (g)	CATALOGUE NUMBER AND PACKAGING		
			LOOSE IN BOX		REEL
			$l_t = 3.5 \pm 0.3 \text{ mm}$	short leads	H = 18.5 mm
			C-tol = $\pm 5\%$	SPQ	SPQ
catalogue number ⁽¹⁾					
Pitch = $15.0 \pm 0.4 \text{ mm}$; $d_t = 0.80 \pm 0.08 \text{ mm}$					
0.015	5.0 × 11.0 × 17.5	1.2	2222 378 64153	1000	1100
0.016			2222 378 64163		
0.018			2222 378 64183		
0.02			2222 378 64203		
0.022			2222 378 64223		
0.024	6.0 × 12.0 × 17.5	1.4	2222 378 64243	1000	900
0.027			2222 378 64273		
0.03			2222 378 64303		
0.033			2222 378 64333		
0.036	7.0 × 13.5 × 17.5	1.9	2222 378 64363	1000	800
0.039			2222 378 64393		
0.043			2222 378 64433		
0.047	8.5 × 15.0 × 17.5	2.6	2222 378 64473	1000	650
0.051			2222 378 64513		

Note

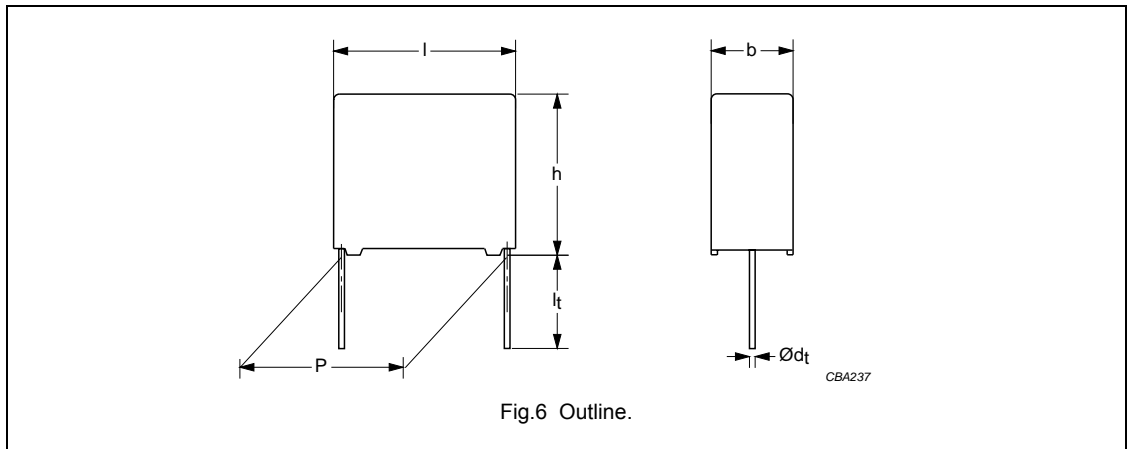
- The shading indicates preferred types.

AC and Pulse metallized polypropylene film capacitor

MKP/MKP 378

MKP/MKP 378 GENERAL DATA

PITCH 22.5/27.5 mm



Specific reference data for the 630 V DC capacitors

DESCRIPTION	VALUE	
	at 10 kHz	at 100 kHz
Tangent of loss angle: $C \leq 0.18 \mu\text{F}$ $0.2 \mu\text{F} \leq C \leq 0.3 \mu\text{F}$ $0.33 \mu\text{F} \leq C \leq 0.39 \mu\text{F}$ $0.43 \mu\text{F} \leq C \leq 0.51 \mu\text{F}$ $C > 0.51 \mu\text{F}$	$\leq 8 \times 10^{-4}$ $\leq 10 \times 10^{-4}$ $\leq 10 \times 10^{-4}$ $\leq 10 \times 10^{-4}$ $\leq 10 \times 10^{-4}$	$\leq 15 \times 10^{-4}$ $\leq 25 \times 10^{-4}$ $\leq 30 \times 10^{-4}$ $\leq 40 \times 10^{-4}$ $\leq 45 \times 10^{-4}$
Rated voltage pulse slope $(dU/dt)_R$ at 630 V (DC): $P = 22.5 \text{ mm}$ $P = 27.5 \text{ mm}$ $P = 27.5 \text{ mm}$	370 V/ μs 230 V/ μs (b < 15 mm) 120 V/ μs (b \geq 15 mm)	
R between leads, for $C \leq 1 \mu\text{F}$; 500 V; 1 minute	>100000 M Ω	
R between leads and case; 500 V; 1 minute	>100000 M Ω	
Ionization (AC)voltage (typical value) at 50 pC peak discharge	>400 V	
Withstanding (DC) voltage (cut off current 10 mA); rise time 100 V/s	1008 V; 1 minute	
Withstanding (DC) voltage between leads and case	2840 V; 1 minute	

Available 630 V DC versions

PACKAGING ⁽¹⁾	DIMENSIONS	C-tol	FIRST 9 DIGITS OF CATALOGUE NUMBER	ORDERING
Loose in box	$l_t = 3.5 \pm 0.3 \text{ mm}$	$\pm 5\%$	2222 378 64...	preferred
	$l_t = 5.0 \pm 1.0 \text{ mm}$	$\pm 5\%$	2222 378 62...	on request
Taped on reel	H = 18.5 mm; note 2	$\pm 5\%$	2222 378 65...	on request

Notes

1. Taped on reel pitch = 27.5 mm is not available.
2. H = in-tape height; for detailed specifications refer to Type detail specification "HQN-384-01/102, Packaging information".

AC and Pulse metallized polypropylene film capacitor

MKP/MKP 378

 $U_{Rdc} = 630 \text{ V}$; $U_{Rac} = 300 \text{ V}$ / $U_{p-p} = 850 \text{ V}$

C (μF)	DIMENSIONS $b \times h \times l$ (mm)	MASS (g)	CATALOGUE NUMBER AND PACKAGING		
			LOOSE IN BOX		REEL
			$l_t = 3.5 \pm 0.3 \text{ mm}$	short leads	H = 18.5 mm
			C-tol = $\pm 5\%$	SPQ	SPQ
catalogue number ⁽¹⁾					
Pitch = $22.5 \pm 0.4 \text{ mm}$; $d_t = 0.80 \pm 0.08 \text{ mm}$					
0.056	6.0 × 15.5 × 26.0	2.6	2222 378 64563	300	600
0.062			2222 378 64623		
0.068	7.0 × 16.5 × 26.0	3.2	2222 378 64683	200	550
0.075			2222 378 64753		
0.082			2222 378 64823		
0.091			2222 378 64913		
0.1	8.5 × 18.0 × 26.0	4.4	2222 378 64104	200	450
0.11			2222 378 64114		
0.12			2222 378 64124		
0.13			2222 378 64134		
0.15	10.0 × 19.5 × 26.0	5.5	2222 378 64154	200	350
0.16			2222 378 64164		
0.18			2222 378 64184		
Pitch = $27.5 \pm 0.4 \text{ mm}$; $d_t = 0.80 \pm 0.08 \text{ mm}$					
0.2	11.0 × 21.0 × 31.0	7.8	2222 378 64204	100	not available
0.22			2222 378 64224		
0.24			2222 378 64244		
0.27			2222 378 64274		
0.3	13.0 × 23.0 × 31.0	10.4	2222 378 64304	100	
0.33			2222 378 64334		
0.36			2222 378 64364		
0.39			2222 378 64394		
0.43	15.0 × 25.0 × 31.0	12.8	2222 378 64434	100	
0.47			2222 378 64474		
0.51			2222 378 64514		
0.56	18.0 × 28.0 × 31.0	17.2	2222 378 64564	100	
0.62			2222 378 64624		
0.68			2222 378 64684		

Note

1. The shading indicates preferred types.

AC and Pulse metallized polypropylene film capacitor

MKP/MKP 378

MKP/MKP 378 GENERAL DATA

PITCH 15 mm

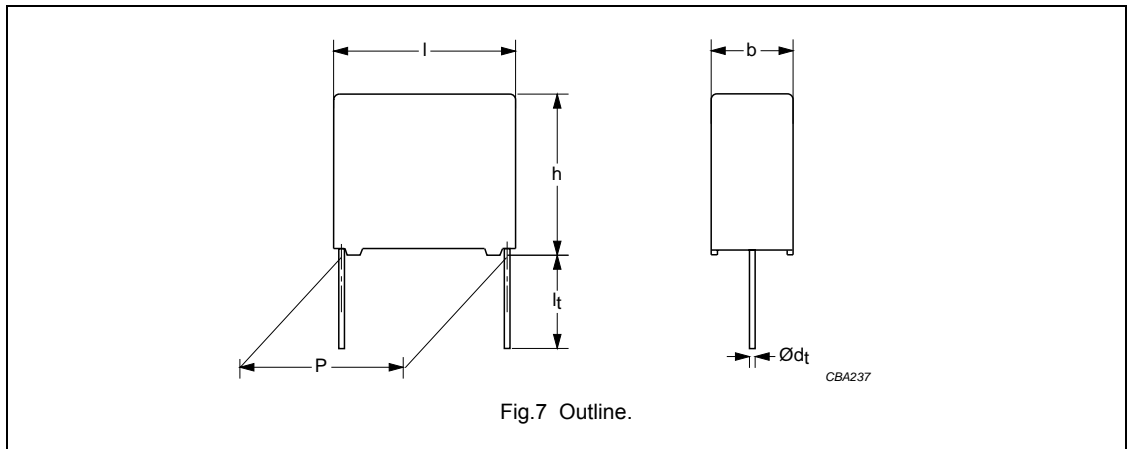


Fig.7 Outline.

Specific reference data for the 1000 V DC capacitors

DESCRIPTION	VALUE	
	at 10 kHz	at 100 kHz
Tangent of loss angle: $C \leq 0.011 \mu\text{F}$	$\leq 6 \times 10^{-4}$	$\leq 15 \times 10^{-4}$
Rated voltage pulse slope $(dU/dt)_R$ at 1000 V (DC)	1300 V/ μs	
R between leads, for $C \leq 1 \mu\text{F}$; 500 V; 1 minute	$>100000 \text{ M}\Omega$	
R between leads and case; 500 V; 1 minute	$>100000 \text{ M}\Omega$	
Ionization (AC)voltage (typical value) at 50 pC peak discharge	$>500 \text{ V}$	
Withstanding (DC) voltage (cut off current 10 mA); rise time 100 V/s	1600 V; 1 minute	
Withstanding (DC) voltage between leads and case	2840 V; 1 minute	

Available 1000 V DC versions

PACKAGING	DIMENSIONS	C-tol	FIRST 9 DIGITS OF CATALOGUE NUMBER	ORDERING
Loose in box	$l_t = 3.5 \pm 0.3 \text{ mm}$	$\pm 5\%$	2222 378 74...	preferred
	$l_t = 5.0 \pm 1.0 \text{ mm}$	$\pm 5\%$	2222 378 72...	on request
Taped on reel	H = 18.5 mm; note 1	$\pm 5\%$	2222 378 75...	on request

Available 1000 V DC versions on request

C (μF)	Pitch = $15.0 \pm 0.4 \text{ mm}$; $b \times h \times l = 8.5 \text{ mm} \times 15.0 \text{ mm} \times 17.5 \text{ mm}$		
	LOOSE IN BOX; SPQ = 1000		REEL; SPQ = 650
	$l_t = 3.5 \pm 0.3 \text{ mm}$	$l_t = 5.0 \pm 1.0 \text{ mm}$	H = 18.5 mm ⁽¹⁾
0.012	2222 378 90051	2222 378 90052	2222 378 90053
0.013	2222 378 90055	2222 378 90056	2222 378 90057
0.015	2222 378 90059	2222 378 90061	2222 378 90062
0.016	2222 378 90064	2222 378 90065	2222 378 90066
0.018	2222 378 90068	2222 378 90069	2222 378 90071

Note

- H = in-tape height; for detailed specifications refer to Type detail specification "HQN-384-01/102, Packaging information".

AC and Pulse metallized polypropylene film capacitor

MKP/MKP 378

 $U_{Rdc} = 1000 \text{ V}$; $U_{Rac} = 400 \text{ V}$ / $U_{p-p} = 1130 \text{ V}$

C (μF)	DIMENSIONS $b \times h \times l$ (mm)	MASS (g)	CATALOGUE NUMBER AND PACKAGING		
			LOOSE IN BOX		REEL
			$l_t = 3.5 \pm 0.3 \text{ mm}$	short leads	H = 18.5 mm
			C-tol = $\pm 5\%$	SPQ	SPQ
catalogue number ⁽¹⁾					
Pitch = $15.0 \pm 0.4 \text{ mm}$; $d_t = 0.80 \pm 0.08 \text{ mm}$					
0.003	$5.0 \times 11.0 \times 17.5$	1.2	2222 378 74302	1000	1100
0.0033			2222 378 74332		
0.0036			2222 378 74362		
0.0039			2222 378 74392		
0.0043			2222 378 74432		
0.0047			2222 378 74472		
0.0051			2222 378 74512		
0.0056			2222 378 74562		
0.0062			2222 378 74622		
0.0068			2222 378 74682		
0.0075	2222 378 74752				
0.0082	$6.0 \times 12.0 \times 17.5$	1.4	2222 378 74822	1000	900
0.0091			2222 378 74912		
0.01			2222 378 74103		
0.011			2222 378 74113		

Note

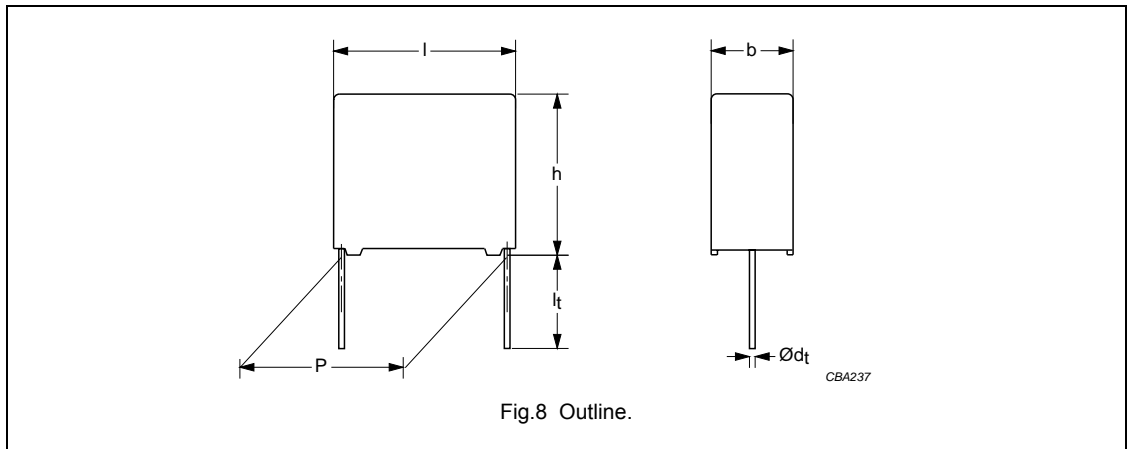
1. The shading indicates preferred types.

AC and Pulse metallized polypropylene film capacitor

MKP/MKP 378

MKP/MKP 378 GENERAL DATA

PITCH 22.5/27.5 mm



Specific reference data for the 1000 V DC capacitors

DESCRIPTION	VALUE	
	at 10 kHz	at 100 kHz
Tangent of loss angle: C ≤ 0.051 μF 0.056 μF ≤ C ≤ 0.22 μF	≤ 6 × 10 ⁻⁴ ≤ 8 × 10 ⁻⁴	≤ 15 × 10 ⁻⁴ ≤ 20 × 10 ⁻⁴
Rated voltage pulse slope (dU/dt) _R at 1000 V (DC): P = 22.5 mm P = 27.5 mm P = 27.5 mm	1200 V/μs 600 V/μs (b < 15 mm) 300 V/μs (b ≥ 15 mm)	
R between leads, for C ≤ 1 μF; 500 V; 1 minute	> 100000 MΩ	
R between leads and case; 500 V; 1 minute	> 100000 MΩ	
Ionization (AC)voltage (typical value) at 50 pC peak discharge	> 500 V	
Withstanding (DC) voltage (cut off current 10 mA); rise time 100 V/s	1600 V; 1 minute	
Withstanding (DC) voltage between leads and case	2840 V; 1 minute	

Available 1000 V DC versions

PACKAGING ⁽¹⁾	DIMENSIONS	C-tol	FIRST 9 DIGITS OF CATALOGUE NUMBER	ORDERING
Loose in box	l _t = 3.5 ± 0.3 mm	±5%	2222 378 74...	preferred
	l _t = 5.0 ± 1.0 mm	±5%	2222 378 72...	on request
Taped on reel	H = 18.5 mm; note 2	±5%	2222 378 75...	on request

Notes

1. Taped on reel pitch = 27.5 mm is not available.
2. H = in-tape height; for detailed specifications refer to Type detail specification "HQN-384-01/102, Packaging information".

AC and Pulse metallized polypropylene film capacitor

MKP/MKP 378

 $U_{Rdc} = 1000 \text{ V}$; $U_{Rac} = 400 \text{ V}/U_{p-p} = 1130 \text{ V}$

C (μF)	DIMENSIONS $b \times h \times l$ (mm)	MASS (g)	CATALOGUE NUMBER AND PACKAGING		
			LOOSE IN BOX		REEL
			$l_t = 3.5 \pm 0.3 \text{ mm}$	short leads	H = 18.5 mm
			C-tol = $\pm 5\%$	SPQ	SPQ
catalogue number ⁽¹⁾					
Pitch = $22.5 \pm 0.4 \text{ mm}$; $d_t = 0.80 \pm 0.08 \text{ mm}$					
0.012	6.0 × 15.5 × 26.0	2.6	2222 378 74123	300	600
0.013			2222 378 74133		
0.015			2222 378 74153		
0.016			2222 378 74163		
0.018			2222 378 74183		
0.02	7.0 × 16.5 × 26.0	3.2	2222 378 74203	200	550
0.022			2222 378 74223		
0.024			2222 378 74243		
0.027	8.5 × 18.0 × 26.0	4.4	2222 378 74273	200	450
0.03			2222 378 74303		
0.033			2222 378 74333		
0.036			2222 378 74363		
0.039	10.0 × 19.5 × 26.0	5.5	2222 378 74393	200	350
0.043			2222 378 74433		
0.047			2222 378 74473		
0.051			2222 378 74513		
Pitch = $27.5 \pm 0.4 \text{ mm}$; $d_t = 0.80 \pm 0.08 \text{ mm}$					
0.056	11.0 × 21.0 × 31.0	7.8	2222 378 74563	100	not available
0.062			2222 378 74623		
0.068			2222 378 74683		
0.075			2222 378 74753		
0.082			2222 378 74823		
0.091	13.0 × 23.0 × 31.0	10.4	2222 378 74913	100	
0.1			2222 378 74104		
0.11			2222 378 74114		
0.12	15.0 × 25.0 × 31.0	12.8	2222 378 74124	100	
0.13			2222 378 74134		
0.15			2222 378 74154		
0.16	18.0 × 28.0 × 31.0	17.5	2222 378 74164	100	
0.18			2222 378 74184		
0.2			2222 378 74204		
0.22			2222 378 74224		

Note

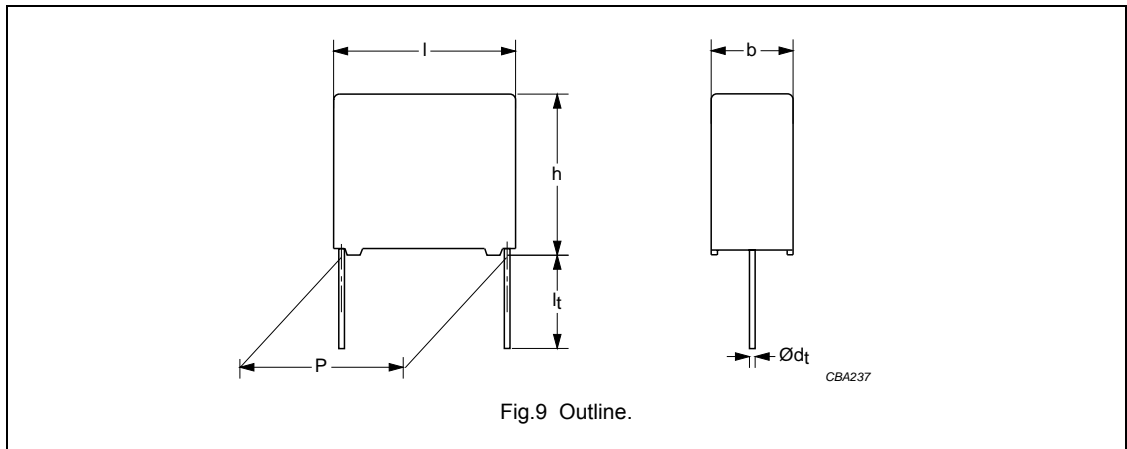
1. The shading indicates preferred types.

AC and Pulse metallized polypropylene film capacitor

MKP/MKP 378

MKP/MKP 378 GENERAL DATA

PITCH 22.5/27.5 mm



Specific reference data for the 1600 V DC capacitors

DESCRIPTION	VALUE	
	at 10 kHz	at 100 kHz
Tangent of loss angle: C ≤ 0.022 μF 0.024 μF ≤ C ≤ 0.1 μF	≤ 5 × 10 ⁻⁴ ≤ 6 × 10 ⁻⁴	≤ 10 × 10 ⁻⁴ ≤ 15 × 10 ⁻⁴
Rated voltage pulse slope (dU/dt) _R at 1600 V (DC): P = 22.5 mm P = 27.5 mm P = 27.5 mm	1600 V/μs 900 V/μs (b < 15 mm) 450 V/μs (b ≥ 15 mm)	
R between leads, for C ≤ 1 μF; 500 V; 1 minute	> 100000 MΩ	
R between leads and case; 500 V; 1 minute	> 100000 MΩ	
Ionization (AC)voltage (typical value) at 20 pC peak discharge	> 600 V	
Withstanding (DC) voltage (cut off current 10 mA); rise time 100 V/s	2560 V; 1 minute	
Withstanding (DC) voltage between leads and case	2840 V; 1 minute	

Available 1600 V DC versions

PACKAGING ⁽¹⁾	DIMENSIONS	C-tol	FIRST 9 DIGITS OF CATALOGUE NUMBER	ORDERING
Loose in box	l _t = 3.5 ± 0.3 mm	±5%	2222 378 84...	preferred
	l _t = 5.0 ± 1.0 mm	±5%	2222 378 82...	on request
Taped on reel	H = 18.5 mm; note 2	±5%	2222 378 85...	on request

Notes

1. Taped on reel pitch = 27.5 mm is not available.
2. H = in-tape height; for detailed specifications refer to Type detail specification "HQN-384-01/102, Packaging information".

AC and Pulse metallized polypropylene film capacitor

MKP/MKP 378

 $U_{Rdc} = 1600 \text{ V}$; $U_{Rac} = 500 \text{ V}/U_{p-p} = 1400 \text{ V}$

C (μF)	DIMENSIONS $b \times h \times l$ (mm)	MASS (g)	CATALOGUE NUMBER AND PACKAGING		
			LOOSE IN BOX		REEL
			$l_t = 3.5 \pm 0.3 \text{ mm}$	short leads	H = 18.5 mm
			C-tol = $\pm 5\%$	SPQ	SPQ
catalogue number ⁽¹⁾					
Pitch = $22.5 \pm 0.4 \text{ mm}$; $d_t = 0.80 \pm 0.08 \text{ mm}$					
0.0056	6.0 × 15.5 × 26.0	2.6	2222 378 84562	300	600
0.0062			2222 378 84622		
0.0068			2222 378 84682		
0.0075	7.0 × 16.5 × 26.0	3.2	2222 378 84752	200	550
0.0082			2222 378 84822		
0.0091			2222 378 84912		
0.01			2222 378 84103		
0.011	8.5 × 18.0 × 26.0	4.4	2222 378 84113	200	450
0.012			2222 378 84123		
0.013			2222 378 84133		
0.015			2222 378 84153		
0.016			2222 378 84163		
0.018	10.0 × 19.5 × 26.0	5.5	2222 378 84183	200	350
0.02			2222 378 84203		
0.022			2222 378 84223		
Pitch = $27.5 \pm 0.4 \text{ mm}$; $d_t = 0.80 \pm 0.08 \text{ mm}$					
0.024	11.0 × 21.0 × 31.0	7.8	2222 378 84243	100	not available
0.027			2222 378 84273		
0.03			2222 378 84303		
0.033			2222 378 84333		
0.036			2222 378 84363		
0.039	13.0 × 23.0 × 31.0	10.4	2222 378 84393	100	
0.043			2222 378 84433		
0.047			2222 378 84473		
0.051			2222 378 84513		
0.056	15.0 × 25.0 × 31.0	12.8	2222 378 84563	100	
0.062			2222 378 84623		
0.068			2222 378 84683		
0.075	18.0 × 28.0 × 31.0	17.2	2222 378 84753	100	
0.082			2222 378 84823		
0.091			2222 378 84913		
0.1			2222 378 84104		

Note

1. The shading indicates preferred types.

AC and Pulse metallized polypropylene film capacitor

MKP/MKP 378

MKP/MKP 378 GENERAL DATA

PITCH 22.5/27.5 mm

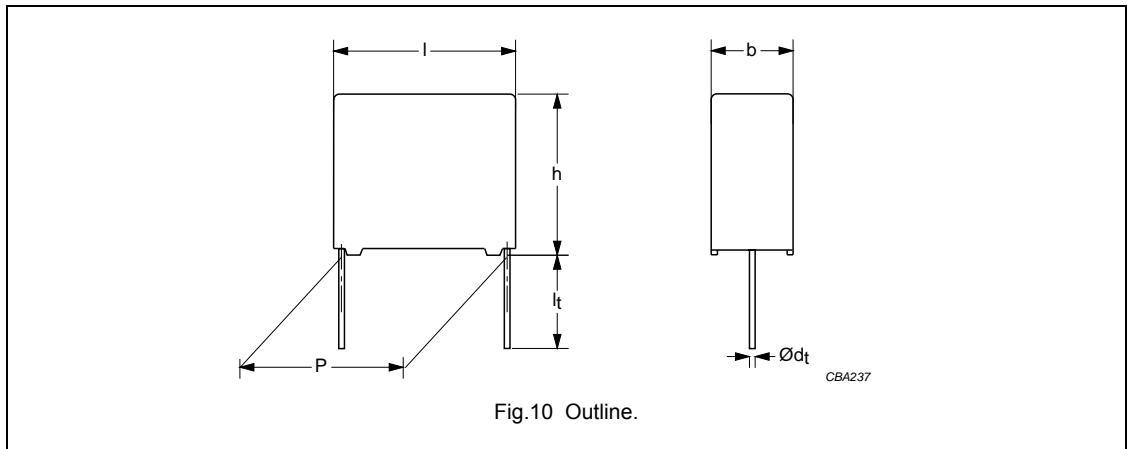


Fig.10 Outline.

Specific reference data for the 2000 V DC capacitors

DESCRIPTION	VALUE	
	at 10 kHz	at 100 kHz
Tangent of loss angle: $C \leq 0.051 \mu\text{F}$	$\leq 5 \times 10^{-4}$	$\leq 10 \times 10^{-4}$
Rated voltage pulse slope $(dU/dt)_R$ at 2000 V (DC): P = 22.5 mm P = 27.5 mm P = 27.5 mm	2000 V/ μs 1200 V/ μs (b < 15 mm) 600 V/ μs (b \geq 15 mm)	
R between leads, for $C \leq 1 \mu\text{F}$; 500 V; 1 minute	>100000 M Ω	
R between leads and case; 500 V; 1 minute	>100000 M Ω	
Ionization (AC)voltage (typical value) at 20 pC peak discharge	>600 V	
Withstanding (DC) voltage (cut off current 10 mA); rise time 100 V/s	3200 V; 1 minute	
Withstanding (DC) voltage between leads and case	2840 V; 1 minute	

Available 2000 V DC versions

PACKAGING ⁽¹⁾	DIMENSIONS	C-tol	FIRST 9 DIGITS OF CATALOGUE NUMBER	ORDERING
Loose in box	$l_t = 3.5 \pm 0.3 \text{ mm}$	$\pm 5\%$	2222 378 94...	preferred
	$l_t = 5.0 \pm 1.0 \text{ mm}$	$\pm 5\%$	2222 378 92...	on request
Taped on reel	H = 18.5 mm; note 2	$\pm 5\%$	2222 378 95...	on request

Notes

1. Taped on reel pitch = 27.5 mm is not available.
2. H = in-tape height; for detailed specifications refer to Type detail specification "HQN-384-01/102, Packaging information".

AC and Pulse metallized polypropylene film capacitor

MKP/MKP 378

 $U_{Rdc} = 2000 \text{ V}$; $U_{Rac} = 600 \text{ V}$ / $U_{p-p} = 1700 \text{ V}$

C (μF)	DIMENSIONS $b \times h \times l$ (mm)	MASS (g)	CATALOGUE NUMBER AND PACKAGING		
			LOOSE IN BOX		REEL
			$l_t = 3.5 \pm 0.3 \text{ mm}$	short leads	H = 18.5 mm
			C-tol = $\pm 5\%$	SPQ	SPQ
catalogue number ⁽¹⁾					
Pitch = $22.5 \pm 0.4 \text{ mm}$; $d_t = 0.80 \pm 0.08 \text{ mm}$					
0.0033 0.0036	6.0 × 15.5 × 26.0	2.6	2222 378 94332 2222 378 94362	300	600
0.0039 0.0043 0.0047 0.0051	7.0 × 16.5 × 26.0	3.2	2222 378 94392 2222 378 94432 2222 378 94472 2222 378 94512	200	550
0.0056 0.0062 0.0068 0.0075 0.0082	8.5 × 18.0 × 26.0	4.4	2222 378 94562 2222 378 94622 2222 378 94682 2222 378 94752 2222 378 94822	200	450
0.0091 0.01 0.011 0.012	10.0 × 19.5 × 26.0	5.5	2222 378 94912 2222 378 94103 2222 378 94113 2222 378 94123	200	350
Pitch = $27.5 \pm 0.4 \text{ mm}$; $d_t = 0.80 \pm 0.08 \text{ mm}$					
0.013 0.015 0.016 0.018 0.02	11.0 × 21.0 × 31.0	7.8	2222 378 94133 2222 378 94153 2222 378 94163 2222 378 94183 2222 378 94203	100	not available
0.022 0.024 0.027	13.0 × 23.0 × 31.0	10.4	2222 378 94223 2222 378 94243 2222 378 94273	100	
0.030 0.033 0.036	15.0 × 25.0 × 31.0	12.8	2222 378 94303 2222 378 94333 2222 378 94363	100	
0.039 0.043 0.047 0.051	18.0 × 28.0 × 31.0	17.5	2222 378 94393 2222 378 94433 2222 378 94473 2222 378 94513	100	

Note

1. The shading indicates preferred types.

AC and Pulse metallized polypropylene film capacitor

MKP 378
MKP/MKP 378**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 for pitch = 6e (case size 1750 and 1760)
 - Copper wire for pitch = 6e (case size 1770 and 1785) and for 9e and 11e
- Small stand-off pips allow removal of solder flux etc. during cleaning of the printed-circuit board.

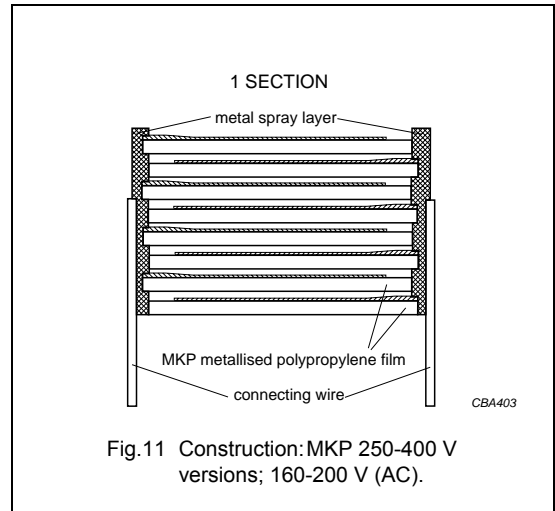


Fig.11 Construction: MKP 250-400 V versions; 160-200 V (AC).

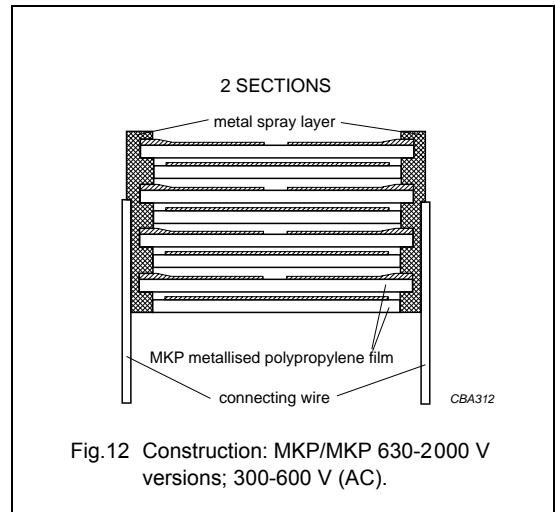


Fig.12 Construction: MKP/MKP 630-2000 V versions; 300-600 V (AC).

AC and Pulse metallized polypropylene film capacitor

MKP 378
MKP/MKP 378**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 Type detail specification "HQN-384-01/102, Packaging information".

SPECIFIC METHOD OF MOUNTING TO WITHSTAND VIBRATION AND SHOCK

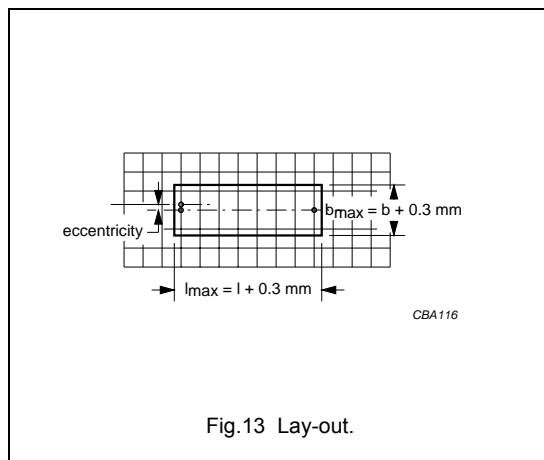
In order to withstand vibration and shock tests, it must be ensured that the stand-off pips are in good contact with the printed-circuit board:

- For pitches of 15 mm the 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.13:

- Eccentricity as in Fig.13. 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: $h_{\max} \leq h + 0.3 \text{ mm}$.

**RATINGS AND CHARACTERISTICS**

Unless otherwise specified, all electrical values apply at an ambient free air 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 over 96 ± 4 hours by heating the products in a circulating air oven at the rated temperature and a relative humidity not exceeding 20%.

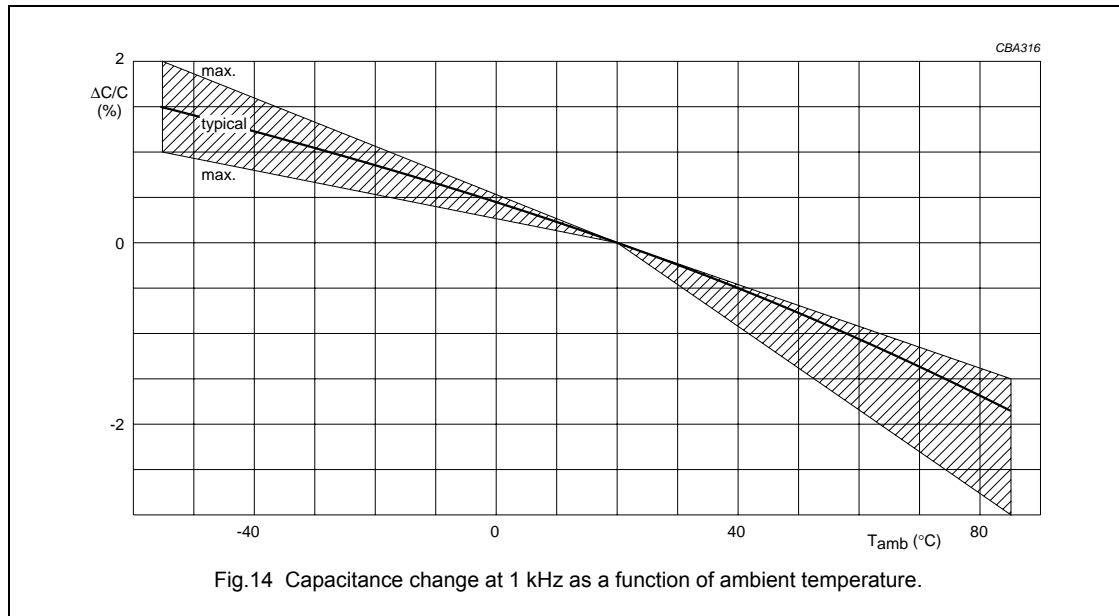
AC and Pulse metallized polypropylene film capacitor

MKP 378
MKP/MKP 378

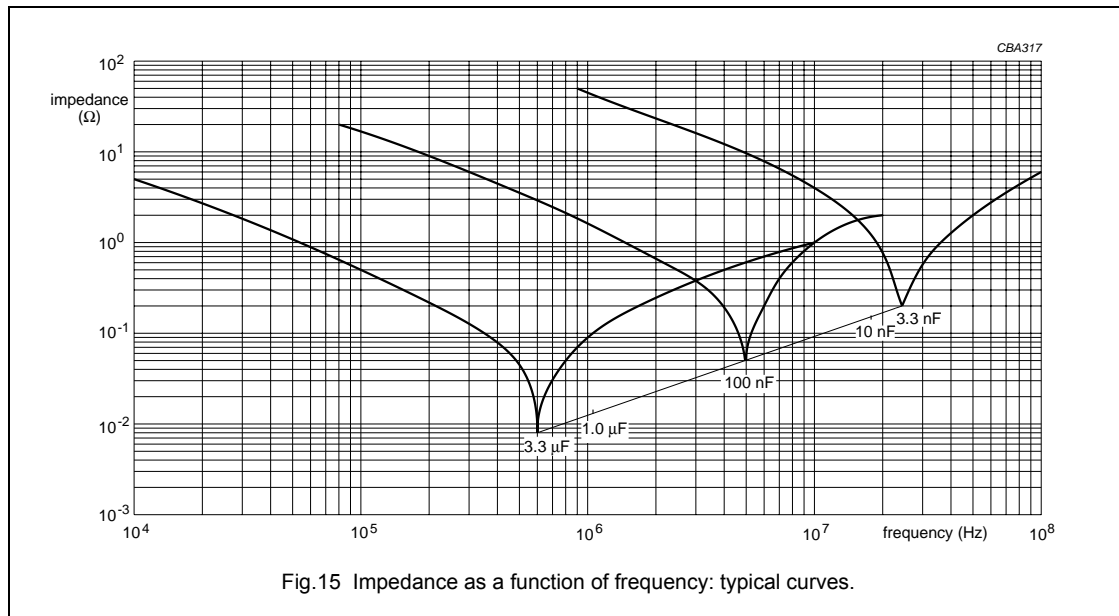


CHARACTERISTICS

Capacitance



Impedance



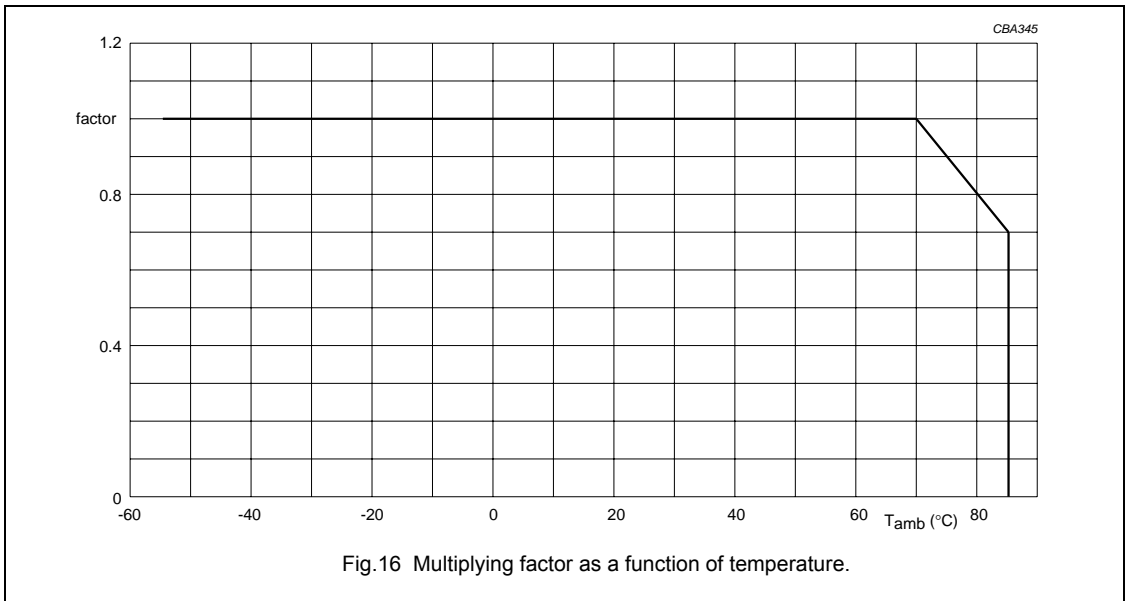
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AC and Pulse metallized polypropylene film capacitor

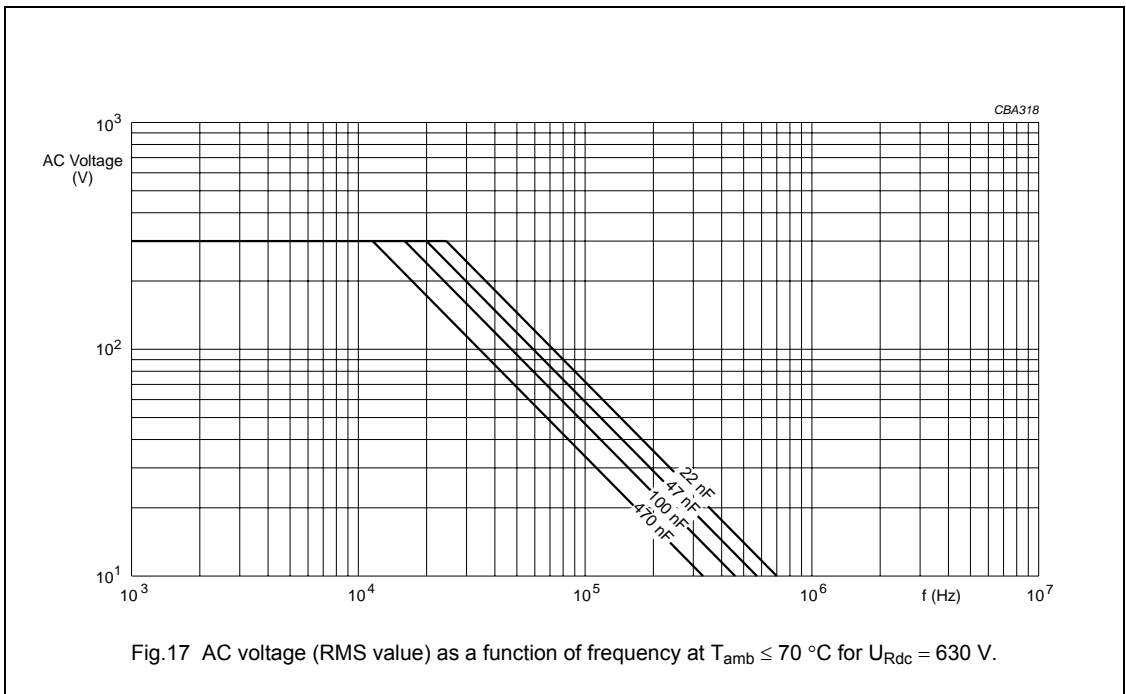
MKP 378
MKP/MKP 378



Maximum RMS voltage (sinewave) as a function of temperature



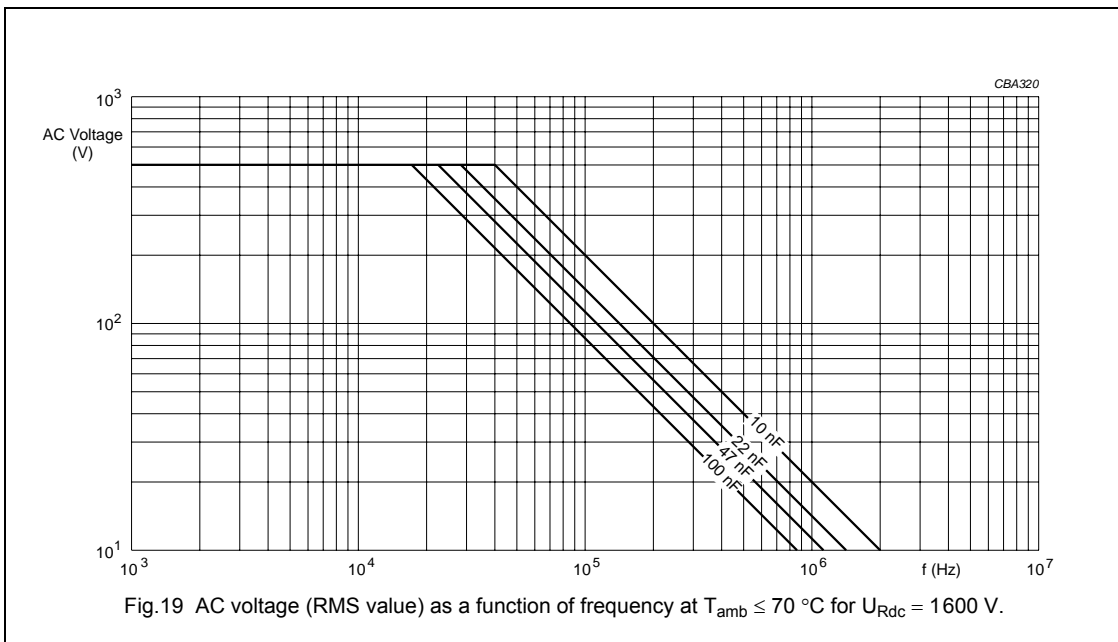
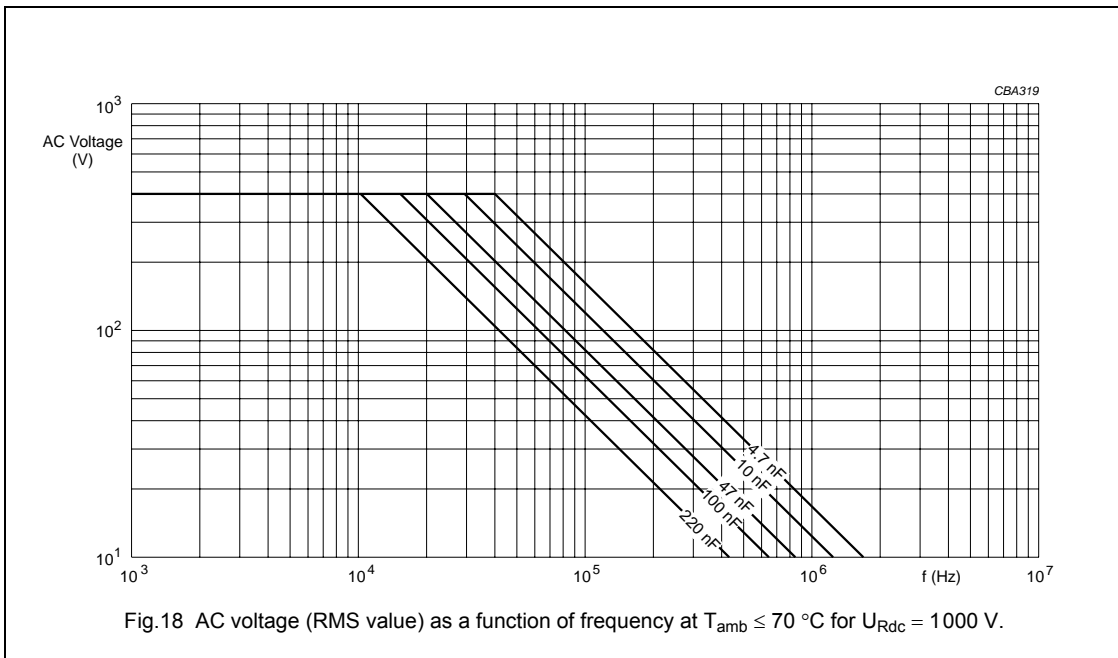
Maximum RMS voltage (sinewave) as a function of frequency for T_{amb} ≤ 70 °C



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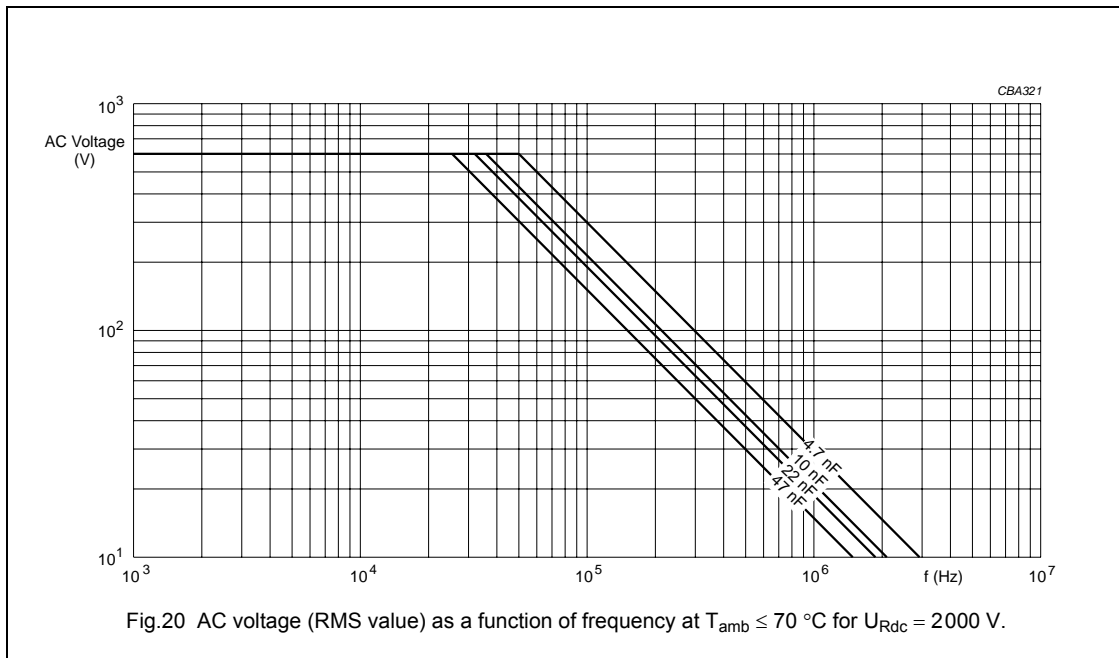
AC and Pulse metallized polypropylene film capacitor

MKP 378
MKP/MKP 378



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AC and Pulse metallized polypropylene film capacitor

MKP 378
MKP/MKP 378**Maximum RMS current (sinewave) as a function of frequency**

The maximum RMS current is defined by $I_{ac} = \omega \times C \times U_{ac}$.

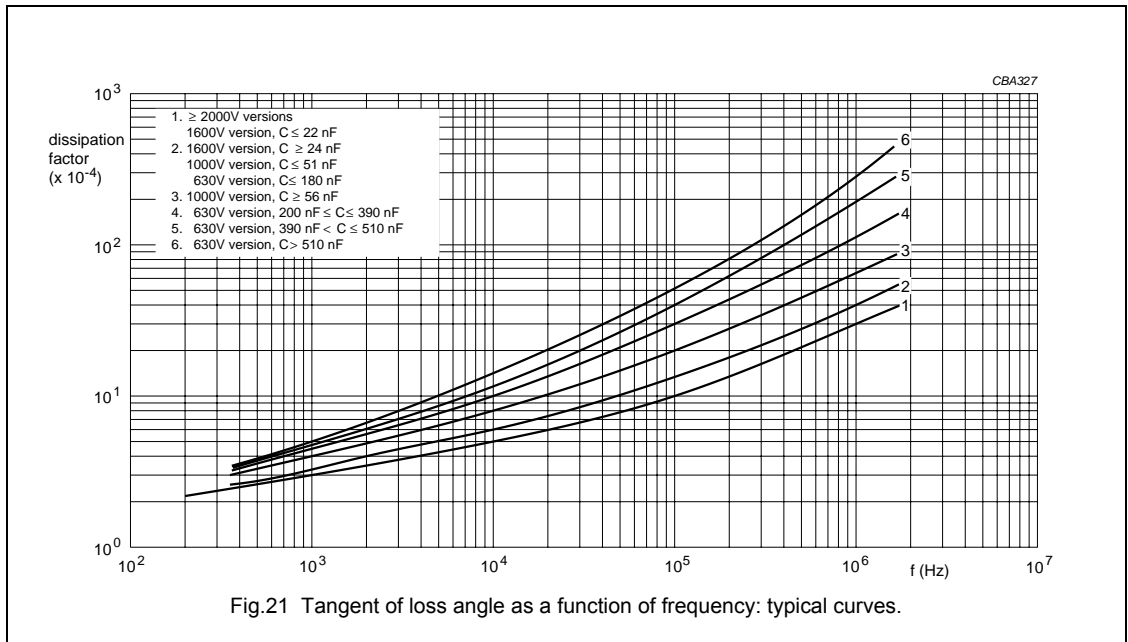
U_{ac} is the maximum AC voltage depending on the ambient temperature in Figs 17 to 20.

AC and Pulse metallized polypropylene film capacitor

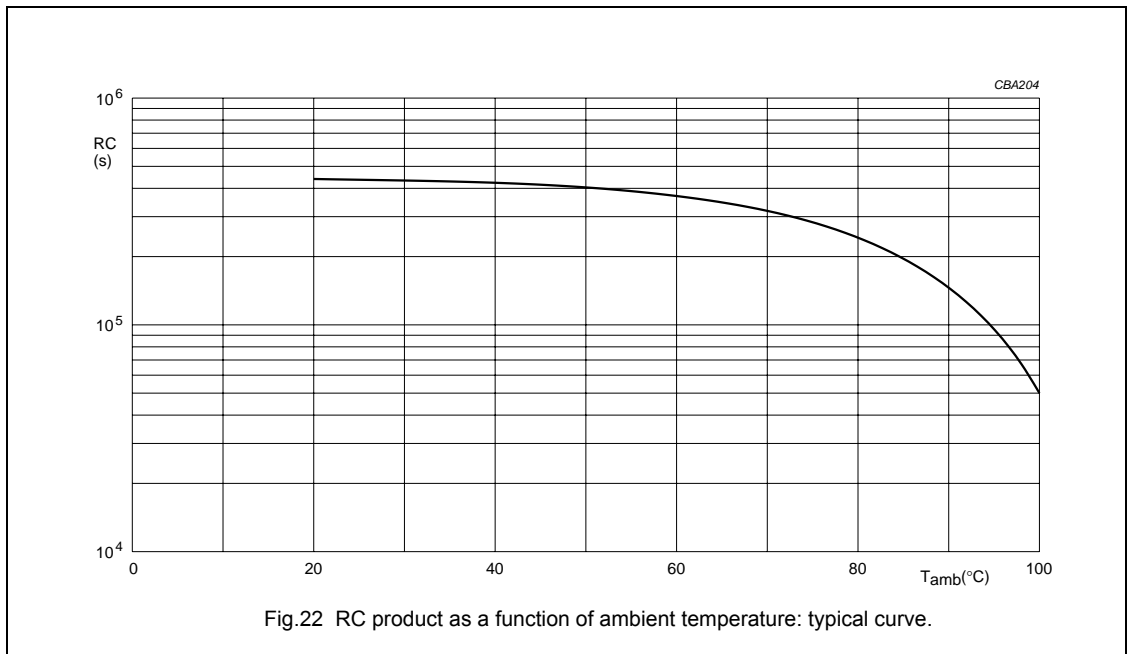
MKP 378
MKP/MKP 378



Tangent of loss angle



Insulation resistance



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AC and Pulse metallized polypropylene film capacitor

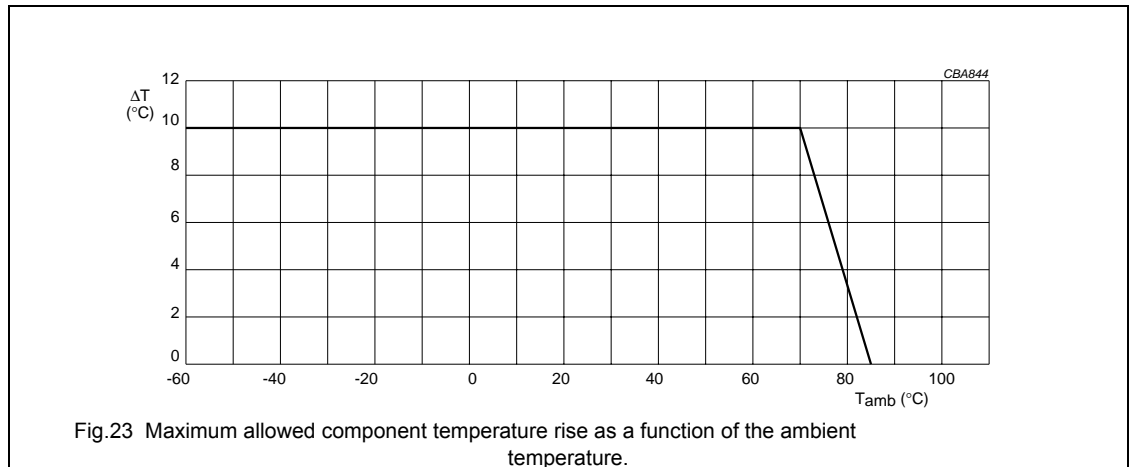
MKP 378
MKP/MKP 378Maximum allowed component temperature rise (ΔT) as a function of the ambient temperature (T_{amb})

Fig.23 Maximum allowed component temperature rise as a function of the ambient temperature.

Heat conductivity (G) as a function of pitch and capacitor body thickness in mW/°C

Table 1 Heat conductivity

b_{max} (mm)	PITCH (mm)		
	15	22.5	27.5
4.0	–	–	–
5.0	10	–	–
6.0	11	19	–
7.0	12	21	–
8.5	16	25	–
10.0	18	28	–
11.0	–	–	36
13.0	–	–	42
15.0	–	–	48
18.0	–	–	57

Power dissipation and maximum component temperature rise

The power dissipation must be limited in order not to exceed the maximum allowed component temperature rise as a function of the free air ambient temperature.

The power dissipation can be calculated according Chapter "Introduction", section "Maximum power dissipation".

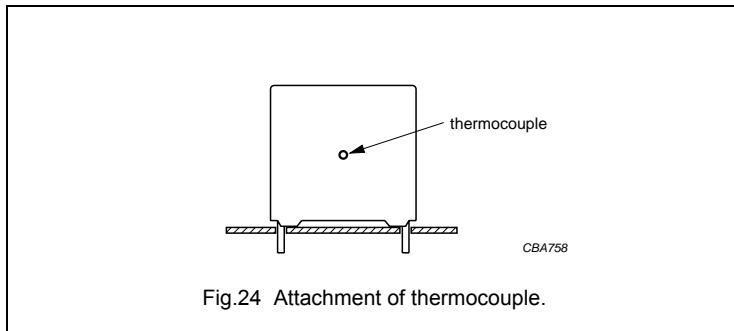
The component temperature rise (ΔT) can be measured (see Section "Measuring the component temperature" for more details) or calculated by $\Delta T = P/G$:

- ΔT = component temperature rise (°C).
- P = power dissipation of the component (mW).
- G = heat conductivity of the component (mW/°C).

AC and Pulse metallized polypropylene film capacitor

MKP 378
MKP/MKP 378**Measuring the component temperature**

A thermocouple must be attached to the capacitor body; see Fig.24.



The temperature is measured in unloaded (T_{amb}) and maximum loaded condition (T_c).

The temperature rise is given by $\Delta T = T_c - T_{amb}$.

To avoid radiation or convection, the capacitor should be tested in a wind-free box.

AC and Pulse metallized polypropylene film capacitor

MKP 378
MKP/MKP 378**Application note and limiting conditions**

These capacitors are not suitable for mains applications as across-the-line capacitors without additional protection, as described hereunder. These mains applications are strictly regulated in safety standards and therefore electromagnetic interference suppression capacitors conforming the standards must be used.

To select the capacitor for a certain application, the following conditions must be checked:

1. The peak voltage (U_p) shall not be greater than the rated DC voltage (U_{Rdc}).
2. The peak-to-peak voltage (U_{p-p}) shall not be greater than the maximum U_{p-p} to avoid the ionisation inception level.
3. The voltage pulse slope (dU/dt) shall not exceed the rated voltage pulse slope in an RC-circuit at rated voltage and without ringing. If the pulse voltage is lower than the rated DC voltage, the rated voltage pulse slope may be multiplied by U_{Rdc} and divided by the applied voltage.

For all other pulses following equation must be fulfilled:

$$2 \times \int_0^T \left(\frac{dU}{dt} \right)^2 \times dt < U_{Rdc} \times \left(\frac{dU}{dt} \right)_{\text{rated}}$$

T is the pulse duration.

The rated voltage pulse slope is valid for ambient temperatures up to 70 °C. For higher temperatures a derating factor of 3% per K shall be applied.

4. The maximum component surface temperature rise must be lower than the limits in Fig.23.
5. Since in circuits used at voltages over 280 V peak-to-peak the risk for an intrinsically active flammability after a capacitor breakdown (short circuit) increases, it is recommended that the power to the component is limited to 100 times the values mentioned in Table 1 "Heat conductivity".
6. When using these capacitors as across-the-line capacitor in the input filter for mains applications or as series connected with an impedance to the mains the applicant must guarantee that following conditions are fulfilled in any case (spikes and surge voltages from the mains included).

VOLTAGE CONDITIONS FOR 6 ABOVE

ALLOWED VOLTAGES	$T_{\text{amb}} \leq 70 \text{ } ^\circ\text{C}$	$70 \text{ } ^\circ\text{C} < T_{\text{amb}} \leq 70 \text{ } ^\circ\text{C}$
Maximum continuous RMS voltage	U_{Rac}	$0.7 \times U_{Rac}$
Maximum temporary RMS -overvoltage (<24 hours)	$1.25 \times U_{Rac}$	$0.875 \times U_{Rac}$
Maximum peak voltage (V_{o-p}) (<2 s)	$1.6 \times U_{Rdc}$	$1.1 \times U_{Rdc}$

AC and Pulse metallized polypropylene film capacitor

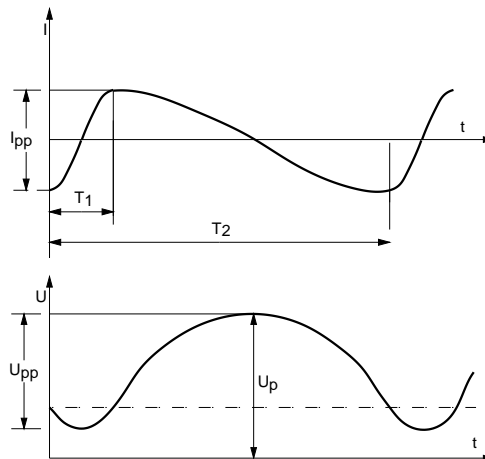
MKP 378
MKP/MKP 378**Example**

$C = 470 \text{ nF}$, 630 V used for S-correction.

This is a signal as in Fig.25 with:

$$U_{p-p} = 108 \text{ V}; U_p = 170 \text{ V}; T_1 = 12 \text{ } \mu\text{s}; T_2 = 64 \text{ } \mu\text{s}; I_{p-p} = 5 \text{ A}$$

The ambient temperature is $50 \text{ }^\circ\text{C}$.



CBA279

Fig.25 Voltage signal.

Checking the conditions:

1. The peak voltage $U_p = 170 \text{ V}$ is lower than 630 V (DC).
2. The peak-to-peak voltage 108 V is lower than $2 \times \sqrt{2} \times 300 \text{ V(AC)} = 850 U_{p-p}$.
3. $I_p = 2.5 \text{ A}$ is lower than $0,47 \mu\text{F} \times 370 \text{ V} / \mu\text{s} = 174 \text{ A}$.
4. The dissipated power is about 40 mW as calculated with Fourier terms and $\text{tg}\delta$ maximum values.

This gives a temperature rise of $\frac{40 \text{ mW}}{48 \text{ mW}/^\circ\text{C}} = 0,8^\circ\text{C}$ which is allowed according Fig.23.

5. Depends on actual application.
6. Not applicable.

AC and Pulse metallized polypropylene film capacitor

MKP 378
MKP/MKP 378

MARKING

Product marking

CAPACITORS WITH PITCH 15 TO 27.5 mm

The capacitors are marked by laser print; on the top for pitch ≥ 22.5 mm (see Fig.26) or on the top and one side for pitch = 15 mm (see Fig.27), with the following information:

1. Rated capacitance code in accordance with "IEC 62"
2. Tolerance on rated capacitance: J = $\pm 5\%$
3. Rated voltage (DC) (e.g. 1000 V)
4. Code for dielectric material (MKP/MKP)
5. Code for factory of origin (HQ)
6. Manufacturer's type designation (378)
7. Manufacturer' name
8. Year and week of manufacture (e.g. 0001).

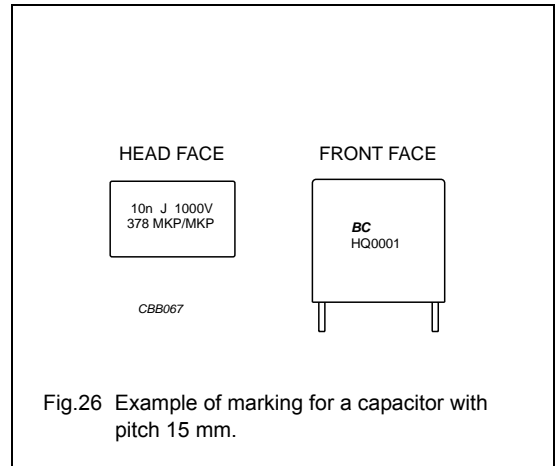


Fig.26 Example of marking for a capacitor with pitch 15 mm.

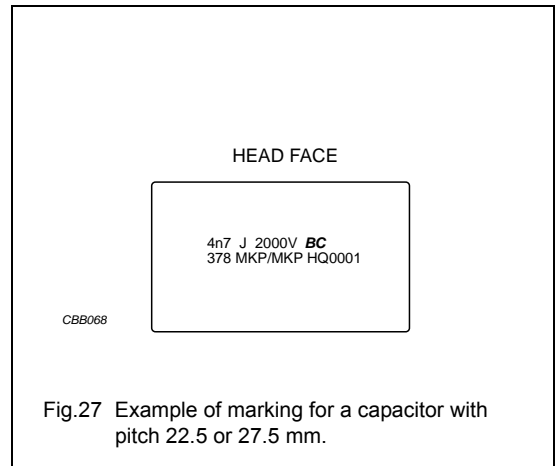



Fig.27 Example of marking for a capacitor with pitch 22.5 or 27.5 mm.

AC and Pulse metallized polypropylene film capacitor

MKP 378
MKP/MKP 378

Package marking

The package containing the capacitors is marked as shown in Fig.28.



BCcomponents
MADE IN BELGIUM
AC AND PULSE FILM CAPACITOR
MKP RADIAL POTTED TYPE
0.68 μ F ±5% 400V= 55/085/56

WO: 12345678

ORIG **A170** RPC HQ

TYPE **MKP 378**

QTY **100** DATE **0003**

CODENO **2222 378 52684**

Barcode label marking

LINE	MARKING EXPLANATION
1	Manufacturer's name
2	Country of origin
3	Sub-family
4	Type description
5	Capacitance value, tolerance, voltage and climatic category ("IEC 60068-1")
6	–
7	Preference origin code: A Country of origin in code: 170 (Belgium) Responsible production centre: HQ Work order: WO
8	Product type description
9	Quantity and production period, year and week code
10	Product code (12NC)

Fig.28 Barcode label.

AC and Pulse metallized polypropylene film capacitor

MKP 378
MKP/MKP 378

QUICK REFERENCE TEST REQUIREMENTS

TEST	PROCEDURE (quick reference)	REQUIREMENTS
Robustness of leads		
Tensile and bending: "IEC 60068-2-21"	–	no visible damage legible marking
Resistance to soldering heat: "IEC 60068-2-20"	solder bath: 260 °C; 10 s	$ \Delta C/C \leq 1\%$
Component solvent resistance	isopropyl alcohol; 23 °C; 5 minutes	$\Delta \tan \delta \leq 5 \times 10^{-4}$ ($C \leq 100$ nF) $\Delta \tan \delta \leq 10 \times 10^{-4}$ (100 nF < $C \leq 470$ nF) $\Delta \tan \delta \leq 15 \times 10^{-4}$ ($C > 470$ nF)
Robustness of component		
Vibration: "IEC 60068-2-6"	10 Hz to 55 Hz; amplitude 0.75 mm or acceleration 98 m/s ² ; 6 hours	$ \Delta C/C \leq 1\%$ $\Delta \tan \delta \leq 5 \times 10^{-4}$ ($C \leq 100$ nF)
Shock: "IEC 60068-2-27"	half sinewave; 490 m/s ² ; 11 ms	$\Delta \tan \delta \leq 10 \times 10^{-4}$ (100 nF < $C \leq 470$ nF) $\Delta \tan \delta \leq 15 \times 10^{-4}$ ($C > 470$ nF)
Climatic sequence		
Dry heat: "IEC 60068-2-2"	16 hours; 85 °C	$ \Delta C/C \leq 1\%$ (22.5/27.5 mm pitch) $ \Delta C/C \leq 2\%$ (15 mm pitch)
Damp heat, cyclic, test Db, first cycle: "IEC 60068-2-30"	–	$\Delta \tan \delta \leq 5 \times 10^{-4}$ ($C \leq 100$ nF) $\Delta \tan \delta \leq 10 \times 10^{-4}$
Cold: "IEC 60068-2-1"	2 hours; –55 °C	(100 nF < $C \leq 470$ nF) $\Delta \tan \delta \leq 15 \times 10^{-4}$ ($C > 470$ nF)
Damp heat, cyclic, test Db, remaining cycles: "IEC 60068-2-30"	–	$R_{ins} \geq 50\%$ of specified value
Other applicable tests		
Damp heat, steady state: "IEC 60068-2-3"	56 days; 40 °C; 90 to 95% RH	$ \Delta C/C \leq 1\%$ (22.5/27.5 mm pitch) $ \Delta C/C \leq 2\%$ (15 mm pitch) $\Delta \tan \delta \leq 5 \times 10^{-4}$ ($C \leq 100$ nF) $\Delta \tan \delta \leq 10 \times 10^{-4}$ (100 nF < $C \leq 470$ nF) $\Delta \tan \delta \leq 15 \times 10^{-4}$ ($C > 470$ nF) $R_{ins} \geq 50\%$ of specified value
Endurance (AC): "IEC 60384-17"	1000 h: 85 °C $1.25 \times U_{Rac}$ (RMS); 50 Hz	$ \Delta C/C \leq 5\%$ $\Delta \tan \delta \leq 5 \times 10^{-4}$ ($C \leq 100$ nF) $\Delta \tan \delta \leq 10 \times 10^{-4}$ (100 nF < $C \leq 470$ nF) $\Delta \tan \delta \leq 15 \times 10^{-4}$ ($C > 470$ nF) $R_{ins} \geq 50\%$ of specified value

AC and Pulse metallized polypropylene film capacitor

MKP 378
MKP/MKP 378

TEST	PROCEDURE (quick reference)	REQUIREMENTS
Heat storage: "IEC 60384-17"	2000 hours; 85 °C	$ \Delta C/C \leq 1\%$ (22.5/27.5 mm pitch) $ \Delta C/C \leq 2\%$ (15 mm pitch) $\Delta \tan \delta \leq 5 \times 10^{-4}$ ($C \leq 100$ nF) $\Delta \tan \delta \leq 10 \times 10^{-4}$ (100 nF < $C \leq 470$ nF) $\Delta \tan \delta \leq 15 \times 10^{-4}$ ($C > 470$ nF)
Resistance to soldering heat with preheating: "IEC 60384-17"	body temperature: 85 °C; bath temperature: 260 °C; dwell time: 10 s	$ \Delta C/C \leq 1\%$ $\Delta \tan \delta \leq 5 \times 10^{-4}$ ($C \leq 100$ nF) $\Delta \tan \delta \leq 10 \times 10^{-4}$ (100 nF < $C \leq 470$ nF) $\Delta \tan \delta \leq 15 \times 10^{-4}$ ($C > 470$ nF)
Passive flammability: "IEC 60384-1"	class B	no burning
Endurance (DC): "IEC 60384-17"	2000 hours; $1.25 \times U_{Rdc}$; 85 °C	$ \Delta C/C \leq 1\%$ (22.5/27.5 mm pitch) $ \Delta C/C \leq 2\%$ (15 mm pitch) $\Delta \tan \delta \leq 5 \times 10^{-4}$ ($C \leq 100$ nF) $\Delta \tan \delta \leq 10 \times 10^{-4}$ (100 nF < $C \leq 470$ nF) $\Delta \tan \delta \leq 15 \times 10^{-4}$ ($C > 470$ nF) $R_{ins} \geq 50\%$ of specified value

AC and Pulse metallized polypropylene film capacitor

MKP 378
MKP/MKP 378

INSPECTION REQUIREMENT

General points

1. Sub-clause numbers of tests and performance requirements refer to the "Sectional Specification, IEC-publication IEC 60384-17 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 this 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"
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 Section "Product marking" of this specification As specified in Chapters "General data" of this specification
4.1 Dimensions; note 2		Gauging.	S3	note 1	
SUB-GROUP A2; note 3					
ND					
4.2.2 Capacitance		at 1 kHz			Within specified tolerance No breakdown or flash-over As specified in Section "Tangent of loss angle" of this specification As specified in Section "Insulation resistance" of this specification
4.2.1 Voltage proof (Test A)		at $1.6 \times U_{Rdc}$ for 1 s			
4.2.3 Tangent of loss angle		for $C \leq 1 \mu F$ at 100 kHz for $C > 1 \mu F$ at 10 kHz			
4.2.4 Insulation resistance (Test A)		at 100 V for $U_{Rdc} < 630 V$ at 500 V for $U_{Rdc} \geq 630 V$			

Notes:

1. Number to be tested: Sample size as directly allotted to the code letter for IL in Table II A of "IEC 60410" (Single sampling plan for normal inspection).
2. The test may be replaced by in-production testing, if SPC on dimensional measurements or other mechanisms to avoid parts exceeding the limits is installed.
3. The 100% testing shall be followed by re-inspection by sampling in order to monitor outgoing quality level by non-conforming items per million (ppm). The sampling level is be established by BCcomponents. For the calculation of ppm values any parametric failure shall be counted as non-conforming item. In case one or more non-conforming items occur in a sample, this lot shall be rejected.

AC and Pulse metallized polypropylene film capacitor

MKP 378
MKP/MKP 378

Group C inspection

SUB-CLAUSE NUMBER AND TEST	D or ND	CONDITIONS	p	n	PERFORMANCE REQUIREMENTS
Group C inspection (periodic); see Section "General points"; item 3.					
SUB-GROUP C1A PART OF SAMPLE OF SUB-GROUP C1	D		6	9	
4.1 Dimensions (detail)					As specified in Chapters "General data" of this specification.
4.3.1 Initial measurements		Capacitance. Tangent of loss angle: for $C \leq 1 \mu\text{F}$ at 100 kHz for $C > 1 \mu\text{F}$ at 10 kHz			
4.3 Robustness of terminations		Tensile and bending.			No visible damage.
4.4 Resistance to soldering heat		Method: 1A Solder bath: 260 °C Duration: 10 s.			
4.14 Component solvent resistance		Isopropylalcohol at room temperature Method: 2 Immersion time: 5 ± 0.5 min. Recovery time: min. 1 hour, max. 2 hours.			
4.4.2 Final measurements		Visual examination. Capacitance. Tangent of loss angle.			No visible damage Legible marking. $ \Delta C/C \leq 1\%$ of the value measured initially Increase of $\tan \delta$: ≤ 0.0005 for: $C \leq 100 \text{ nF}$ or ≤ 0.001 for: $100 \text{ nF} < C \leq 470 \text{ nF}$ or ≤ 0.0015 for: $C > 470 \text{ nF}$ compared to the values measured in 4.3.1

AC and Pulse metallized polypropylene film capacitor

MKP 378
MKP/MKP 378

SUB-CLAUSE NUMBER AND TEST	D or ND	CONDITIONS	p	n	PERFORMANCE REQUIREMENTS
SUB-GROUP C1B OTHER PART OF SAMPLE OF SUB-GROUP C1			6	18	
4.6.1 Initial measurements		Capacitance. Tangent of loss angle: for $C \leq 1 \mu\text{F}$ at 100 kHz for $C > 1 \mu\text{F}$ at 10 kHz			No visible damage Legible marking.
4.15 Solvent resistance of the marking: see Section "General points"; item 5.		Isopropylalcohol at room temperature Method: 1 Rubbing material: cotton wool Immersion time: 5.0 ± 0.5 min.			
4.6 Rapid change of temperature		θA = lower category temperature θB = upper category temperature 5 cycles Duration $t = 30$ min. Visual examination.			No visible damage.
4.7 Vibration: see Section "General points"; item 3.		Mounting : see Section "Mounting" for more information 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 Section "General points"; item 3.		Mounting : see Section "Mounting" for more information Pulse shape: half sine Acceleration: 490 m/s^2 Duration of pulse: 11 ms.			
4.9.3 Final measurements		Visual examination. Capacitance.			No visible damage. $ \Delta C/C \leq 1\%$ of the value measured in 4.6.1.

AC and Pulse metallized polypropylene film capacitor

MKP 378
MKP/MKP 378

SUB-CLAUSE NUMBER AND TEST	D or ND	CONDITIONS	p	n	PERFORMANCE REQUIREMENTS
		Tangent of loss angle. Insulation resistance.			Increase of $\tan \delta$: ≤ 0.0005 for: $C \leq 100$ nF or ≤ 0.001 for: 100 nF $< C \leq 470$ nF or ≤ 0.0015 for: $C > 470$ nF compared to the values measured in 4.6.1. As specified in Section "Insulation resistance" of this specification.
SUB-GROUP C1 COMBINED SAMPLE OF SPECIMENS OF SUB-GROUPS C1A AND C1B	D		6	27	
4.10 Climatic sequence 4.10.2 Dry heat 4.10.3 Damp heat, cyclic, test Db, first cycle 4.10.4 Cold 4.10.6 Damp heat, cyclic, test Db, remaining cycles 4.10.6.2 Final measurements		Temperature: upper category temperature Duration: 16 hours. Temperature: lower category temperature Duration: 2 hours. Voltage proof = U_{Rdc} for 1 minute within 15 minutes after removal from testchamber Visual examination. Capacitance.			No breakdown or flashover No visible damage Legible marking. for 22.5 and 27.5 mm pitch: $ \Delta C/C \leq 1\%$ or for 15 mm pitch: $ \Delta C/C \leq 2\%$ of the value measured in 4.4.2 or 4.9.3

AC and Pulse metallized polypropylene film capacitor

MKP 378
MKP/MKP 378

SUB-CLAUSE NUMBER AND TEST	D or ND	CONDITIONS	p	n	PERFORMANCE REQUIREMENTS
		Tangent of loss angle. Insulation resistance.			Increase of $\tan \delta$: ≤ 0.0005 for: $C \leq 100 \text{ nF}$ or ≤ 0.001 for: $100 \text{ nF} < C \leq 470 \text{ nF}$ or ≤ 0.0015 for: $C > 470 \text{ nF}$ compared to the values measured in 4.6.1 or 4.3.1. $\geq 50\%$ of values specified in Section "Insulation resistance" of this specification.
SUB-GROUP C2	D		6	15	
4.11 Damp heat, steady state 4.11.1 Initial measurements 4.11.3 Final measurements		Capacitance. Tangent of loss angle at 1 kHz. Voltage proof = U_{Rdc} for 1 minute within 15 minutes after removal from testchamber Visual examination. Capacitance. Tangent of loss angle. Insulation resistance.			No breakdown or flashover No visible damage Legible marking. for 22.5 and 27.5 mm pitch: $ \Delta C/C \leq 1\%$ or for 15 mm pitch: $ \Delta C/C \leq 2\%$ of the value measured in 4.11.1. Increase of $\tan \delta$: ≤ 0.0005 for: $C \leq 100 \text{ nF}$ or ≤ 0.001 for: $100 \text{ nF} < C \leq 470 \text{ nF}$ or ≤ 0.0015 for: $C > 470 \text{ nF}$ compared to the values measured in 4.11.1 $\geq 50\%$ of values specified in Section "Insulation resistance" of this specification.

AC and Pulse metallized polypropylene film capacitor

MKP 378
MKP/MKP 378

SUB-CLAUSE NUMBER AND TEST	D or ND	CONDITIONS	p	n	PERFORMANCE REQUIREMENTS
SUB-GROUP C3A	D		3	20	
4.12.1 Endurance test at 50 Hz alternating voltage 4.12.1.1 Initial measurements 4.12.1.3 Final measurements		Duration: 1000 hours Temperature: 85 °C Voltage: 1.25 × max. AC voltage (RMS value), 50Hz. Capacitance Tangent of loss angle: for C ≤ 1 μF at 100 kHz for C > 1 μF at 10 kHz Visual examination. Capacitance. Tangent of loss angle. Insulation resistance.			No visible damage Legible marking. $ \Delta C/C \leq 5\%$ of value measured in 4.12.1.1. Increase of tan δ : ≤0.0005 for: C ≤ 100 nF or ≤0.001 for: 100 nF < C ≤ 470 nF or ≤0.0015 for: C > 470 nF compared to the values measured in 4.12.1.1. ≥50% of values specified in Section "Insulation resistance" of this specification.
SUB-GROUP C4	D		3	9	
4.2.6 Temperature characteristics Initial measurements Intermediate measurements Final measurements		Capacitance. Capacitance at lower category temperature Capacitance at 20 °C Capacitance at upper category temperature Capacitance. Insulation resistance.			for -55 °C to +20 °C: $0\% \leq \Delta C/C \leq 3.75\%$ or for 20 °C to 85 °C: $-3.25\% \leq \Delta C/C \leq 0\%$ As specified in Section "Capacitance" of this specification. As specified in Section "Insulation resistance" of this specification.

AC and Pulse metallized polypropylene film capacitor

MKP 378
MKP/MKP 378

SUB-CLAUSE NUMBER AND TEST	D or ND	CONDITIONS	p	n	PERFORMANCE REQUIREMENTS
4.13 Charge and discharge		10000 cycles (1 ... 50 c/s) $1.5 \times (dU/dt)_R$ charge to U_{Rdc} with maximum pulse slope $\leq 0.01(dU/dt)_R$ Duration: 5 ms Discharge resistance: $R = \frac{U_{Rdc}}{1,5 \times C(dU/dt)}$ $R_{min} = 2,2\Omega$			
4.13.1 Initial measurements		Capacitance. Tangent of loss angle: for $C \leq 1 \mu F$ at 100 kHz for $C > 1 \mu F$ at 10 kHz			
4.13.3 Final measurements		Capacitance. Tangent of loss angle. Insulation resistance.			$ \Delta C/C \leq 1\%$ of the value measured in 4.13.1. Increase of $\tan \delta$: ≤ 0.0005 for: $C \leq 100 \text{ nF}$ or ≤ 0.001 for: $100 \text{ nF} < C \leq 470 \text{ nF}$ or ≤ 0.0015 for: $C > 470 \text{ nF}$ compared to the values measured in 4.13.1. $\geq 50\%$ of values specified in Section "Insulation resistance" of this specification.

AC and Pulse metallized polypropylene film capacitor

MKP 378
MKP/MKP 378

Group additional inspection requirements

ADDITIONAL TESTS	D or ND	CONDITIONS	p	n	PERFORMANCE REQUIREMENTS
SUB-GROUP ADD1	D		3	20	
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: 2000 hours Temperature: upper category temperature.			No visible damage. for 22.5 and 27.5 mm pitch: $ \Delta C/C \leq 1\%$ or for 15 mm pitch: $ \Delta C/C \leq 2\%$ of the value measured in A.2.1. Increase of $\tan \delta$: ≤ 0.0005 for: $C \leq 100$ nF or ≤ 0.001 for: 100 nF < $C \leq 470$ nF or ≤ 0.0015 for: $C > 470$ nF compared to the values measured in A.2.1. As specified in Section "Insulation resistance" of this specification.
A.2.1 Initial measurements		Capacitance. Tangent of loss angle: for $C \leq 1$ μ F at 100 kHz for $C > 1$ μ F at 10 kHz			
A.2.2 Final measurements		Visual examination. Capacitance. Tangent of loss angle. Insulation resistance.			

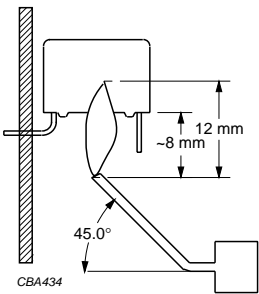
AC and Pulse metallized polypropylene film capacitor

MKP 378
MKP/MKP 378

ADDITIONAL TESTS	D or ND	CONDITIONS	p	n	PERFORMANCE REQUIREMENTS
SUB-GROUP ADD3			3	9	
A.3 Detergent resistance		Density 20g/l dishwasher detergent Temperature 70 °C, during 3 minutes; followed by rinsing in clear water for 1 minute Recovery time: min. 1hour and max. 2 hours.			No visible damage Legible marking. $ \Delta C/C \leq 1\%$ of the value measured in A.3.1. Increase of tan δ : ≤ 0.0005 for: $C \leq 100$ nF or ≤ 0.001 for: 100 nF $< C \leq 470$ nF or ≤ 0.0015 for: $C > 470$ nF compared to the values measured in A.3.1. $\geq 50\%$ of values specified in Section "Insulation resistance" of this specification.
A.3.1 Initial measurements		Capacitance. Tangent of loss angle: for $C \leq 1 \mu\text{F}$ at 100 kHz for $C > 1 \mu\text{F}$ at 10 kHz			
A.3.2 Final measurements		Visual examination. Capacitance. Tangent of loss angle. Insulation resistance.			
SUB-GROUP ADD4	D		6	15	
A.4 Resistance to soldering heat with preheating		Capacitors mounted on a 1.6 mm board with non-plated holes Body temp.: 85 °C Bath temp.: 260 °C Dwell time: 10 s.			
A.4.1 Initial measurements		Capacitance Tangent of loss angle: for $C \leq 1 \mu\text{F}$ at 100 kHz for $C > 1 \mu\text{F}$ at 10 kHz			

AC and Pulse metallized polypropylene film capacitor

MKP 378
MKP/MKP 378

ADDITIONAL TESTS	D or ND	CONDITIONS	p	n	PERFORMANCE REQUIREMENTS
A.4.2 Final measurements		Visual examination. Capacitance. Tangent of loss angle.			No visible damage. $ \Delta C/C \leq 1\%$ of the value measured in A.4.1. Increase of $\tan \delta$: ≤ 0.0005 for: $C \leq 100 \text{ nF}$ or ≤ 0.001 for: $100 \text{ nF} < C \leq 470 \text{ nF}$ or ≤ 0.0015 for: $C > 470 \text{ nF}$ compared to the values measured in A.4.1.
SUB-GROUP ADD5	D		6	15	
A.5.1 Passive flammability Class B		Bore of gas jet: $\varnothing 0.5 \text{ mm}$ Fuel : butane Test duration for actual volume V in mm^3 : $\leq 250 = 10 \text{ s}$ $250 < V \leq 500 = 20 \text{ s}$ $500 < V \leq 1750 = 30 \text{ s}$ $V > 1750 = 60 \text{ s}$. 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.
SUB-GROUP ADD6	D		3	21	
A.6 Endurance A.6.1 Initial measurements		Capacitance Tangent of loss angle: for $C \leq 1 \mu\text{F}$ at 100 kHz for $C > 1 \mu\text{F}$ at 10 kHz			

AC and Pulse metallized polypropylene film capacitor

MKP 378
MKP/MKP 378

ADDITIONAL TESTS		D or ND	CONDITIONS	p	n	PERFORMANCE REQUIREMENTS
A.6.2	Endurance DC		Duration: 2000 hours $1.25 \times U_{Rdc}$ at 85 °C			No visible damage. $ \Delta C/C \leq 3\%$ of the value measured in A.6.1. Increase of tan δ : ≤ 0.0005 for: C \leq 100 nF or ≤ 0.001 for: 100 nF < C \leq 470 nF or ≤ 0.0015 for: C > 470 nF compared to the values measured in A.6.1. $\geq 50\%$ of values specified in Section "Insulation resistance" of this specification.
A.6.3	Final measurements		Visual examination. Capacitance. Tangent of loss angle. Insulation resistance.			
SUB-GROUP ADD7		D		3	15	
A.7	Climatic test on taped type		10 days at 40 ± 2 °C R.H. 90 to 95% Recovery time : 24h.			Angle of component $\leq 4^\circ$ pull out Tearing forces $\geq 50\%$ of values specified in "HQN-384-01/102, Taping specification for film capacitors".

AC and Pulse metallized polypropylene film capacitor

MKP 378
MKP/MKP 378

AMENDMENT RECORD

DATE	CHANGE DESCRIPTION
92-02-25	First edition
93-05-04	New lay-out
93-08-24	p. 27: HQ 2285 K: change from taping method from one tape to two small tapes
93-10-19	different corrections add. of reference testing
94-01-11	p. 36: sub-group ADD4: A.4: body temp. = 85 °C i.s.o. 80 °C
94-03-22	p. 13: 2000 V: cap. range: 0.016 - 0.051: AFD add. of mass. (g) epoxy resin i.s.o. blue epoxyresin
94-04-19	lead diameter 0.8 ±0.08 mm
95-02-07	adj. of ADD2 and ADD6 adj. of 630 and 1000 V pitch 15 mm new lay-out
96-02-06	add. of: 2222 378 44... : MKP 250 V - L _t = 3.5 ±0.5 mm add. of: 2222 378 54... : MKP 400 V - L _t = 3.5 ±0.5 mm
97-09-16	New lay-out and renumbering of tests (WV-HQ7012K) Test "Solvent resistance of marking" before "Rapid change of temp." (WV-HQ6140K)
98-03-17	p. 8 until p. 19: adj. of Header MKP/MKP 378 i.s.o. MKP 378
98-05-26	pitch 27.5 mm: taped on reel products no longer available (WV-HQ8060K) MKP: l _t = 3.5 ±0.3 mm i.s.o. 3.5 ±0.5 mm; l _t = 3.2 ±0.5 mm is cancelled (WV-HQ8092 and WV-HQ6117K)
99-12-07	Adjustment of product marking and label (WV-HQ9128K) Philips becomes BC Components
00-02-15	Addition of package quantities BC Beyschlag Centralab Components wordt BCcomponents (WV-HQ0011K)
00-05-09	Case size 1770 - 1785 becomes copper wire (WV-HQ0066K)
00-12-05	Addition if there must be a voltage proof test after damp heat test (WV-HQ0198K) Adjustment of ΔC/C in ADD6-test (WV-HQ0240K)
01-10-23	Replacement of AQL 0.65% by zero defect (WV-HQ0252K) Passive flammability becomes class B i.s.o. class C (WV-HQ01009K)
01-12-11	Correction Passive flammability-test
03-02-18	Adjustment of packing quantities for case size 2560 (WV-HQ01132K)