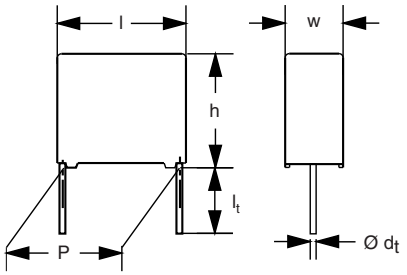
Interference Suppression Film Capacitors
MKP Radial Potted Type



FEATURES

- 7.5 mm to 37.5 mm lead pitch
- Supplied loose in box, taped on ammopack or reel
- Compliant to RoHS Directive 2002/95/EC

Pb-free

e3

RoHS COMPLIANT

RATED VOLTAGE

AC 310 V; 50 Hz to 60 Hz

PERMISSIBLE DC VOLTAGE

800 V_{DC} at 85 °C
630 V_{DC} at 110 °C

APPLICATIONS

For standard across the line X2 applications.
See also application note: www.vishay.com/doc?28153

REFERENCE STANDARDS

"IEC 60384-14 ed-3 and EN60384-14"
"IEC 60065, pass. flamm. class B"
CSA-C22.2 No. 1; UL 1414
CSA-E384-14; UL 1283; CQC

MARKING

C-value; tolerance; rated voltage; sub-class; manufacturer's type; code for dielectric material; manufacturer location; manufacturer's logo; year and week; safety approvals

DIELECTRIC

Polypropylene film

ELECTRODES

Metallized film

CONSTRUCTION

Mono construction

ENCAPSULATION

Plastic case, epoxy resin sealed, flame retardant class UL 94 V-0

CLIMATIC TESTING CLASS ACC. TO IEC 60068-1

55/110/56/B

CAPACITANCE RANGE (E12 SERIES)

E12 series 0.001 µF to 4.7 µF
Preferred values acc. to E6

CAPACITANCE TOLERANCE

± 20 %; ± 10 %; (± 5 % on request)

LEADS

Tinned wire

MAXIMUM APPLICATION TEMPERATURE

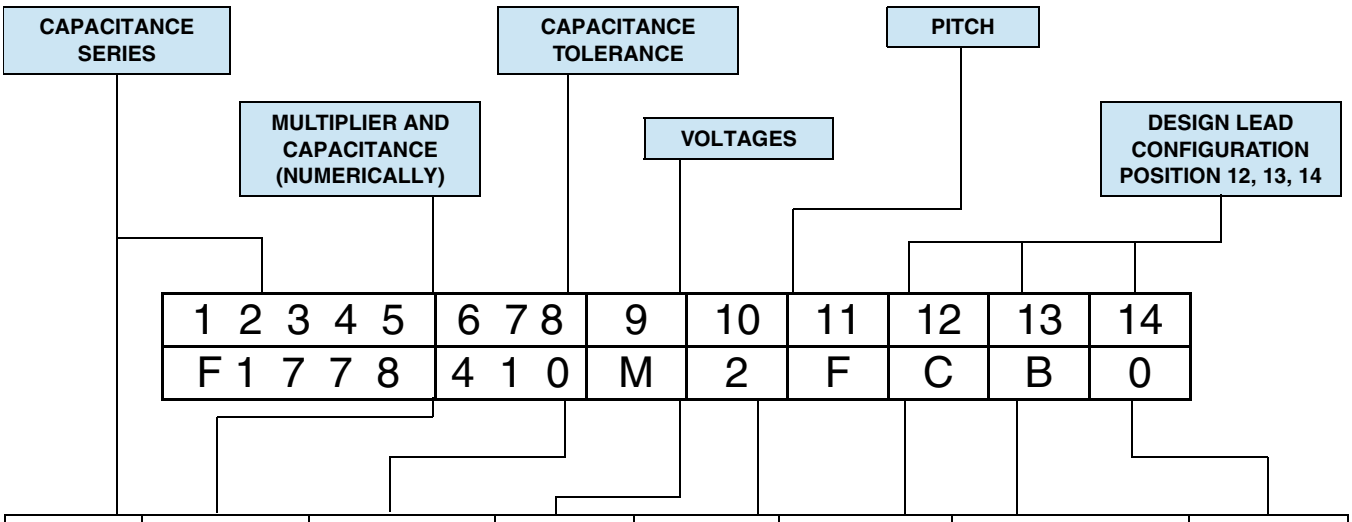
C ≤ 470 nF: 110 °C (125 °C for less than 1000 h)
C > 470 nF: 110 °C

DETAIL SPECIFICATION

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

RFI FILM CAPACITORS SERIES F1778

The new RFI Film Capacitor Code is made up 14 digit code (example)



1 2 3 4 5	6 7 8	9	10	11	12	13	14 (POS.)
F 1 7 7 8	4 1 0	M	2	F	C	B	0
Capacitance Series	Capacitance Value expressed in pF	Capacitance Tolerance	Rated Voltage or special versions	Pitch	Design (lead configuration) Pos. 12/13/14		
Pos. 1 to 5	Pos. 6/7/8	Pos. 9	Pos. 10	Pos. 11	Pos. 12	Pos. 13	Pos. 14
	represent significant figures Pos. 5 specifies multiplier (in 10) e.g.: 0.01 µF = 310 0.1 µF = 410 1.0 µF = 510	e.g. 0 (zero) = spaceholder M = ± 20 % K = ± 10 % J = ± 5 % Specials: A = + 10 %/- 0 % B = + 5 %/+ 15 % P = + 0 %/- 15 % R = + 10 %/- 5 % U = + 10 %/+ 20 %	e.g. 0 (zero) = spaceholder 2 = 310 V_{AC} 3 = 310 V_{AC}	e.g. 0 (zero) = spaceholder C = 7.5 mm D = 10.0 mm F = 15.0 mm I = 22.5 mm K = 27.5 mm P = 37.5 mm	e.g. 0 (zero) = spaceholder S = 3.5 - 0.5 mm P = 3.5 ± 0.3 mm B = 4 - 1 mm M = 5 - 1 mm C = 6 - 1 mm E = 10 - 1 mm T = 11 - 1 mm D = 15 - 1 mm F = 19 - 1 mm H = 20 + 5 mm L = 30 + 5 mm K = 40 + 5 mm N = 45 - 2 mm other = special version	Packaging of specialities 0 (zero) = spaceholder B = bulk/loose M = magazine T = tray/pallet [2] U = tape and reel [1] (H: 16.5 mm, Ø 350 mm) R = tape and reel [1] (H: 16.5 mm, Ø 500 mm) V = tape and reel [1] (H: 18.5 mm, Ø 350 mm) W = tape and reel [1] (H: 18.5 mm, Ø 500 mm) G = Ammopack [1] (H: 18.5 mm) Z = leaded wound element (unencapsulated) other = special version	Special internal code 0 (zero) = spaceholder R = discharging resistor C = deal with CoC other = special version

Notes

[1] For detailed tape specification refer to Packaging Information: www.vishay.com/doc?28139

[2] Packaging will be bulk for all capacitors with pitch ≤ 15 mm with bulk and tray packing

SPECIFIC REFERENCE DATA

DESCRIPTION	VALUE	
Rated AC voltage (U_{RAC})	310 V	
Permissible DC voltage (U_{RDC})	630 V	
Tangent of loss angle:	at 1 kHz	at 10 kHz
C < 470 nF	≤ 10 x 10^{-4}	≤ 20 x 10^{-4}
470 nF ≤ C ≤ 1 µF	≤ 20 x 10^{-4}	≤ 70 x 10^{-4}
C > 1 µF	≤ 30 x 10^{-4}	-
Rated voltage pulse slope $(dU/dt)_R$ at 435 V_{DC}		
Pitch = 7.5 mm	600 V/µs	
Pitch = 10 mm and 7.5 mm (bent back)	600 V/µs	
Pitch = 15 mm and 7.5 mm (bent back)	400 V/µs	
Pitch = 22.5 mm	150 V/µs	
Pitch = 27.5 mm	100 V/µs	
Pitch = 37.5 mm	100 V/µs	
R between leads, for C ≤ 0.33 µF at 100 V; 1 min	> 15 000 MΩ	
RC between leads, for C > 0.33 µF at 100 V; 1 min	> 5000 s	
R between leads and case; 100 V; 1 min	> 30 000 MΩ	
Withstanding (DC) voltage (cut off current 10 mA) [1]; rise time 1000 ≤ V/s:		
C ≤ 1 µF	2200 V; 1 min	
C > 1 µF	1800 V; 1 min	
Withstanding (AC) voltage between leads and case	2120 V; 1 min	
Max. application temperature for 0.001 µF ≤ C ≤ 0.47 µF	110 °C (125 °C less than 1000 h)	
Max. application temperature for C > 0.47 µF	110 °C	

Note

[1] See “Voltage Proof Test for Metallized Film Capacitors”: www.vishay.com/doc?28169

CAPACITANCE µF POS. 5 TO 7	TOLERANCE CODE POS. 8 J = ± 5 % K = ± 10 % M = ± 20 %	DIMENSIONS MAX. w x h x l (mm)	MASS (G) [3]	SPQ [4] SHORT LEADS (PIECES)	ORDERING CODE [2]					
					TYPE	C-VALUE	TOL.	VOLTAGE	PITCH	LEAD LENGTH DESIGN
					1 TO 5	6 TO 8	9	10	11	12 TO 14 [1]
Pitch 7.5 mm ± 0.4 mm; d_t = 0.50 mm ± 0.05 mm										
0.001	K/M	4.0 x 9.0 x 10.0	0.45	1500	F1778	210	.	.	C	. . 0
0.0012	K	4.0 x 9.0 x 10.0	0.45	1500	F1778	212	K	.	C	. . 0
0.0015	K/M	4.0 x 9.0 x 10.0	0.45	1500	F1778	215	.	.	C	. . 0
0.0018	K	4.0 x 9.0 x 10.0	0.45	1500	F1778	218	K	.	C	. . 0
0.0022	K/M	4.0 x 9.0 x 10.0	0.45	1500	F1778	222	.	.	C	. . 0
0.0027	K	4.0 x 9.0 x 10.0	0.45	1500	F1778	227	K	.	C	. . 0
0.0033	K/M	4.0 x 9.0 x 10.0	0.45	1500	F1778	233	.	.	C	. . 0
0.0039	K	4.0 x 9.0 x 10.0	0.45	1500	F1778	239	K	.	C	. . 0
0.0047	K/M	4.0 x 9.0 x 10.0	0.45	1500	F1778	247	.	.	C	. . 0
0.0056	K	4.0 x 9.0 x 10.0	0.45	1500	F1778	256	K	.	C	. . 0
0.0068	K/M	4.0 x 9.0 x 10.0	0.45	1500	F1778	268	.	.	C	. . 0
0.0082	K	4.0 x 9.0 x 10.0	0.45	1500	F1778	282	K	.	C	. . 0
0.01	K/M	4.0 x 9.0 x 10.0	0.45	1500	F1778	310	.	.	C	. . 0
0.012	K	4.0 x 9.0 x 10.0	0.45	1500	F1778	312	K	.	C	. . 0
0.015	K/M	4.0 x 9.0 x 10.0	0.45	1500	F1778	315	.	.	C	. . 0
0.018	K	4.0 x 9.0 x 10.0	0.45	1500	F1778	318	K	.	C	. . 0
0.022	K/M	4.0 x 9.0 x 10.0	0.45	1500	F1778	322	.	.	C	. . 0
0.027	K	4.0 x 9.0 x 10.0	0.45	1500	F1778	327	K	.	C	. . 0
0.033	K	5.0 x 10.5 x 10.0	0.6	1000	F1778	333	K	.	C	. . 0
0.033	M	4.0 x 9.0 x 10.0	0.45	1500	F1778	333	M	.	C	. . 0
0.039	K	5.0 x 10.5 x 10.0	0.6	1000	F1778	339	K	.	C	. . 0
0.047	K	5.0 x 10.5 x 10.0	0.6	1000	F1778	347	K	.	C	. . 0
0.047	M	5.0 x 10.5 x 10.0	0.4	1000	F1778	347	M	.	C	. . 0
0.056	K	6.0 x 11.5 x 10.0	0.8	750	F1778	356	K	.	C	. . 0
0.068	M	6.0 x 11.5 x 10.0	0.8	750	F1778	368	M	.	C	. . 0

CAPACITANCE µF POS. 5 TO 7	TOLERANCE CODE POS. 8 J = ± 5 % K = ± 10 % M = ± 20 %	DIMENSIONS MAX. w x h x l (mm)	MASS (G) [3]	SPQ [4] SHORT LEADS (PIECES)	ORDERING CODE [2]					
					TYPE	C-VALUE	TOL.	VOLTAGE	PITCH	LEAD LENGTH DESIGN
					1 TO 5	6 TO 8	9	10	11	12 TO 14 [1]
Pitch 10 mm ± 0.4 mm; d_t = 0.60 mm ± 0.06 mm										
0.001	K/M	4.0 x 10.0 x 12.5	0.6	1500	F1778	210	.	.	D	. . 0
0.0012	K	4.0 x 10.0 x 12.5	0.6	1500	F1778	212	K	.	D	. . 0
0.0015	K/M	4.0 x 10.0 x 12.5	0.6	1500	F1778	215	.	.	D	. . 0
0.0018	K	4.0 x 10.0 x 12.5	0.6	1500	F1778	218	K	.	D	. . 0
0.0022	K/M	4.0 x 10.0 x 12.5	0.6	1500	F1778	222	.	.	D	. . 0
0.0027	K	4.0 x 10.0 x 12.5	0.6	1500	F1778	227	K	.	D	. . 0
0.0033	K/M	4.0 x 10.0 x 12.5	0.6	1500	F1778	233	.	.	D	. . 0
0.0039	K	4.0 x 10.0 x 12.5	0.6	1500	F1778	239	K	.	D	. . 0
0.0047	K/M	4.0 x 10.0 x 12.5	0.6	1500	F1778	247	.	.	D	. . 0
0.0056	K	4.0 x 10.0 x 12.5	0.6	1500	F1778	256	K	.	D	. . 0
0.0068	K/M	4.0 x 10.0 x 12.5	0.6	1500	F1778	268	.	.	D	. . 0
0.0082	K	4.0 x 10.0 x 12.5	0.6	1500	F1778	282	K	.	D	. . 0
0.01	K/M	4.0 x 10.0 x 12.5	0.6	1500	F1778	310	.	.	D	. . 0
0.012	K	4.0 x 10.0 x 12.5	0.6	1500	F1778	312	K	.	D	. . 0
0.015	K/M	4.0 x 10.0 x 12.5	0.6	1500	F1778	315	.	.	D	. . 0
0.018	K	4.0 x 10.0 x 12.5	0.6	1250	F1778	318	K	.	D	. . 0
0.022	K/M	4.0 x 10.0 x 12.5	0.6	1250	F1778	322	.	.	D	. . 0
0.027	K	4.0 x 10.0 x 12.5	0.6	1250	F1778	327	K	.	D	. . 0
0.033	K/M	4.0 x 10.0 x 12.5	0.6	1000	F1778	333	.	.	D	. . 0
0.039	K	4.0 x 10.0 x 12.5	0.6	1000	F1778	339	K	.	D	. . 0
0.047	K	4.0 x 10.0 x 12.5	0.6	750	F1778	347	K	.	D	. . 0
0.047	M	4.0 x 10.0 x 12.5	0.6	1000	F1778	347	M	.	D	. . 0
0.056	K	5.0 x 11.0 x 12.5	0.82	1000	F1778	356	K	.	D	. . 0
0.068	K/M	5.0 x 11.0 x 12.5	0.82	750	F1778	368	.	.	D	. . 0
0.082	K	6.0 x 12.0 x 12.5	1.10	750	F1778	382	K	.	D	. . 0
0.1	K/M	6.0 x 12.0 x 12.5	1.10	750	F1778	410	.	.	D	. . 0
Pitch 15 mm ± 0.4 mm; d_t = 0.60 mm ± 0.06 mm										
0.01	K/M	5.0 x 11.0 x 17.5	1.0	750	F1778	310	.	.	F	. . 0
0.012	K	5.0 x 11.0 x 17.5	1.0	750	F1778	312	K	.	F	. . 0
0.015	K/M	5.0 x 11.0 x 17.5	1.0	750	F1778	315	.	.	F	. . 0
0.018	K	5.0 x 11.0 x 17.5	1.0	750	F1778	318	K	.	F	. . 0
0.022	K/M	5.0 x 11.0 x 17.5	1.0	750	F1778	322	.	.	F	. . 0
0.027	K	5.0 x 11.0 x 17.5	1.0	750	F1778	327	K	.	F	. . 0
0.033	K/M	5.0 x 11.0 x 17.5	1.0	750	F1778	333	.	.	F	. . 0
0.039	K	5.0 x 11.0 x 17.5	1.0	750	F1778	339	K	.	F	. . 0
0.047	K/M	5.0 x 11.0 x 17.5	1.0	750	F1778	347	.	.	F	. . 0
0.056	K	5.0 x 11.0 x 17.5	1.0	750	F1778	356	K	.	F	. . 0
0.068	K/M	5.0 x 11.0 x 17.5	1.0	750	F1778	368	.	.	F	. . 0
0.082	K	5.0 x 11.0 x 17.5	1.0	750	F1778	382	K	.	F	. . 0
0.1	K	5.0 x 11.0 x 17.5	1.0	600	F1778	410	K	.	F	. . 0
0.1	M	5.0 x 11.0 x 17.5	1.0	750	F1778	410	M	.	F	. . 0
0.12	K	6.0 x 12.0 x 17.5	1.4	600	F1778	412	K	.	F	. . 0
0.15	K	6.0 x 12.0 x 17.5	1.4	450	F1778	415	K	.	F	. . 0
0.15	M	6.0 x 12.0 x 17.5	1.4	600	F1778	415	M	.	F	. . 0

CAPACITANCE µF POS. 5 TO 7	TOLERANCE CODE POS. 8 J = ± 5 % K = ± 10 % M = ± 20 %	DIMENSIONS MAX. w x h x l (mm)	MASS (G) [3]	SPQ [4] SHORT LEADS (PIECES)	ORDERING CODE [2]					
					TYPE	C-VALUE	TOL.	VOLTAGE	PITCH	LEAD LENGTH DESIGN
					1 TO 5	6 TO 8	9	10	11	12 TO 14 [1]
Pitch 15 mm ± 0.4 mm; d_t = 0.80 mm ± 0.08 mm										
0.18	K	7.0 x 13.5 x 17.5	1.8	450	F1778	418	K	.	F	. . 0
0.22	K/M	7.0 x 13.5 x 17.5	1.8	300	F1778	422	.	.	F	. . 0
0.27	K	8.5 x 15.0 x 17.5	2.4	240	F1778	427	K	.	F	. . 0
0.33	K/M	8.5 x 15.0 x 17.5	2.4	240	F1778	433	.	.	F	. . 0
0.39	K	10.0 x 16.5 x 17.5	3	225	F1778	439	K	.	F	. . 0
0.47	K/M	10.0 x 16.5 x 17.5	3	225	F1778	447	.	.	F	. . 0
0.56	K/M	10.0 x 18.5 x 18.0	4.3	225	F1778	456	.	.	F	. . 0
0.68	M	11.0 x 18.5 x 18.0	5.5	225	F1778	468	M	.	F	. . 0
Pitch 22.5 mm ± 0.4 mm; d_t = 0.80 mm ± 0.08 mm										
0.12	K	6.0 x 15.5 x 26.0	2.4	260	F1778	412	K	.	I	. . 0
0.15	K/M	6.0 x 15.5 x 26.0	2.4	260	F1778	415	.	.	I	. . 0
0.18	K	6.0 x 15.5 x 26.0	2.4	260	F1778	418	K	.	I	. . 0
0.22	K/M	6.0 x 15.5 x 26.0	2.4	260	F1778	422	.	.	I	. . 0
0.27	K	6.0 x 15.5 x 26.0	2.4	200	F1778	427	K	.	I	. . 0
0.33	K	6.0 x 15.5 x 26.0	2.4	190	F1778	433	K	.	I	. . 0
0.33	M	6.0 x 15.5 x 26.0	2.4	235	F1778	433	M	.	I	. . 0
0.39	K	7.0 x 16.5 x 26.0	2.9	200	F1778	439	K	.	I	. . 0
0.47	K	7.0 x 16.5 x 26.0	2.9	190	F1778	447	K	.	I	. . 0
0.47	M	7.0 x 16.5 x 26.0	2.9	200	F1778	447	M	.	I	. . 0
0.56	K	8.5 x 18.0 x 26.0	3.8	150	F1778	456	K	.	I	. . 0
0.68	K	10.0 x 19.5 x 26.0	6.8	150	F1778	468	K	.	I	. . 0
0.68	M	8.5 x 18.0 x 26.0	3.8	170	F1778	468	M	.	I	. . 0
0.82	K	10.0 x 19.5 x 26.0	6.8	200	F1778	482	K	.	I	. . 0
1	K	12.0 x 22.0 x 26.0	7.8	150	F1778	510	K	.	I	. . 0
1	M	10.0 x 19.5 x 26.0	6.8	135	F1778	510	M	.	I	. . 0
1.5	M	12.5 x 22.5 x 26.5	10	140	F1778	515	M	.	I	. . 0
Pitch 27.5 mm ± 0.4 mm; d_t = 0.80 mm ± 0.08 mm										
0.47	K/M	9.0 x 19.0 x 31.5	5.5	160	F1778	447	.	.	K	. . 0
0.56	K	9.0 x 19.0 x 31.5	5.5	160	F1778	456	K	.	K	. . 0
0.68	K/M	9.0 x 19.0 x 31.5	5.5	160	F1778	468	.	.	K	. . 0
0.82	K	11.0 x 21.0 x 31.0	7.4	125	F1778	482	K	.	K	. . 0
1	K/M	11.0 x 21.0 x 31.0	7.4	125	F1778	510	.	.	K	. . 0
1.2	K	11.0 x 21.0 x 31.0	7.4	110	F1778	512	K	.	K	. . 0
1.5	K/M	13.0 x 23.0 x 31.0	9.2	110	F1778	515	.	.	K	. . 0
1.8	K	15.0 x 25.0 x 31.5	12.3	85	F1778	518	K	.	K	. . 0
2.2	K/M	15.0 x 25.0 x 31.5	12.3	85	F1778	522	.	.	K	. . 0
2.7	K	18.0 x 28.0 x 31.5	16.1	100	F1778	527	K	.	K	. . 0
3.3	K	21.0 x 31.0 x 31.0	20.3	70	F1778	533	K	.	K	. . 0
3.3	M	18.0 x 28.0 x 31.5	16.1	80	F1778	533	M	.	K	. . 0
3.9	K	21.0 x 31.0 x 31.0	20.3	50	F1778	539	K	.	K	. . 0
4.7	M	21.0 x 31.0 x 31.0	20.3	50	F1778	547	M	.	K	. . 0
Pitch 37.5 mm ± 0.4 mm; d_t = 0.80 mm ± 0.08 mm										
2.2	K/M	14.5 x 24.5 x 41.5	19.0	80	F1778	522	.	.	P	. . 0
3.3	M	16.0 x 28.5 x 41.5	25.0	70	F1778	533	M	.	P	. . 0
4.7	M	18.0 x 32.5 x 41.5	31.6	60	F1778	547	M	.	P	. . 0

Notes

[1] Further information about packaging quantities with different lead length and/or taped versions see document no. 26535 (Packaging Quantities)
[2] These capacitors can be delivered on continuous tape and reel (refer Document No. 26535)
[3] Weight for short lead product only
[4] SPQ = Standard Packing Quantity

APPROVALS

SAFETY APPROVALS X2	VOLTAGE	VALUE	FILE NUMBERS
Pitch 7.5 mm to 27.5 mm			
EN*60384-14* (ENEC) (= IEC *60384-14 ed-3*)	310 V_{AC}	1 nF to 4.7 µF	FI 2008038 A1
UL 1414 and CSA-C22.2 No. 1	250 V_{AC}	1 nF to 1 µF	E112471
UL 1283	305 V_{AC}	1 nF to 4.7 µF	E109565
CSA-E384-14	310 V_{AC}	1 nF to 4.7 µF	2123580
CQC	310 V_{AC}	1 nF to 4.7 µF	CQC08001026060 (F) CQC08001026061 (L)
CB Test Certificate	310 V_{AC}	1 nF to 4.7 µF	FI 5123 A1
Pitch 37.5 mm			
EN*60384-14* (ENEC) (= IEC *60384-14 ed-3*)	305 V_{AC}	2.2 µF to 4.7 µF	40000787
UL 1283	275 V_{AC}	2.2 µF to 4.7 µF	E76297
CSA-C22.2 No. 8	250 V_{AC}	2.2 µF to 4.7 µF	1114383
The ENEC-approval together with the CB-Certificate replace all national marks of the following countries (they have already signed the ENEC-Agreement): Austria; Belgium; Czech Republic; Denmark; Finland; France; Germany; Greece; Hungary; Ireland; Italy; Luxembourg; Netherlands; Norway; Portugal; Slovenian; Spain; Sweden; Switzerland and United Kingdom.			

MOUNTING

Normal Use

The capacitors are designed for mounting on printed-circuit boards. The capacitors packed in bandoliers are designed for mounting in printed circuit boards by means of automatic insertion machines.
For detailed tape specifications refer to Packaging Information: www.vishay.com/doc?28139

Specific Method of Mounting to Withstand Vibration and Shock

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

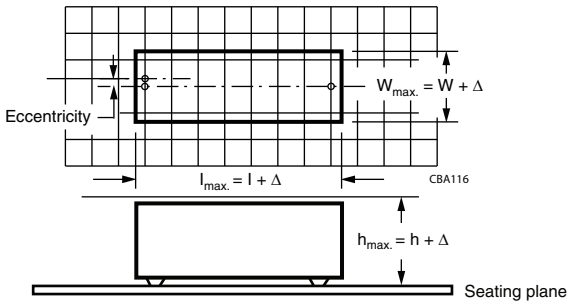
- For pitches ≤ 15 mm capacitors shall be mechanically fixed by the leads
- For larger pitches the capacitors shall be mounted in the same way and the body clamped

Space Requirements on Printed Circuit-Board

The maximum space for length ($l_{max.}$), width ($W_{max.}$), and height ($h_{max.}$) of film capacitors to take in account on the printed circuit board is shown in the drawings:

- For products with pitch ≤ 15 mm, Δw x Δl = 0.3 mm and Δh = 0.1 mm
- For products with 15 mm < pitch ≤ 27.5 mm, Δw x Δl = 0.5 mm and Δh = 0.1 mm
- For products with pitch = 37.5 mm, Δw x Δl = 0.7 mm and Δh = 0.5 mm

Eccentricity defined as in drawing. The maximum eccentricity is smaller than or equal to the lead diameter of the product concerned.



SOLDERING CONDITIONS

For general soldering conditions and wave soldering profile, we refer to the application note:
"**Soldering Guideline for Film Capacitors**": www.vishay.com/doc?28171

Storage Temperature

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

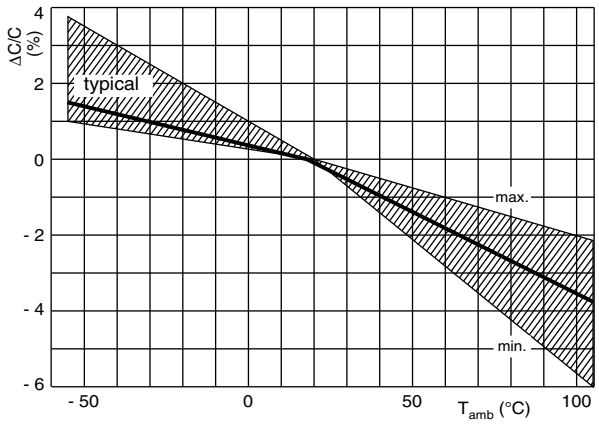
Ratings and Characteristics Reference Conditions

Unless otherwise specified, all electrical values apply to an ambient free air temperature of 23 °C ± 1 °C, an atmospheric pressure of 86 kPa to 106 kPa and a relative humidity of 50 % ± 2 %.

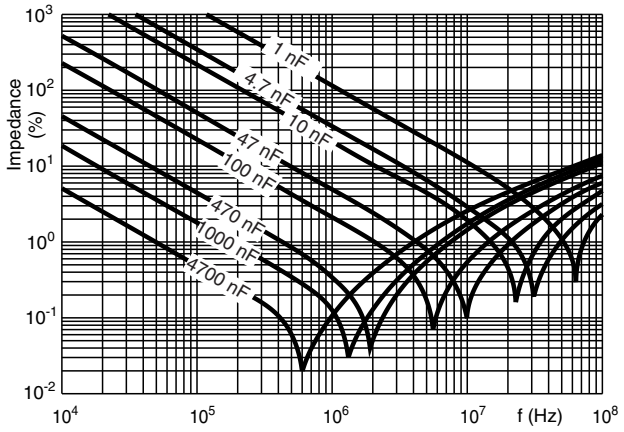
For reference testing, a conditioning period shall be applied over 96 h ± 4 h by heating the products in a circulating air oven at the rated temperature and a relative humidity not exceeding 20 %.

CHARACTERISTICS

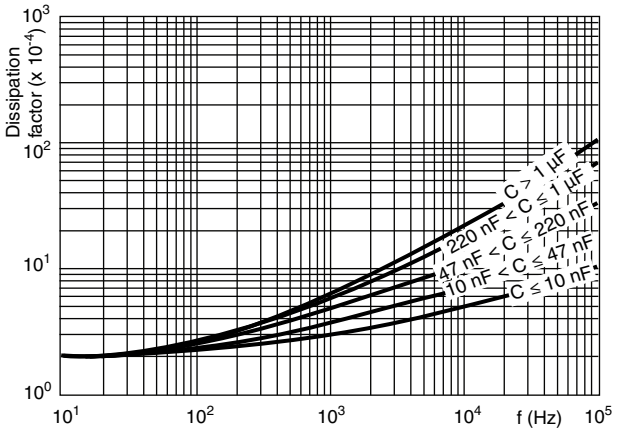
Capacitance as a function of ambient temperature (typical curve)



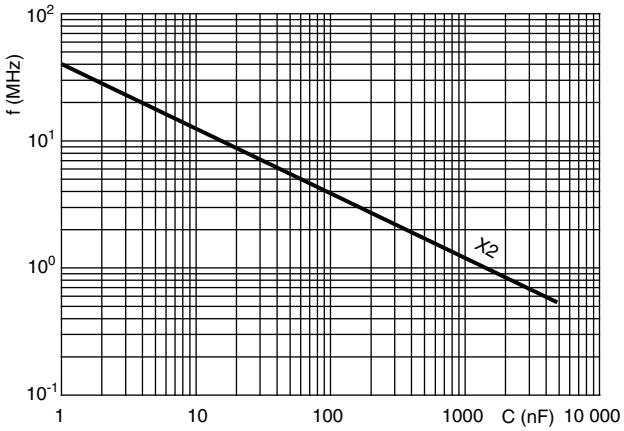
Impedance as a function of frequency (typical curve)



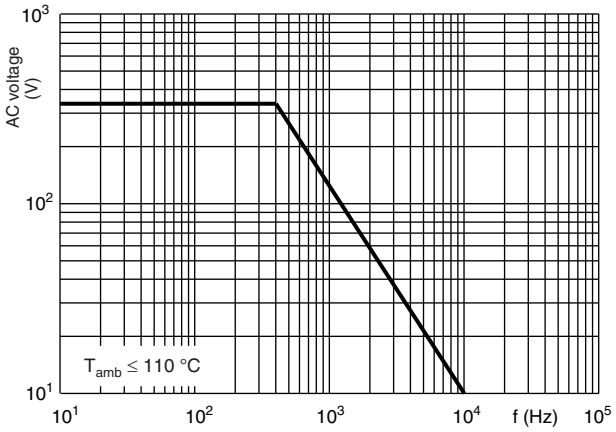
Tangent of loss angle as a function of frequency (typical curve)



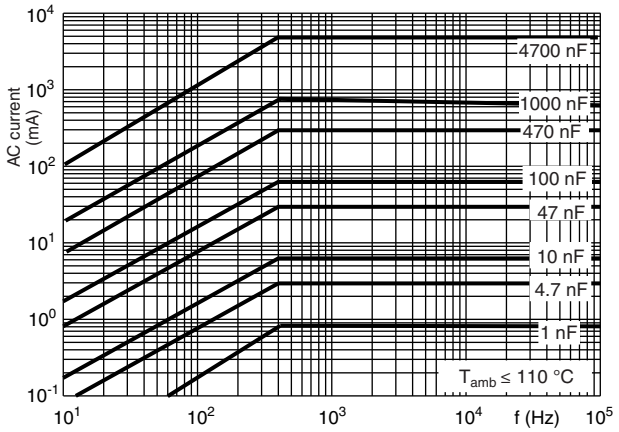
Resonant frequency as a function of capacitance (typical curve)



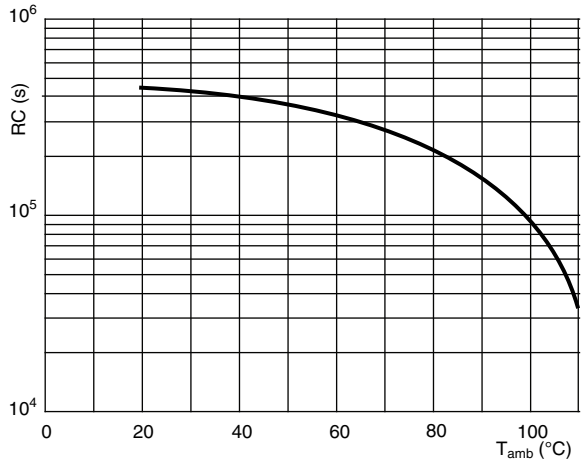
Max. RMS voltage as a function of frequency (typical curve)



Max. RMS current as a function of frequency (typical curve)



Insulation resistance as a function of ambient temperature (typical curve)



APPLICATION NOTES

- For X2 electromagnetic interference suppression in **standard across the line applications** (50 Hz/60 Hz) with a maximum mains voltage of 310 V_{AC}.
- For series impedance applications we refer to application note www.vishay.com/doc?28153
- For capacitors connected in parallel, normally the proof voltage and possibly the rated voltage must be reduced. For information depending of the capacitance value and the number of parallel connections contact: dc-film@vishay.com
- These capacitors are not intended for continuous pulse applications. For these situations, capacitors of the AC and pulse programs must be used.
- The maximum ambient temperature must not exceed110 °C (125 °C for less than 1000 h) for C ≤ 470 nF and 110 °C for C > 470 nF.
- Rated voltage pulse slope:
  If the pulse voltage is lower than the rated voltage, the values of the specific reference data can be multiplied by 435 V_{DC} and divided by the applied voltage.

INSPECTION REQUIREMENTS

General Notes:

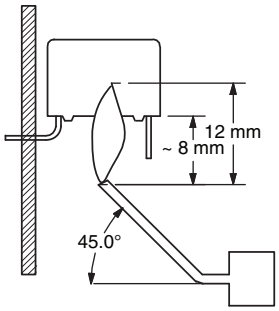
- Sub-clause numbers of tests and performance requirements refer to the “Sectional Specification, IEC Publication IEC 60384-14 ed-3 and Specific Reference Data”.

Group C Inspection Requirements

SUB-CLAUSE NUMBER AND TEST	CONDITIONS	PERFORMANCE REQUIREMENTS
SUB-GROUP C1A PART OF SAMPLE OF SUB-GROUP C1		
4.1 Dimensions (detail)		As specified in section “General Data” of this specification
Initial measurements	Capacitance Tangent of loss angle: For C ≤ 1 µF at 10 kHz For C > 1 µF at 1 kHz	
4.3 Robustness of terminations	Tensile: load 10 N; 10 s Bending: load 5 N; 4 x 90°	No visible damage
4.4 Resistance to soldering heat	No pre-drying Method: 1A Solder bath: 280 °C ± 5 °C Duration: 10 s	
4.19 Component solvent resistance	Isopropylalcohol at room temperature Method: 2 Immersion time: 5 min ± 0.5 min Recovery time: Min. 1 h, max. 2 h	
4.4.2 Final measurements	Visual examination	No visible damage Legible marking
	Capacitance	¦ΔC/C¦ ≤ 5 % of the value measured initially.
	Tangent of loss angle	Increase of tan δ: ≤ 0.008 for: C ≤ 1 µF or ≤ 0.005 for: C > 1 µF Compared to values measured initially
	Insulation resistance	As specified in section “Insulation Resistance” of this specification
SUB-GROUP C1B PART OF SAMPLE OF SUB-GROUP C1		
Initial measurements	Capacitance Tangent of loss angle: For C ≤ 1 µF at 10 kHz For C > 1 µF at 1 kHz	
4.20 Solvent resistance of the marking	Isopropylalcohol at room temperature Method: 1 Rubbing material: cotton wool Immersion time: 5 min ± 0.5 min	No visible damage Legible marking
4.6 Rapid change of temperature	θA = - 55 °C θB = + 110 °C 5 cycles Duration t = 30 min	
4.6.1 Inspection	Visual examination	No visible damage
4.7 Vibration	Mounting: see section “Mounting” of this specification Procedure B4 Frequency range: 10 Hz to 55 Hz Amplitude: 0.75 mm or Acceleration 98 m/s² (whichever is less severe) Total duration 6 h	

SUB-CLAUSE NUMBER AND TEST	CONDITIONS	PERFORMANCE REQUIREMENTS
SUB-GROUP C1B PART OF SAMPLE OF SUB-GROUP C1		
4.7.2 Final inspection	Visual examination	No visible damage
4.9 Shock	Mounting: see section “Mounting” for more information Pulse shape: half sine Acceleration: 490 m/s² Duration of pulse: 11 ms	
4.9.2 Final measurements	Visual examination	No visible damage
	Capacitance	¦ΔC/C¦ ≤ 5 % of the value measured initially.
	Tangent of loss angle	Increase of tan δ: ≤ 0.008 for: C ≤ 1 µF or ≤ 0.005 for: C > 1 µF Compared to values measured initially
	Insulation resistance	As specified in section “Insulation Resistance” of this specification
SUB-GROUP C1 COMBINED SAMPLE OF SPECIMENS OF SUB-GROUPS C1A AND C1B		
4.11 Climatic sequence		
4.11.1 Initial measurements	Capacitance Measured in 4.4.2 and 4.9.2 Tangent of loss angle: Measured initially in C1A and C1B	
4.11.2 Dry heat	Temperature: 110 °C	
4.11.3 Damp heat cyclic Test Db First cycle	Duration: 16 h	
4.11.4 Cold	Temperature: - 55 °C	
4.11.5 Damp heat cyclic Test Db Remaining cycles	Duration: 2 h	
4.11.6 Final measurements	Visual examination	No visible damage Legible marking
	Capacitance	¦ΔC/C¦ ≤ 5 % of the value measured in 4.11.1.
	Tangent of loss angle	Increase of tan δ: ≤ 0.008 for: C ≤ 1 µF or ≤ 0.005 for: C > 1 µF Compared to values measured in 4.11.1.
	Voltage proof 1350 V_{DC}; 1 min between terminations	No permanent breakdown or flash-over
	Insulation resistance	≥ 50 % of values specified in section “Insulation Resistance” of this specification
SUB GROUP C2		
4.12 Damp heat steady state	56 days; 40 °C; 90 % to 95 % RH no load	
4.12.1 Initial measurements	Capacitance Tangent of loss angle: at 1 kHz	
4.12.3 Final measurements	Visual examination	No visible damage Legible marking
	Capacitance	¦ΔC/C¦ ≤ 5 % of the value measured in 4.12.1.

SUB-CLAUSE NUMBER AND TEST	CONDITIONS	PERFORMANCE REQUIREMENTS
SUB GROUP C2		
4.12.3 Final measurements	Tangent of loss angle	Increase of tan δ: ≤ 0.008 for: C ≤ 1 µF or ≤ 0.005 for: C > 1 µF Compared to values measured in 4.12.1.
	Voltage proof 1350 V_{DC}; 1 min between terminations	No permanent breakdown or flash-over
	Insulation resistance	≥ 50 % of values specified in section "Insulation Resistance" of this specification
SUB-GROUP C3		
4.13.1 Initial measurements	Capacitance Tangent of loss angle: For C ≤ 1 µF at 10 kHz For C > 1 µF at 1 kHz	
4.13 Impulse voltage	3 successive impulses, full wave, peak voltage: X2: 2.5 kV for C ≤ 1 µF X2: 2.5 kV/√C for C > 1 µF Max. 24 pulses	No self healing, breakdowns or flash-over
4.14 Endurance	Duration: 1000 h 1.25 x U_{Rac} at 110 °C Once in every hour the voltage is increased to 1000 V_{RMS} for 0.1 s via resistor of 47 Ω ± 5 %	
4.14.7 Final measurements	Visual examination	No visible damage Legible marking
	Capacitance	¦ΔC/C¦ ≤ 10 % compared to values measured in 4.13.1.
	Tangent of loss angle	Increase of tan δ: ≤ 0.008 for: C ≤ 1 µF or ≤ 0.005 for: C > 1 µF Compared to values measured in 4.13.1.
	Voltage proof 1350 V_{DC}; 1 min between terminations 2120 V_{AC}; 1 min between terminations and case	No permanent breakdown or flash-over
	Insulation resistance	≥ 50 % of values specified in section "Insulation Resistance" of this specification
SUB-GROUP C4		
4.15 Charge and discharge	10 000 cycles Charged to 435 Vdc Discharge resistance: $R = \frac{435\ Vdc}{1.25 \times C\ (dU/dt)}$	
4.15.1 Initial measurements	Capacitance Tangent of loss angle: For C ≤ 1 µF at 10 kHz For C > 1 µF at 1 kHz	
4.15.3 Final measurements	Capacitance	¦ΔC/C¦ ≤ 10 % compared to values measured in 4.15.1.
	Tangent of loss angle	Increase of tan δ: ≤ 0.008 for: C ≤ 1 µF or ≤ 0.005 for: C > 1 µF Compared to values measured in 4.15.1.
	Insulation resistance	≥ 50 % of values specified in section "Insulation Resistance" of this specification

SUB-CLAUSE NUMBER AND TEST	CONDITIONS	PERFORMANCE REQUIREMENTS
SUB-GROUP C5		
4.16 Radio frequency characteristic	Resonance frequency	≥ 0.9 times the value as specified in section "Resonant Frequency" of this specification.
SUB-GROUP C6		
4.17 Passive flammability Class B	Bore of gas jet: Ø 0.5 mm Fuel: butane Test duration for actual volume V in mm^3: V ≤ 250: 10 s 250 < V ≤ 500: 20 s 500 < V ≤ 1750: 30 s V > 1750: 60 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 C7		
4.18 Active flammability	20 cycles of 2.5 kV discharges on the test capacitor connected to U_{RAC}	The cheese cloth around the capacitors shall not burn with a flame. No electrical measurements are required.

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