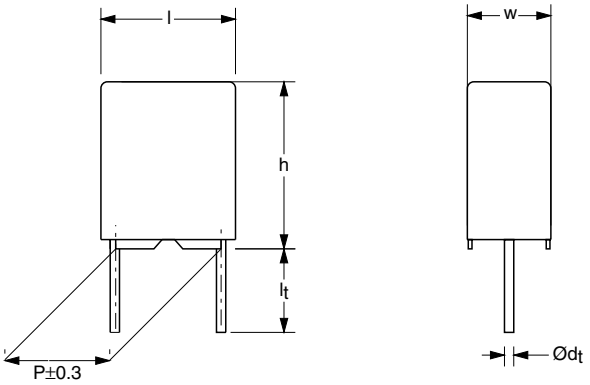
Metallized Polypropylene Film Capacitors
MKP Radial Potted Type



Dimensions in mm

APPLICATIONS

Low losses due to low contact resistance and low loss dielectric result in applications where high frequency occur or high stability is preferred. Their small dimensions make them suitable for circuits with high packaging density.

MARKING

C-value; rated voltage; tolerance; code for manufacturer; year and week of manufacture; manufacturers type designation

DIELECTRIC

Polypropylene film

ELECTRODES

Vacuum deposited aluminum

ENCAPSULATION

Flame retardant plastic case and epoxy resin (UL-class 94 V-0)

CONSTRUCTION

Wound mono construction

LEADS

Tinned wire

CAPACITANCE RANGE (E24 SERIES)

0.001 to 1.2 µF

FEATURES

5, 10 and 15 mm lead pitch. Supplied loose in box, in ammopack and taped on reel. Intermediate values are available of the E96 series

Lead (Pb)-free product

RoHS-compliant product

Pb-free

e3

RoHS COMPLIANT

CAPACITANCE TOLERANCE

± 5 %; ± 2 %

RATED (DC) VOLTAGE

63 V; 160 V; 250 V; 400 V; 630 V

RATED (AC) VOLTAGE

25 V; 63 V;100 V; 125 V; 160 V

RATED PEAK-TO-PEAK VOLTAGE

70 V; 180 V; 280 V; 350 V; 450 V

CLIMATIC CATEGORY

55/085/56

RATED TEMPERATURE (DC)

85 °C

RATED TEMPERATURE (AC)

85 °C

MAXIMUM APPLICATION TEMPERATURE

85 °C

REFERENCE SPECIFICATIONS

IEC 60384-16

PERFORMANCE GRADE

Grade 1 (long life)

STABILITY GRADE

Grade 1

DETAIL SPECIFICATION

For more detailed data and test requirements contact: filmcaps.roeselare@vishay.com

COMPOSITION OF CATALOG NUMBER

TYPE AND PITCHES	
416	5.0/10.0/15.0 mm
417	5.0/10.0/15.0 mm
418	5.0/10.0/15.0 mm
419	5.0/10.0/15.0 mm
420	5.0/10.0/15.0 mm

CAPACITANCE (numerically)

MULTIPLIER (nF)	
0.01	2
0.1	3
1	4

Example:
1004 = 100 x 1 = 100 nF

2222	4..	XX	XX	X
BFC2*	4..	XX	XX	X

* Use this partnumber for those with access to the Vishay's SAP system and Partners website within the Americas

TYPE	PACKAGING	PITCH (mm)	LEAD CONFIGURATION	PREFERRED TYPES					
				C-TOL	63 V	160 V	250 V	400 V	630 V
416	Taped; see note	5/10/15	H = 18.5 mm; P_0 = 12.7 mm	± 2 %	1				
	Loose in box	15	lead length 3.5 ± 0.3 mm	± 2 %	7				
417	Taped; see note	5/10/15	H = 18.5 mm; P_0 = 12.7 mm	± 2 %		1			
	Loose in box	15	lead length 3.5 ± 0.3 mm	± 2 %		7			
418	Taped; see note	5/10/15	H = 18.5 mm; P_0 = 12.7 mm	± 2 %			1		
	Loose in box	15	lead length 3.5 ± 0.3 mm	± 2 %			7		
419	Taped; see note	5/10/15	H = 18.5 mm; P_0 = 12.7 mm	± 2 %				1	
	Loose in box	15	lead length 3.5 ± 0.3 mm	± 2 %				7	
420	Taped; see note	5/10/15	H = 18.5 mm; P_0 = 12.7 mm	± 2 %					1
	Loose in box	15	lead length 3.5 ± 0.3 mm	± 2 %					7
					ON REQUEST				
416	Taped; see note	5/10/15	H = 18.5 mm; P_0 = 12.7 mm	± 5 %	0				
	Loose in box	5/10	lead length 4.0 + 1.0/– 0.5 mm	± 5 %	3				
				± 2 %	4				
		15	lead length 3.5 ± 0.3 mm	± 5 %	6				
417	Taped; see note	5/10/15	H = 18.5 mm; P_0 = 12.7 mm	± 5 %		0			
	Loose in box	5/10	lead length 4.0 + 1.0/– 0.5 mm	± 5 %		3			
				± 2 %		4			
		15	lead length 3.5 ± 0.3 mm	± 5 %		6			
418	Taped; see note	5/10/15	H = 18.5 mm; P_0 = 12.7 mm	± 5 %			0		
	Loose in box	5/10	lead length 4.0 + 1.0/– 0.5 mm	± 5 %			3		
				± 2 %			4		
		15	lead length 3.5 ± 0.3 mm	± 5 %			6		
419	Taped; see note	5/10/15	H = 18.5 mm; P_0 = 12.7 mm	± 5 %				0	
	Loose in box	5/10	lead length 4.0 + 1.0/– 0.5 mm	± 5 %				3	
				± 2 %				4	
		15	lead length 3.5 ± 0.3 mm	± 5 %				6	
420	Taped; see note	5/10/15	H = 18.5 mm; P_0 = 12.7 mm	± 5 %					0
	Loose in box	5/10	lead length 4.0 + 1.0/– 0.5 mm	± 5 %					3
				± 2 %					4
		15	lead length 3.5 ± 0.3 mm	± 5 %					6

Note:
Pitch = 5 and 10 mm: taped on ammopack
Pitch = 15 mm: taped on reel with diameter = 356 mm

SPECIFIC REFERENCE DATA

DESCRIPTION	VALUE				
Tangent of loss angle:	at 10 kHz			at 100 kHz	
$C \leq 0.0091\ \mu F$	$\leq 5 \times 10^{-4}$			$\leq 10 \times 10^{-4}$	
$0.0091\ \mu F < C \leq 0.027\ \mu F$	$\leq 5 \times 10^{-4}$			$\leq 15 \times 10^{-4}$	
$0.027\ \mu F < C \leq 0.075\ \mu F$	$\leq 5 \times 10^{-4}$			$\leq 20 \times 10^{-4}$	
$0.075\ \mu F < C \leq 0.11\ \mu F$	$\leq 5 \times 10^{-4}$			$\leq 25 \times 10^{-4}$	
$0.11\ \mu F < C \leq 0.18\ \mu F$	$\leq 10 \times 10^{-4}$			$\leq 30 \times 10^{-4}$	
$0.18\ \mu F < C \leq 0.27\ \mu F$	$\leq 10 \times 10^{-4}$			$\leq 35 \times 10^{-4}$	
$0.27\ \mu F < C \leq 0.39\ \mu F$	$\leq 10 \times 10^{-4}$			$\leq 40 \times 10^{-4}$	
$0.39\ \mu F < C \leq 0.56\ \mu F$	$\leq 10 \times 10^{-4}$			$\leq 45 \times 10^{-4}$	
$0.56\ \mu F < C \leq 0.75\ \mu F$	$\leq 10 \times 10^{-4}$			$\leq 50 \times 10^{-4}$	
$0.75\ \mu F < C \leq 1.1\ \mu F$	$\leq 10 \times 10^{-4}$			$\leq 60 \times 10^{-4}$	
Rated voltage pulse slope $(dU/dt)_R$:	at 63 V (DC)	at 100 V (DC)	at 250 V (DC)	at 400 V (DC)	at 630 V (DC)
P = 5 mm	50 V/µs	50 V/µs	50 V/µs	50 V/µs	50 V/µs
P = 10 mm	20 V/µs	20 V/µs	20 V/µs	20 V/µs	50 V/µs
P = 15 mm	50 V/µs	50 V/µs	50 V/µs	50 V/µs	50 V/µs
R between leads, for C ≤ 0.33 µF:					
at 50 V; 1 minute	> 100000 MΩ				
at 100 V; 1 minute		> 100000 MΩ	> 100000 MΩ	> 100000 MΩ	> 100000 MΩ
RC between leads, for C > 0.33 µF at 10 V; 1 minute	> 30000 s	>30000 s	>30000 s	>30000 s	
R between interconnecting leads and casing; 50 V; 1 minute	> 100000 MΩ	> 100000 MΩ	> 100000 MΩ	> 100000 MΩ	> 100000 MΩ
Withstanding (DC) voltage (cut off current 10 mA); rise time 100 V/s	100 V; 1 minute	260 V; 1 minute	400 V; 1 minute	640 V; 1 minute	1000 V; 1 minute
Withstanding (DC) voltage between leads and case	2840 V; 1 minute	2840 V; 1 minute	2840 V; 1 minute	2840 V; 1 minute	1260 V; 1 minute

U_{Rdc} = 63 V; U_{Rac} = 25 V; U_{p-p} = 70 V

C (E 24) (µF)	DIMENSIONS w × h × l (mm)	MASS (g)	CATALOG NUMBER 2222 416 ..... AND PACKAGING							
			AMMOPACK		LOOSE IN BOX		REEL		LOOSE IN BOX	
			H = 18.5 mm; P_0 = 12.7 mm		lt = 4.0 + 1.0/– 0.5 mm		H = 18.5 mm; P_0 = 12.7 mm		lt = 3.5 ± 0.3 mm	
			C-tol = ± 2 %		C-tol = ± 2 %		C-tol = ± 2 %		C-tol = ± 2 %	
			last 5 digits of catalog number	SPQ	last 5 digits of catalog number	SPQ	last 5 digits of catalog number	SPQ	last 5 digits of catalog number	SPQ
Pitch = 5.0 ± 0.3 mm; d_t = 0.50 ± 0.05 mm										
0.036	4.5 × 9.0 × 7.2	0.45	13603	1000	43603	2000				
0.039			13903		43903					
0.043			14303		44303					
0.047			14703		44703					
0.051	6.0 × 11.0 × 7.2	0.60	15103	750	45103	1500				
0.056			15603		45603					
0.062			16203		46203					
0.068			16803		46803					
0.075			17503		47503					
0.082			18203		48203					
0.091			19103		49103					
0.1			11004		41004					
0.11			11104		41104					
0.12			11204		41204					
Pitch = 10.0 ± 0.4 mm; d_t = 0.60 ± 0.06 mm										
0.13	5.0 × 11.0 × 12.5	0.85	11304	600	41304	1000				
0.15			11504		41504					
0.16	6.0 × 12.0 × 12.5	1.10	11604	500	41604	750				
0.18			11804		41804					
0.20			12004		42004					
0.22			12204		42204					
0.24			12404		42404					
0.27			12704		42704					
Pitch = 15.0 ± 0.4 mm; d_t = 0.60 ± 0.06 mm										
0.3	6.0 × 12.0 × 17.5	1.4					13004	900	73004	1000
0.33							13304		73304	
0.36							13604		73604	
0.39							13904		73904	
Pitch = 15.0 ± 0.4 mm; d_t = 0.80 ± 0.08 mm										
0.43	7.0 × 13.5 × 17.5	1.9					14304	800	74304	750
0.47							14704		74704	
0.51							15104		75104	
0.56							15604		75604	
0.62	8.5 × 15.0 × 17.5	2.6					16204	650	76204	750
0.68							16804		76804	
0.75							17504		77504	
0.82							18204		78204	
0.91	10.0 × 16.5 × 17.5	3.1					19104	600	79104	500
1.0							11005		71005	
1.1							11105		71105	

U_{Rdc} = 160 V; U_{Rac} = 63 V; U_{p-p} = 180 V

C (E 24) (µF)	DIMENSIONS w × h × l (mm)	MASS (g)	CATALOG NUMBER 2222 417 ..... AND PACKAGING							
			AMMOPACK		LOOSE IN BOX		REEL		LOOSE IN BOX	
			H = 18.5 mm; P_0 = 12.7 mm		lt = 4.0 + 1.0/– 0.5 mm		H = 18.5 mm; P_0 = 12.7 mm		lt = 3.5 ± 0.3 mm	
			C-tol = ± 2 %		C-tol = ± 2 %		C-tol = ± 2 %		C-tol = ± 2 %	
			last 5 digits of catalog number	SPQ	last 5 digits of catalog number	SPQ	last 5 digits of catalog number	SPQ	last 5 digits of catalog number	SPQ
Pitch = 5.0 ± 0.3 mm; d_t = 0.50 ± 0.05 mm										
0.024	4.5 × 9.0 × 7.2	0.45	12403	1000	42403	2000				
0.027			12703		42703					
0.03			13003		43003					
0.033			13303		43303					
0.036	6.0 × 11.0 × 7.2	0.60	13603	750	43603	1500				
0.039			13903		43903					
0.043			14303		44303					
0.047			14703		44703					
0.051			15103		45103					
0.056			15603		45603					
0.062			16203		46203					
0.068			16803		46803					
Pitch = 10.0 ± 0.4 mm; d_t = 0.60 ± 0.06 mm										
0.075	4.0 × 10.0 × 12.5	0.60	17503	750	47503	1000				
0.082			18203		48203					
0.091			19103		49103					
0.1			11004		41004					
0.11	5.0 × 11.0 × 12.5	0.85	11104	600	41104	1000				
0.12			11204		41204					
0.13			11304		41304					
0.15			11504		41504					
0.16	6.0 × 12.0 × 12.5	1.10	11604	500	41604	750				
0.18			11804		41804					
0.20			12004		42004					
0.22			12204		42204					
0.24			12404		42404					
Pitch = 15.0 ± 0.4 mm; d_t = 0.60 ± 0.06 mm										
0.27	5.0 × 11.0 × 17.5	1.2					12704	1100	72704	1250
0.3	6.0 × 12.0 × 17.5	1.4					13004	900	73004	1000
0.33							13304		73304	
0.36							13604		73604	
0.39							13904		73904	
Pitch = 15.0 ± 0.4 mm; d_t = 0.80 ± 0.08 mm										
0.43	7.0 × 13.5 × 17.5	1.9					14304	800	74304	750
0.47							14704		74704	
0.51							15104		75104	
0.56							15604		75604	
0.62	8.5 × 15.0 × 17.5	2.6					16204	650	76204	750
0.68							16804		76804	
0.75							17504		77504	
0.82							18204		78204	
0.91	10.0 × 16.5 × 17.5	3.1					19104	600	79104	500
1.0							11005		71005	
1.1							11105		71105	

U_{Rdc} = 250 V; U_{Rac} = 25 V; U_{p-p} = 70 V

C (E 24) (µF)	DIMENSIONS w × h × l (mm)	MASS (g)	CATALOG NUMBER 2222 418 ..... AND PACKAGING							
			AMMOPACK		LOOSE IN BOX		REEL		LOOSE IN BOX	
			H = 18.5 mm; P_0 = 12.7 mm		lt = 4.0 + 1.0/– 0.5 mm		H = 18.5 mm; P_0 = 12.7 mm		lt = 3.5 ± 0.3 mm	
			C-tol = ± 2 %		C-tol = ± 2 %		C-tol = ± 2 %		C-tol = ± 2 %	
			last 5 digits of catalog number	SPQ	last 5 digits of catalog number	SPQ	last 5 digits of catalog number	SPQ	last 5 digits of catalog number	SPQ
Pitch = 5.0 ± 0.3 mm; d_t = 0.50 ± 0.05 mm										
0.01	3.5 × 8.0 × 7.2	0.35	11003	1500	41003	3000				
0.011			11103		41103					
0.012			11203		41203					
0.013			11303		41303					
0.015			11503		41503					
0.016	4.5 × 9.0 × 7.2	0.45	11603	1000	41603	2000				
0.018			11803		41803					
0.02			12003		42003					
0.022			12203		42203					
0.024			12403		42403					
0.027	6.0 × 11.0 × 7.2	0.60	12703	750	42703	1500				
0.03			13003		43003					
0.033			13303		43303					
0.036			13603		43603					
0.039			13903		43903					
0.043			14303		44303					
Pitch = 10.0 ± 0.4 mm; d_t = 0.60 ± 0.06 mm										
0.047	4.0 × 10.0 × 12.5	0.60	14703	750	44703	1000				
0.051			15103		45103					
0.056			15603		45603					
0.062			16203		46203					
0.068			16803		46803					
0.075	5.0 × 11.0 × 12.5	0.85	17503	600	47503	1000				
0.082			18203		48203					
0.091			19103		49103					
0.1	6.0 × 12.0 × 12.5	1.10	11004	500	41004	750				
0.11			11104		41104					
0.12			11204		41204					
0.13			11304		41304					
Pitch = 15.0 ± 0.4 mm; d_t = 0.60 ± 0.06 mm										
0.15	5.0 × 11.0 × 17.5	1.2					11504	1100	71504	1250
0.16							11604		71604	
0.18	6.0 × 12.0 × 17.5	1.4					11804	900	71804	1000
0.2							12004		72004	
0.22							12204		72204	
0.24							12404		72404	
Pitch = 15.0 ± 0.4 mm; d_t = 0.80 ± 0.08 mm										
0.27	7.0 × 13.5 × 17.5	1.9					12704	800	72704	750
0.3							13004		73004	
0.33							13304		73304	
0.36							13604		73604	
0.39	8.5 × 15.0 × 17.5	2.6					13904	650	73904	750
0.43							14304		74304	
0.47							14704		74704	
0.51							15104		75104	
0.56	10.0 × 16.5 × 17.5	3.1					15604	600	75604	500
0.62							16204		76204	
0.68							16804		76804	

U_{Rdc} = 400 V; U_{Rac} = 125 V; U_{p-p} = 350 V

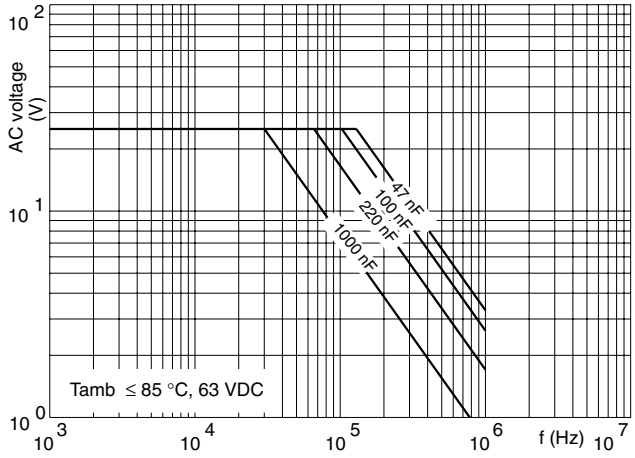
C (E 24) (µF)	DIMENSIONS w × h × l (mm)	MASS (g)	CATALOG NUMBER 2222 419 ..... AND PACKAGING							
			AMMOPACK		LOOSE IN BOX		REEL		LOOSE IN BOX	
			H = 18.5 mm; P_0 = 12.7 mm		lt = 4.0 + 1.0/– 0.5 mm		H = 18.5 mm; P_0 = 12.7 mm		lt = 3.5 ± 0.3 mm	
			C-tol = ± 2 %		C-tol = ± 2 %		C-tol = ± 2 %		C-tol = ± 2 %	
			last 5 digits of catalog number	SPQ	last 5 digits of catalog number	SPQ	last 5 digits of catalog number	SPQ	last 5 digits of catalog number	SPQ
Pitch = 5.0 ± 0.3 mm; d_t = 0.50 ± 0.05 mm										
0.001	3.5 × 8.0 × 7.2	0.35	11002	1500	41002	3000				
0.0011			11102		41102					
0.0012			11202		41202					
0.0013			11302		41302					
0.0015			11502		41502					
0.0016			11602		41602					
0.0018			11802		41802					
0.002			12002		42002					
0.0022			12202		42202					
0.0024			12402		42402					
0.0027			12702		42702					
0.003			13002		43002					
0.0033			13302		43302					
0.0036			13602		43602					
0.0039			13902		43902					
0.0043	4.5 × 9.0 × 7.2	0.45	14302	1000	44302	2000				
0.0047			14702		44702					
0.0051			15102		45102					
0.0056			15602		45602					
0.0062			16202		46202					
0.0068			16802		46802					
0.0075			17502		47502					
0.0082			18202		48202					
0.0091			19102		49102					
0.01			11003		41003					
0.011			11103		41103					
0.012			11203		41203					
0.013	6.0 × 11.0 × 7.2	0.60	11303	750	41303	1500				
0.015			11503		41503					
0.016			11603		41603					
0.018			11803		41803					
0.02			12003		42003					
Pitch = 10.0 ± 0.4 mm; d_t = 0.60 ± 0.06 mm										
0.022	4.0 × 10.0 × 12.5	0.60	12203	750	42203	1000				
0.024			12403		42403					
0.027			12703		42703					
0.03			13003		43003					
0.033			13303		43303					
0.036	5.0 × 11.0 × 12.5	0.85	13603	600	43603	1000				
0.039			13903		43903					
0.043			14303		44303					

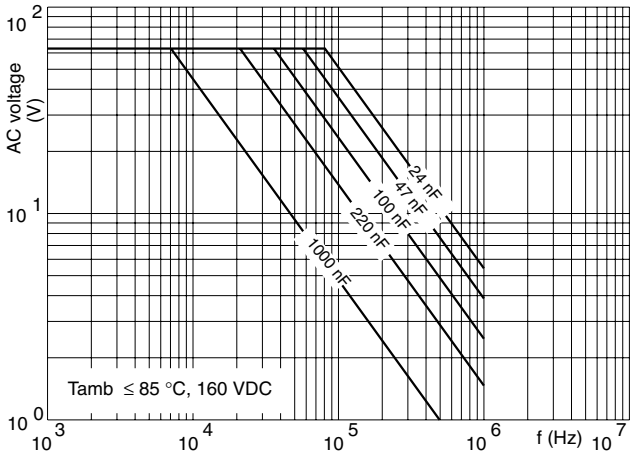
C (E 24) (µF)	DIMENSIONS w × h × l (mm)	MASS (g)	CATALOG NUMBER 2222 419 ..... AND PACKAGING							
			AMMOPACK		LOOSE IN BOX		REEL		LOOSE IN BOX	
			H = 18.5 mm; P_0 = 12.7 mm		lt = 4.0 + 1.0/– 0.5 mm		H = 18.5 mm; P_0 = 12.7 mm		lt = 3.5 ± 0.3 mm	
			C-tol = ± 2 %		C-tol = ± 2 %		C-tol = ± 2 %		C-tol = ± 2 %	
			last 5 digits of catalog number	SPQ	last 5 digits of catalog number	SPQ	last 5 digits of catalog number	SPQ	last 5 digits of catalog number	SPQ
0.047	6.0 × 12.0 × 12.5	1.10	14703	500	44703	750				
0.051			15103		45103					
0.056			15603		45603					
0.062			16203		46203					
0.068			16803		46803					
Pitch = 15.0 ± 0.4 mm; d_t = 0.60 ± 0.06 mm										
0.075	5.0 × 11.0 × 17.5	1.2					17503	1100	77503	1250
0.082							18203		78203	
0.091	6.0 × 12.0 × 17.5	1.4					19103	900	79103	1000
0.1							11004		71004	
0.11							11104		71104	
0.12							11204		71204	
0.13							11304		71304	
Pitch = 15.0 ± 0.4 mm; d_t = 0.80 ± 0.08 mm										
0.15	7.0 × 13.5 × 17.5	1.9					11504	800	71504	750
0.16							11604		71604	
0.18							11804		71804	
0.2	8.5 × 15.0 × 17.5	2.6					12004	650	72004	750
0.22							12204		72204	
0.24							12404		72404	
0.27							12704		72704	
0.3	10.0 × 16.5 × 17.5	3.1					13004	600	73004	500
0.33							13304		73304	
0.36							13604		73604	

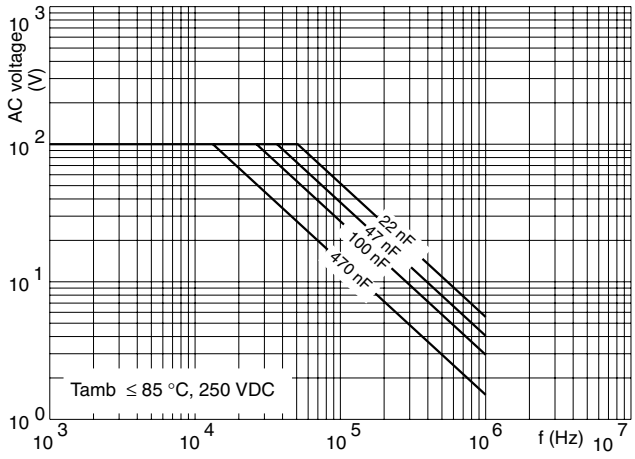
U_{Rdc} = 630 V; U_{Rac} = 160 V; U_{p-p} = 450 V

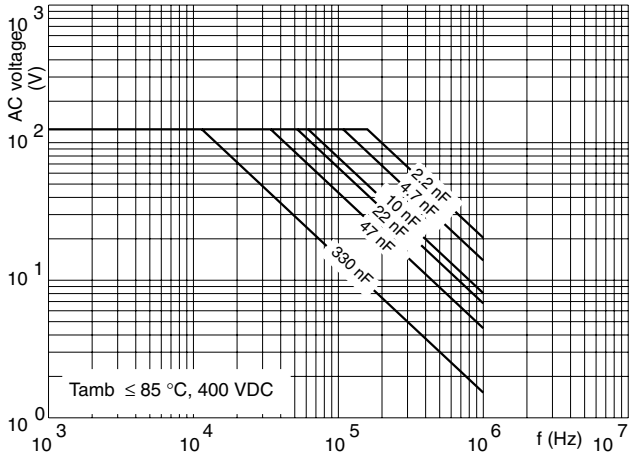
C (E 24) (µF)	DIMENSIONS w × h × l (mm)	MASS (g)	CATALOG NUMBER 2222 420 ..... AND PACKAGING							
			AMMOPACK		LOOSE IN BOX		REEL		LOOSE IN BOX	
			H = 18.5 mm; P_0 = 12.7 mm		lt = 4.0 + 1.0/– 0.5 mm		H = 18.5 mm; P_0 = 12.7 mm		lt = 3.5 ± 0.3 mm	
			C-tol = ± 2 %		C-tol = ± 2 %		C-tol = ± 2 %		C-tol = ± 2 %	
			last 5 digits of catalog number	SPQ	last 5 digits of catalog number	SPQ	last 5 digits of catalog number	SPQ	last 5 digits of catalog number	SPQ
Pitch = 5.0 ± 0.3 mm; d_t = 0.50 ± 0.05 mm										
0.0015	3.5 × 8.0 × 7.2	0.35	11502	1500	41502	3000				
0.0016			11602		41602					
0.0018			11802		41802					
0.002			12002		42002					
0.0022			12202		42202					
0.0024			12402		42402					
0.0027			12702		42702					
0.003	4.5 × 9.0 × 7.2	0.45	13002	1000	43002	2000				
0.0033			13302		43302					
0.0036			13602		43602					
0.0039			13902		43902					
0.0043	6.0 × 11.0 × 7.2	0.60	14302	750	44302	1500				
0.0047			14702		44702					
0.0051			15102		45102					
0.0056			15602		45602					
0.0062			16202		46202					
0.0068			16802		46802					
Pitch = 10.0 ± 0.4 mm; d_t = 0.60 ± 0.06 mm										
0.01	4.0 × 10.0 × 12.5	0.60	11003	750	41003	1000				
0.011			11103		41103					
0.012			11203		41203					
0.013			11303		41303					
0.015			11503		41503					
0.016			11603		41603					
0.018	5.0 × 11.0 × 12.5	0.85	11803	600	41803	1000				
0.02			12003		42003					
0.022			12203		42203					
0.024			12403		42403					
0.027	6.0 × 12.0 × 12.5	1.10	12703	500	42703	750				
0.03			13003		43003					
0.033			13303		43303					
0.036			13603		43603					
0.039			13903		43903					
0.043			14303		44303					
0.047			14703		44703					
Pitch = 15.0 ± 0.4 mm; d_t = 0.60 ± 0.06 mm										
0.051	6.0 × 12.0 × 17.5	1.4					15103	900	75103	1000
0.056							15603		75603	
Pitch = 15.0 ± 0.4 mm; d_t = 0.80 ± 0.08 mm										
0.062	7.0 × 13.5 × 17.5	1.9					16203	800	76203	750
0.068							16803		76803	
0.075							17503		77503	
0.082							18203		78203	
0.091	8.5 × 15.0 × 17.5	2.6					19103	650	79103	750
0.1							11004		71004	
0.11							11104		71104	
0.12							11204		71204	
0.13	10.0 × 16.5 × 17.5	3.1					11304	600	71304	500
0.15							11504		71504	
0.16							11604		71604	

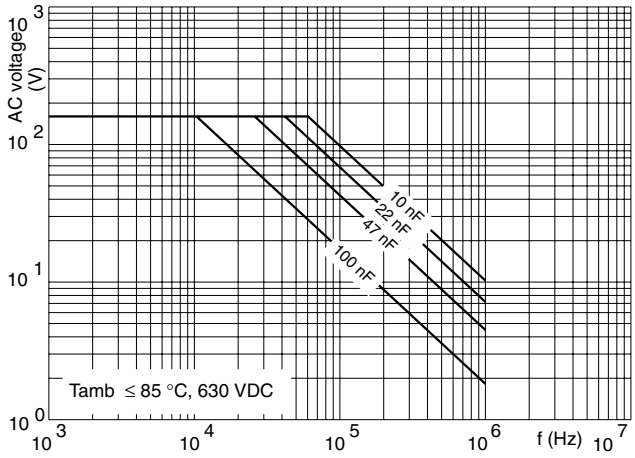
MAXIMUM RMS VOLTAGE (SINEWAVE) AS A FUNCTION OF FREQUENCY



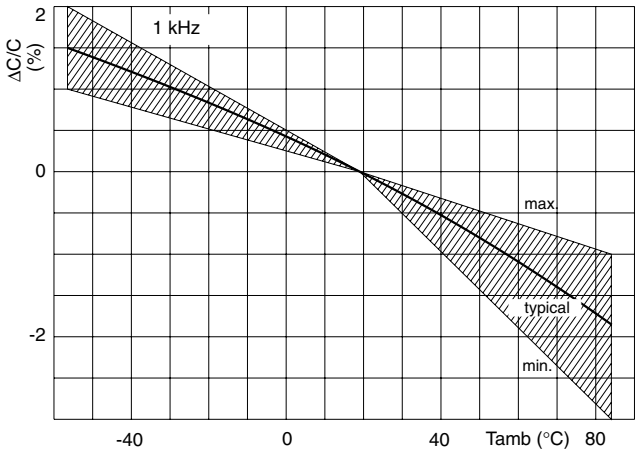




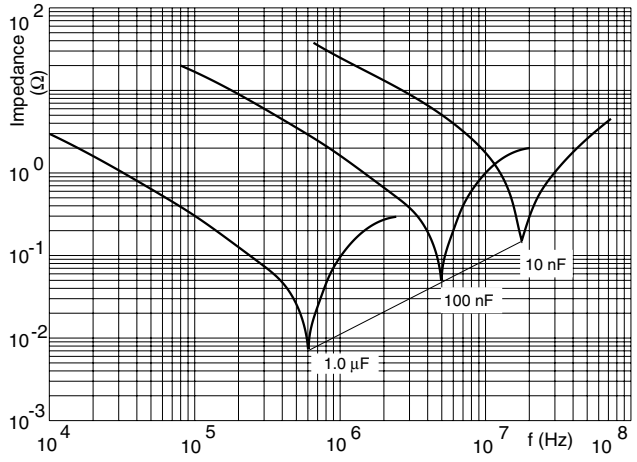




CAPACITANCE



IMPEDANCE



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