

THB AC Filtering Metalized Polypropylene Film Capacitor Radial Type 85 °C / 85 % RH 1000 h at U_{NAC}



FEATURES

- High robustness under high humidity
- THB 85 °C, 85 % RH, 1000 h at rated U_{NAC}
- UL 810 (electrical pending)
- Segmented film
- Material categorization:
for definitions of compliance please see www.vishay.com/doc?99912



RoHS
COMPLIANT
HALOGEN
FREE
GREEN
(5-2008)

APPLICATIONS

- Outdoor applications
- UPS systems
- Renewable energy
- AC harmonic filter
- Welding equipment

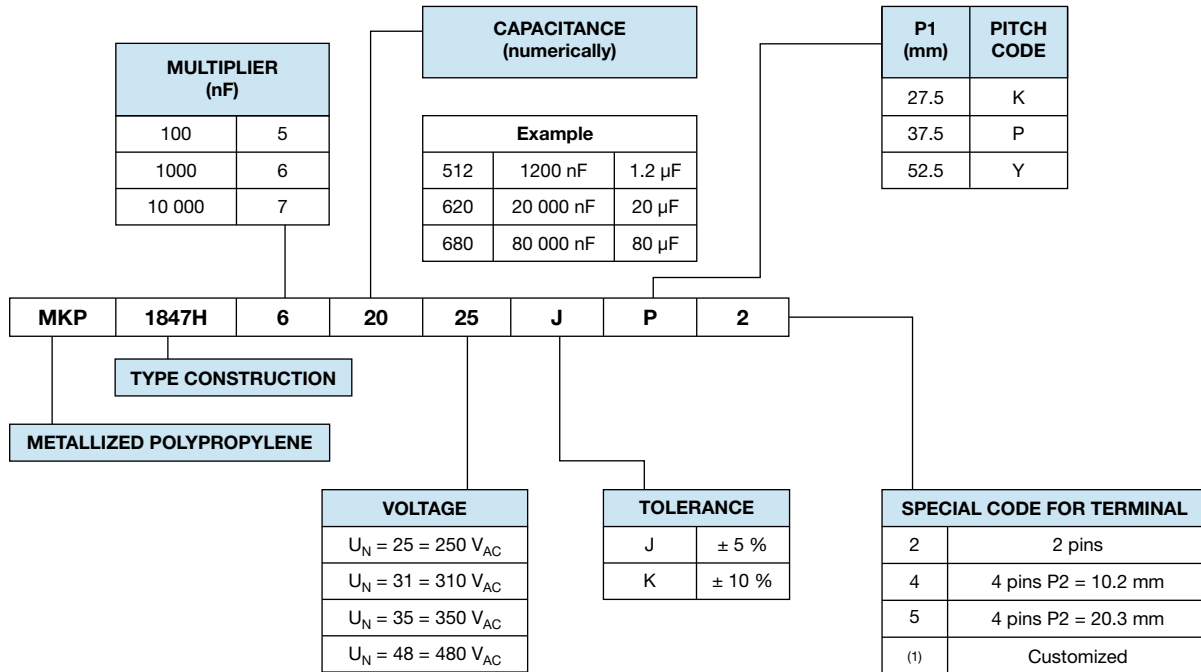
QUICK REFERENCE DATA	
Rated capacitance range	1 µF to 35 µF
Capacitance tolerance	± 10 %, ± 5 %
Maximum continuous AC voltage (50 Hz / 60 Hz) range, U _{NAC}	250 V _{AC} , 310 V _{AC} , 350 V _{AC} , 480 V _{AC}
Climatic testing class	40 / 105 / 56 B
Rated temperature	85 °C
Maximum permissible case temperature	105 °C
Reference standards	IEC 61071, IEC 60068, UL 810
Dielectric	Polypropylene film
Electrodes	Metallized dielectric film
Construction	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Mono construction</p> </div> <div style="text-align: center;"> <p>Series construction</p> </div> </div> <p style="text-align: center;">≤ 310 V_{AC} <</p>
Encapsulation	Plastic case sealed with resin; flame retardant
Terminals	Tinned wire
Self inductance (L _S)	< 1 nH per mm of lead spacing
Withstanding DC voltage between terminals ⁽¹⁾	1.5 U _{NDC} for 10 s, cut off current 10 mA, rise time ≤ 1000 V/s
Insulation resistance	RC between leads, after 1 min > 10 000 s, measuring voltage: 500 V
Life time expectancy ⁽²⁾	FIT: < 10 x 10 ⁻⁹ /h (10 per 10 ⁹ component hours) at 0.5 x U _N , 40 °C
Marking	C-value, tolerance, rated voltage, code for dielectric material, code for manufacturing origin, manufacturer's type designation, manufacturer location, year and week, manufacturer's logo or name

Notes

- For more detailed data and test requirements, contact dc-film@vishay.com
- For general information like characteristics and definitions used for film capacitors follow the link: www.vishay.com/doc?28147
- ⁽¹⁾ See document "Voltage Proof Test for Metalized Capacitors" (www.vishay.com/doc?28169)
- ⁽²⁾ Statements about life time are based on calculations which are based on internal tests. They have to be understood exclusively as estimations. Also due to external factors, the life time in the field application may deviate from the calculated life time. See APPLICATION NOTES AND LIMITING CONDITIONS on page 10 for intended continuous mains voltage.

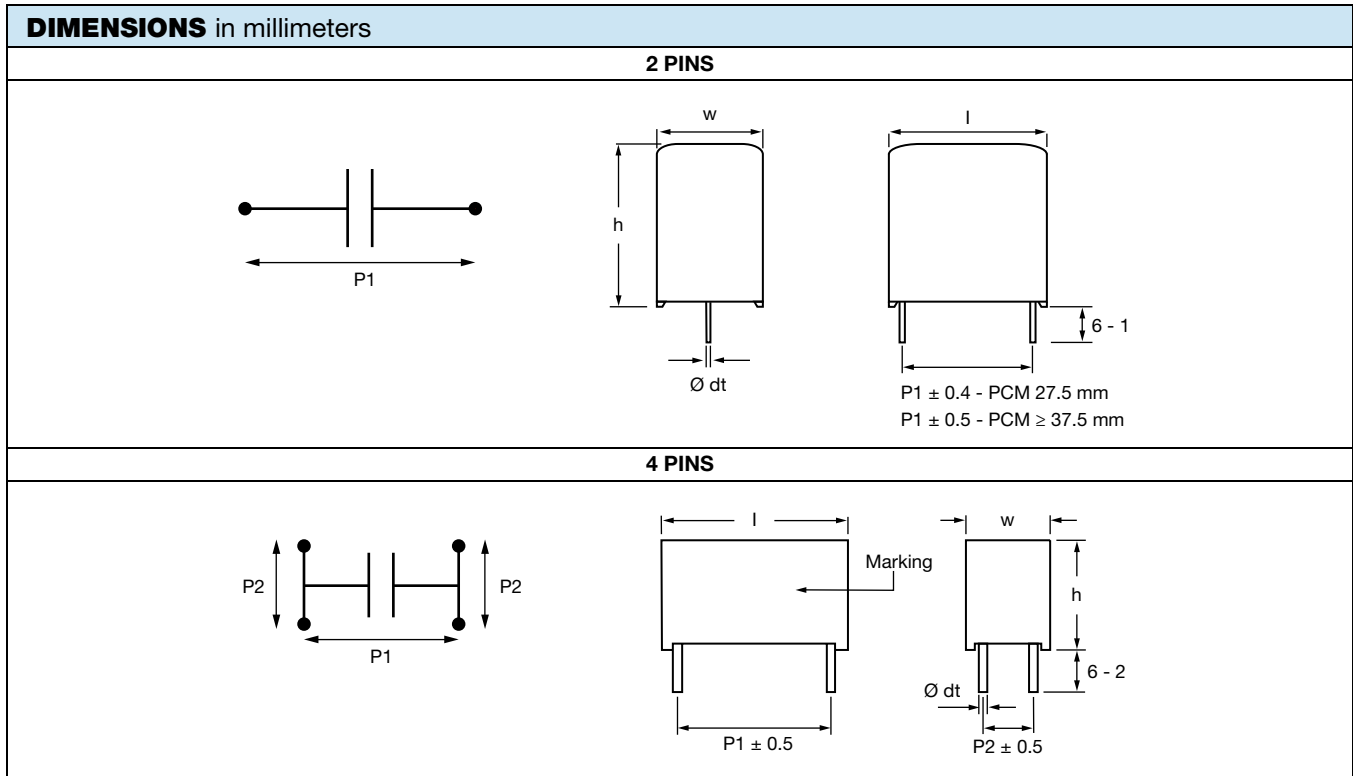
MAXIMUM AC VOLTAGE RATINGS (V _{RMS})				
U _{NAC}	250 V	310 V	350 V	480 V
U _{OPAC} at 85 °C	250 V	310 V	350 V	480 V
U _{OPAC} at 105 °C	175 V	210 V	240 V	330 V

COMPOSITION OF CATALOG NUMBER



Note

(1) Tabs terminals or customized terminals are available on request



Note

- $\varnothing dt \pm 10 \%$ of standard diameter specified



ELECTRICAL DATA AND ORDERING CODE															
U _{NAC} (V)	CAP. (μF)	DIMENSION (mm)			P1 (mm)	P2 (mm)	(dU/dt) _R ⁽¹⁾ (V/μs)	I _{PEAK} (A)	I _{RMS} ⁽²⁾ (A)		ESR ⁽³⁾ 10 kHz (mΩ)		tan δ ⁽⁴⁾ 10 kHz < (x 10 ⁻⁴)		ORDERING CODE ⁽⁵⁾
		w	h	l					2 PINS	4 PINS	2 PINS	4 PINS	2 PINS	4 PINS	
		U _{OPAC} AT 85 °C = 250 V _{AC} , U _{OPAC} AT 105 °C = 175 V _{AC} , C-TOL. = ± 10 % (U _{NDC} = 500 V)													
250	1	15.0	25.0	32.0	27.5	-	50	50	3	-	29.5	-	30	-	MKP1847H51025+K2
	2	15.0	25.0	32.0	27.5	-	50	100	4.5	-	15	-	30	-	MKP1847H52025+K2
	3	18.0	28.0	32.0	27.5	-	50	150	6.5	-	10	-	30	-	MKP1847H53025+K2
	4	21.0	31.0	32.0	27.5	-	50	200	8	-	7.5	-	30	-	MKP1847H54025+K2
	5	21.0	31.0	32.0	27.5	-	50	250	9	-	6	-	30	-	MKP1847H55025+K2
	6	22.0	38.0	32.0	27.5	-	50	300	10.5	-	5	-	30	-	MKP1847H56025+K2
	7	22.0	38.0	32.0	27.5	-	50	350	11.5	-	4.5	-	30	-	MKP1847H57025+K2
	8	22.0	38.0	32.0	27.5	-	50	400	12	-	4	-	30	-	MKP1847H58025+K2
	10	21.5	38.5	42.0	37.5	10.2	25	250	9.5	11	7.5	6.5	70	65	MKP1847H61025+P*
	12	30.0	45.0	42.0	37.5	10.2 / 20.3	25	300	12.5	13.5	6	5.5	70	65	MKP1847H61225+P*
	15	30.0	45.0	42.0	37.5	10.2 / 20.3	25	375	14	15	5	4.5	70	65	MKP1847H61525+P*
	20	30.0	45.0	42.0	37.5	10.2 / 20.3	25	500	16	17.5	3.5	3	70	65	MKP1847H62025+P*
	22	30.0	45.0	57.5	52.5	20.3	12	264	13	14.5	7	6	135	120	MKP1847H62225+Y*
	25	30.0	45.0	57.5	52.5	20.3	12	300	14	15.5	6	5.5	135	120	MKP1847H62525+Y*
	30	35.0	50.0	57.5	52.5	20.3	12	360	16.5	18	5	4.5	135	120	MKP1847H63025+Y*
35	35.0	50.0	57.5	52.5	20.3	12	420	18	19.5	4.5	3.5	135	120	MKP1847H63525+Y*	
U _{OPAC} AT 85 °C = 310 V _{AC} , U _{OPAC} AT 105 °C = 210 V _{AC} , C-TOL. = ± 10 % (U _{NDC} = 630 V)															
310	1	15.0	25.0	32.0	27.5	-	65	65	4	-	19	-	25	-	MKP1847H51031+K2
	2	18.0	28.0	32.0	27.5	-	65	130	6.5	-	9.5	-	25	-	MKP1847H52031+K2
	3	21.0	31.0	32.0	27.5	-	65	195	8.5	-	6.5	-	25	-	MKP1847H53031+K2
	4	22.0	38.0	32.0	27.5	-	65	260	11	-	5	-	25	-	MKP1847H54031+K2
	5	21.5	38.5	42.0	37.5	10.2	35	175	9	10	8.5	7.5	50	45	MKP1847H55031+P*
	6	21.5	38.5	42.0	37.5	10.2	35	210	10	11	7	6	50	45	MKP1847H56031+P*
	7	30.0	45.0	42.0	37.5	10.2 / 20.3	35	245	12.5	14	6	5.5	50	45	MKP1847H57031+P*
	8	30.0	45.0	42.0	37.5	10.2 / 20.3	35	280	13.5	14.5	5	4.5	50	45	MKP1847H58031+P*
	10	30.0	45.0	42.0	37.5	10.2 / 20.3	35	350	15	16.5	4	3.5	50	45	MKP1847H61031+P*
	12	30.0	45.0	57.5	52.5	20.3	15	180	13	14.5	7	6	100	85	MKP1847H61231+Y*
	15	30.0	45.0	57.5	52.5	20.3	15	225	14.5	16	5.5	5	100	85	MKP1847H61531+Y*
	20	35.0	50.0	57.5	52.5	20.3	15	300	18	19.5	4	3.5	100	85	MKP1847H62031+Y*
	22	35.0	50.0	57.5	52.5	20.3	15	330	19	20.5	4	3.5	100	85	MKP1847H62231+Y*
U _{OPAC} AT 85 °C = 350 V _{AC} , U _{OPAC} AT 105 °C = 240 V _{AC} , C-TOL. = ± 10 % (U _{NDC} = 700 V)															
350	1	15.0	25.0	32.0	27.5	-	80	80	4.5	-	20.5	-	20	-	MKP1847H51035+K2
	2	18.0	28.0	32.0	27.5	-	80	160	7	-	10.5	-	20	-	MKP1847H52035+K2
	3	21.0	31.0	32.0	27.5	-	80	240	9	-	7	-	20	-	MKP1847H53035+K2
	4	22.0	38.0	32.0	27.5	-	80	320	11.5	-	5.5	-	20	-	MKP1847H54035+K2
	5	21.5	38.5	42.0	37.5	10.2	50	250	10.5	11	7.5	7.5	40	35	MKP1847H55035+P*
	6	21.5	38.5	42.0	37.5	10.2	50	300	11.5	12.5	6.5	6	40	35	MKP1847H56035+P*
	7	30.0	45.0	42.0	37.5	10.2 / 20.3	50	350	14	15	6	5.5	40	35	MKP1847H57035+P*
	8	30.0	45.0	42.0	37.5	10.2 / 20.3	50	400	15.5	16.5	5	4.5	40	35	MKP1847H58035+P*
	10	30.0	45.0	42.0	37.5	10.2 / 20.3	50	500	17	19	4	3.5	40	35	MKP1847H61035+P*
	12	30.0	45.0	57.5	52.5	20.3	25	300	15.5	16	6	6	80	70	MKP1847H61235+Y*
	15	30.0	45.0	57.5	52.5	20.3	25	375	17	18.5	5	4.5	80	70	MKP1847H61535+Y*
	20	35.0	50.0	57.5	52.5	20.3	25	500	21	23	4	3.5	80	70	MKP1847H62035+Y*
	22	35.0	50.0	57.5	52.5	20.3	25	550	22.5	24.5	3.5	3	80	70	MKP1847H62235+Y*
U _{OPAC} AT 85 °C = 480 V _{AC} , U _{OPAC} AT 105 °C = 330 V _{AC} , C-TOL. = ± 10 % (U _{NDC} = 1000 V)															
480	2	21.5	38.5	42.0	37.5	10.2	80	160	9	10	9.5	9	20	15	MKP1847H52048+P*
	3	30.0	45.0	42.0	37.5	10.2 / 20.3	80	240	13.5	14	6.5	6	20	15	MKP1847H53048+P*
	4	30.0	45.0	57.5	52.5	20.3	80	320	12.5	13	9	8	40	35	MKP1847H54048+Y*
	5	30.0	45.0	57.5	52.5	20.3	35	175	14.0	14.5	7.5	6.5	40	35	MKP1847H55048+Y*
	6	35.0	50.0	57.5	52.5	20.3	35	210	16.5	17.5	6.5	6	40	35	MKP1847H56048+Y*
	7	35.0	50.0	57.5	52.5	20.3	35	245	18.0	18.5	5.5	5	40	35	MKP1847H57048+Y*

Notes


- (1) Rated voltage pulse slope (dU/dt)_R at voltage U_{NDC}
- (2) Maximum RMS current at 10 kHz, +85 °C, capacitance tolerance specified
- (3) Equivalent series resistance typical values at f = 10 kHz
- (4) Maximum tan δ values
- (5) Change the "*" symbol with special code for the terminals and "+" for tolerance



PACKAGING INFORMATION									
U _{NAC} (V)	U _{NDC} (V)	CAP. ⁽¹⁾ (µF)	DIMENSION (mm)			Ø dt (mm)	ORDERING CODE ⁽²⁾	MASS (g)	SPQ ⁽³⁾ (pcs)
			w	h	l				
250	500	1	15.0	25.0	32.0	0.8	MKP1847H51025+K2	11	100
		2	15.0	25.0	32.0	0.8	MKP1847H52025+K2	14	100
		3	18.0	28.0	32.0	0.8	MKP1847H53025+K2	18	80
		4	21.0	31.0	32.0	0.8	MKP1847H54025+K2	23	65
		5	21.0	31.0	32.0	0.8	MKP1847H55025+K2	21	65
		6	22.0	38.0	32.0	0.8	MKP1847H56025+K2	24	60
		7	22.0	38.0	32.0	0.8	MKP1847H57025+K2	23	60
		8	22.0	38.0	32.0	0.8	MKP1847H58025+K2	22	60
		10	21.5	38.5	42.0	1.0	MKP1847H61025+P*	35	91
		12	30.0	45.0	42.0	1.0	MKP1847H61225+P*	68	63
		15	30.0	45.0	42.0	1.0	MKP1847H61525+P*	64	63
		20	30.0	45.0	42.0	1.0	MKP1847H62025+P*	56	63
		22	30.0	45.0	57.5	1.2	MKP1847H62225+Y*	73	45
		25	30.0	45.0	57.5	1.2	MKP1847H62525+Y*	69	45
		30	35.0	50.0	57.5	1.2	MKP1847H63025+Y*	95	40
35	35.0	50.0	57.5	1.2	MKP1847H63525+Y*	86	40		
310	630	1	15.0	25.0	32.0	0.8	MKP1847H51031+K2	10	100
		2	18.0	28.0	32.0	0.8	MKP1847H52031+K2	17	80
		3	21.0	31.0	32.0	0.8	MKP1847H53031+K2	21	65
		4	22.0	38.0	32.0	0.8	MKP1847H54031+K2	24	60
		5	21.5	38.5	42.0	1.0	MKP1847H55031+P*	38	91
		6	21.5	38.5	42.0	1.0	MKP1847H56031+P*	36	91
		7	30.0	45.0	42.0	1.0	MKP1847H57031+P*	70	63
		8	30.0	45.0	42.0	1.0	MKP1847H58031+P*	67	63
		10	30.0	45.0	42.0	1.0	MKP1847H61031+P*	62	63
		12	30.0	45.0	57.5	1.2	MKP1847H61231+Y*	77	45
		15	30.0	45.0	57.5	1.2	MKP1847H61531+Y*	70	45
		20	35.0	50.0	57.5	1.2	MKP1847H62031+Y*	90	40
		22	35.0	50.0	57.5	1.2	MKP1847H62231+Y*	86	40
350	700	1	15.0	25.0	32.0	0.8	MKP1847H51035+K2	16	100
		2	18.0	28.0	32.0	0.8	MKP1847H52035+K2	22	80
		3	21.0	31.0	32.0	0.8	MKP1847H53035+K2	28	65
		4	22.0	38.0	32.0	0.8	MKP1847H54035+K2	34	60
		5	21.5	38.5	42.0	1.0	MKP1847H55035+P*	51	91
		6	21.5	38.5	42.0	1.0	MKP1847H56035+P*	49	91
		7	30.0	45.0	42.0	1.0	MKP1847H57035+P*	83	63
		8	30.0	45.0	42.0	1.0	MKP1847H58035+P*	81	63
		10	30.0	45.0	42.0	1.0	MKP1847H61035+P*	77	63
		12	30.0	45.0	57.5	1.2	MKP1847H61235+Y*	121	45
		15	30.0	45.0	57.5	1.2	MKP1847H61535+Y*	119	45
		20	35.0	50.0	57.5	1.2	MKP1847H62035+Y*	150	40
		22	35.0	50.0	57.5	1.2	MKP1847H62235+Y*	146	40
480	1000	2	21.5	38.5	42.0	1.0	MKP1847H52048+P*	49	91
		3	30.0	45.0	42.0	1.0	MKP1847H53048+P*	77	63
		4	30.0	45.0	57.5	1.2	MKP1847H54048+Y*	121	45
		5	30.0	45.0	57.5	1.2	MKP1847H55048+Y*	119	45
		6	35.0	50.0	57.5	1.2	MKP1847H56048+Y*	152	40
		7	35.0	50.0	57.5	1.2	MKP1847H57048+Y*	147	40

Notes

- (1) Intermediate capacitance values available on request
- (2) Change the “*” symbol with special code for the terminals and “+” for tolerance
- (3) SPQ = Standard Packing Quantity

APPROVALS				
SAFETY APPROVALS	VOLTAGE	VALUE	FILE NUMBERS	LINKS
UL 810 construction	Up to 480 V _{AC}	1 µF to 35 µF	20170525-E490196	www.vishay.com/doc?26086
				

CONSTRUCTION DESCRIPTION

Low inductive wound cell elements of metallized polypropylene film, potted with resin in a flame retardant case.

SPECIFIC METHOD OF MOUNTING TO WITHSTAND VIBRATION AND SHOCK

The capacitor unit is designed for mounting on a printed circuit board.

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

The capacitors shall be mechanically fixed by the leads and the body clamped.

DIMENSIONS TOLERANCES

For the maximum product dimensions for length ($l_{max.}$), width ($w_{max.}$) and height ($h_{max.}$) use the following tolerances:

$$l_{max.} = l + \Delta l, w_{max.} = w + \Delta w, \text{ and } h_{max.} = h + \Delta h$$

$$\text{Pitch} = 27.5 \text{ mm}, \Delta w = \Delta l = \Delta h = 0.7 \text{ mm}$$

$$\text{Pitch} = 37.5 \text{ mm}, \Delta w = \Delta l = \Delta h = 0.7 \text{ mm}$$

$$\text{Pitch} = 52.5 \text{ mm}, \Delta w = \Delta l = \Delta h = 1.0 \text{ mm}$$

$$l_{min.} = l - \Delta l, w_{min.} = w - \Delta w \text{ and } h_{min.} = h - \Delta h$$

$$\text{Pitch} = 27.5 \text{ mm}, \Delta w = \Delta l = \Delta h = 1.0 \text{ mm}$$

$$\text{Pitch} = 37.5 \text{ mm}, \Delta w = \Delta l = \Delta h = 1.0 \text{ mm}$$

$$\text{Pitch} = 52.5 \text{ mm}, \Delta w = \Delta l = \Delta h = 1.5 \text{ mm}$$

SPACE REQUIREMENTS ON PRINTED-CIRCUIT BOARD

For product height with seating plane as given by "IEC 60717" as reference.

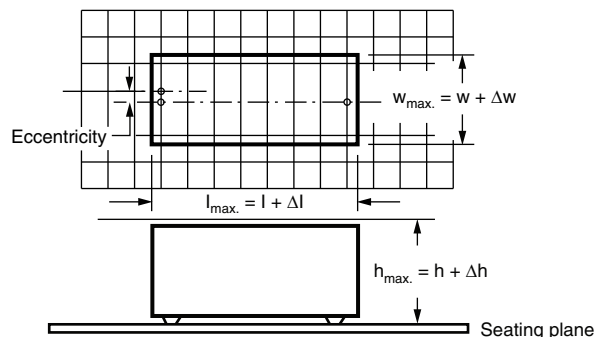
For 2 pins:

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.

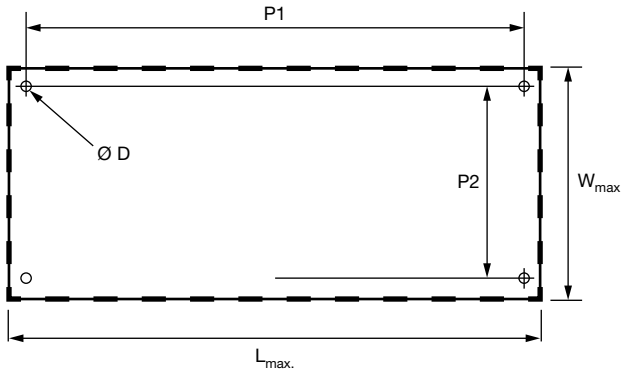
- For products with pitch ≤ 27.5 mm, $\Delta w = \Delta l = \Delta h = 0.7$ mm
- For products with pitch = 37.5 mm, $\Delta w = \Delta l = \Delta h = 0.7$ mm
- For products with pitch = 52.5 mm, $\Delta w = \Delta l = \Delta h = 1.0$ mm

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

The maximum length and width of film capacitors is shown in the figure:



For 4 pins:

DIMENSIONS in millimeters				
				
P1	L _{max.}	W _{max.}	Ø D	H
37.5	l + 1.5	w + 1.8	1.5	h + 0.7
52.5	l + 1.8	w + 2.0	1.7	h + 1.0

SOLDERING CONDITIONS

For general soldering conditions and wave soldering profile we refer to the document “Characteristics and Definitions Used for Film Capacitors”: www.vishay.com/doc?26033.

STORAGE TEMPERATURE

T_{stg} = -25 °C to +35 °C with relative humidity of maximum 75 % without condensation

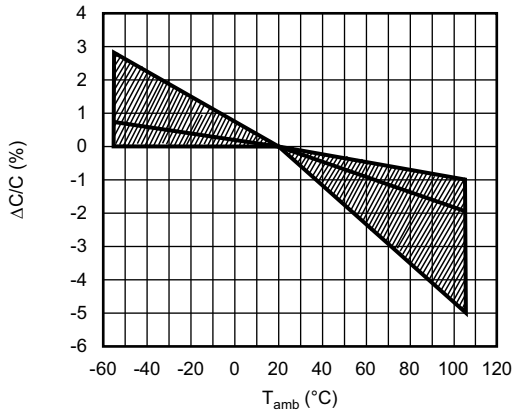
RATINGS AND CHARACTERISTICS REFERENCE CONDITIONS

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

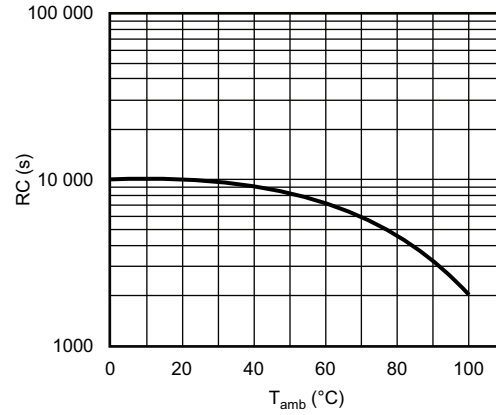
For reference testing, a conditioning period shall be applied over 96 h ± 4 h by heating the products in a circulating air oven at the rated temperature and a relative humidity not exceeding 20 %.



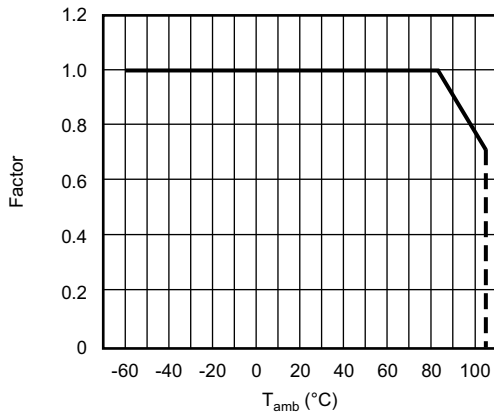
CHARACTERISTICS



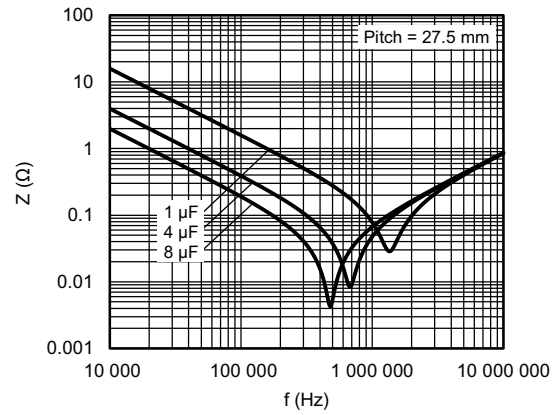
Capacitance as a function of ambient temperature (typical)



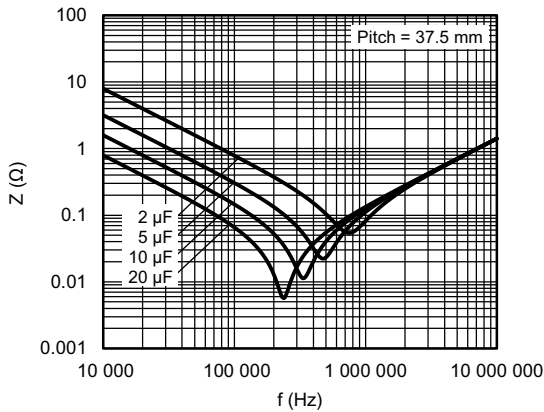
Insulation resistance as a function of ambient temperature (typical)



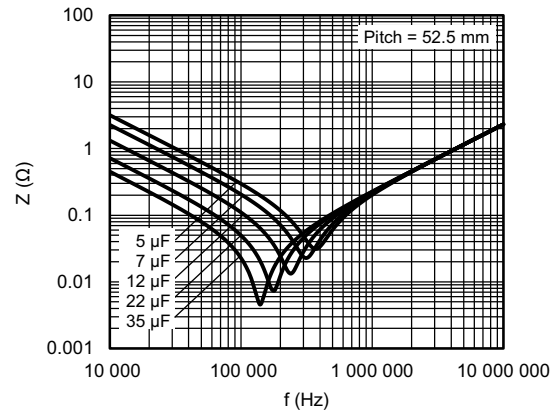
RMS voltage in function of temperature



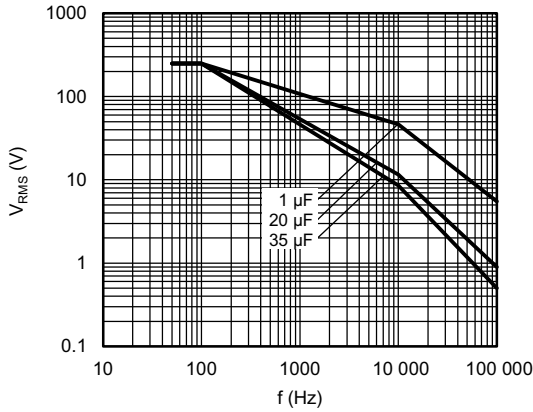
Impedance vs. Frequency (typical)



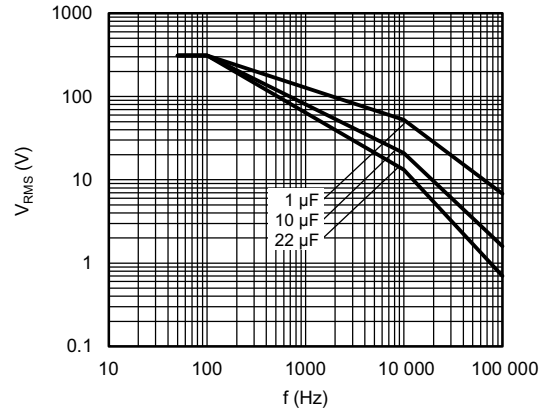
Impedance vs. Frequency (typical)



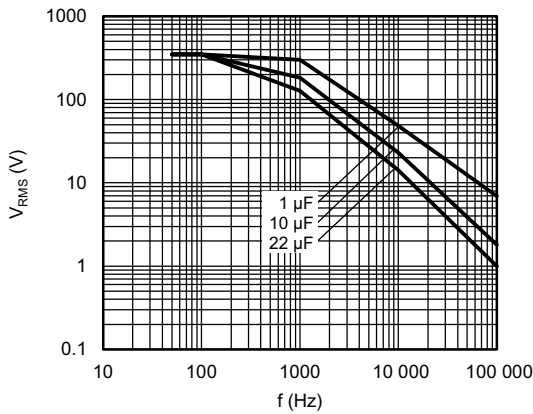
Impedance vs. Frequency (typical)



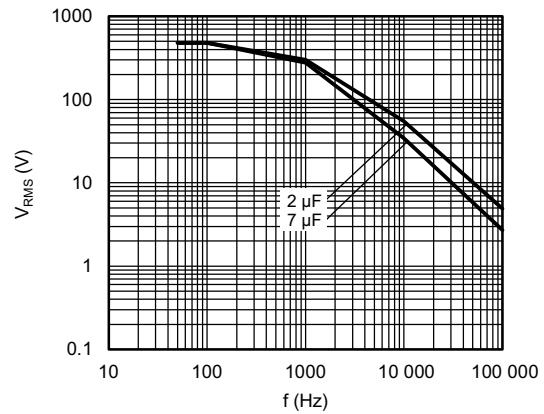
Maximum RMS voltage as function of frequency
 $T_{amb} \leq 85\text{ }^{\circ}\text{C}$; $U_n = 250\text{ V}_{AC}$



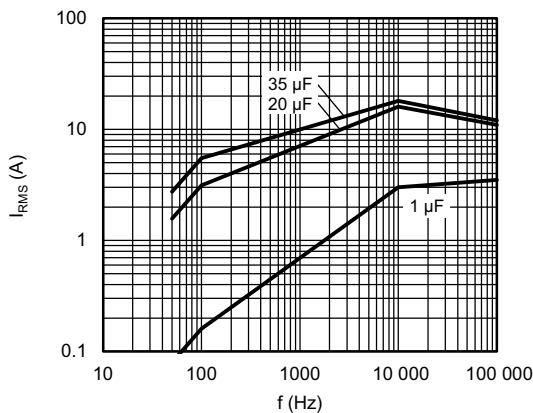
Maximum RMS voltage as function of frequency
 $T_{amb} \leq 85\text{ }^{\circ}\text{C}$; $U_n = 310\text{ V}_{AC}$



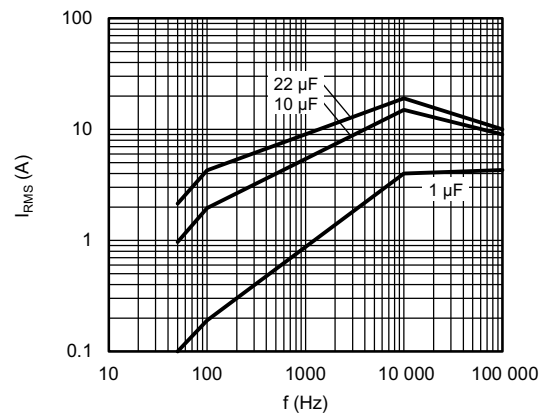
Maximum RMS voltage as function of frequency
 $T_{amb} \leq 85\text{ }^{\circ}\text{C}$; $U_n = 350\text{ V}_{AC}$



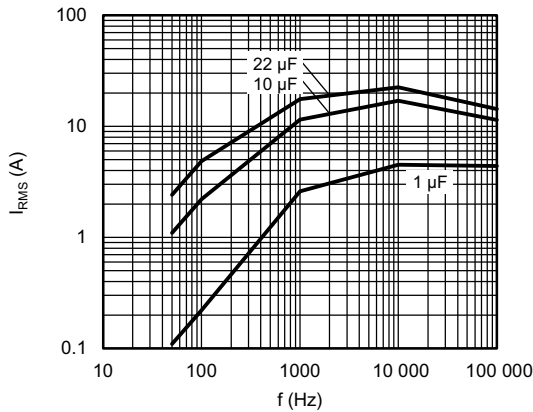
Maximum RMS voltage as function of frequency
 $T_{amb} \leq 85\text{ }^{\circ}\text{C}$; $U_n = 480\text{ V}_{AC}$



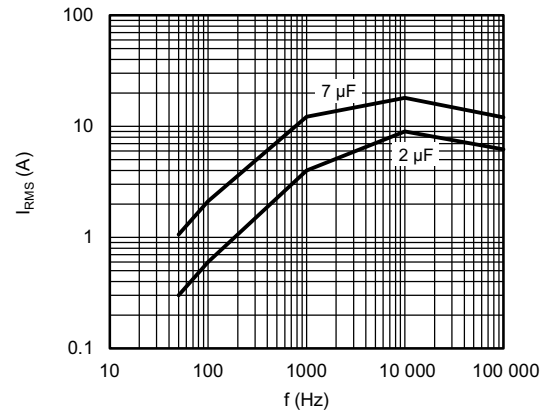
Maximum RMS current as function of frequency
 $T_{amb} \leq 85\text{ }^{\circ}\text{C}$; $U_n = 250\text{ V}_{AC}$



Maximum RMS current as function of frequency
 $T_{amb} \leq 85\text{ }^{\circ}\text{C}$; $U_n = 310\text{ V}_{AC}$



Maximum RMS current as function of frequency
 $T_{amb} \leq 85\text{ }^{\circ}\text{C}$; $U_n = 350\text{ V}_{AC}$



Maximum RMS current as function of frequency
 $T_{amb} \leq 85\text{ }^{\circ}\text{C}$; $U_n = 480\text{ V}_{AC}$

HEAT CONDUCTIVITY			
DIMENSION (mm)			HEAT CONDUCTIVITY (mW/°C)
w	h	l	
13.0	23.0	32.0	22
15.0	25.0	32.0	25
18.0	28.0	32.0	30
21.0	31.0	32.0	35
22.0	38.0	32.0	41
21.5	38.5	42.0	52
30.0	45.0	42.0	70
30.0	45.0	57.5	86
35.0	50.0	57.5	100

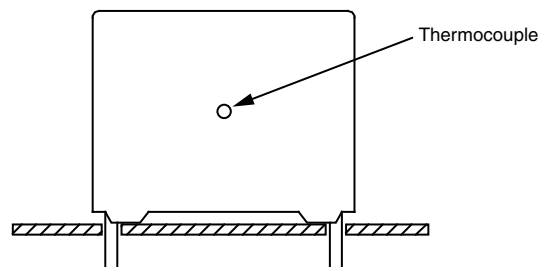
POWER DISSIPATION AND MAXIMUM COMPONENT TEMPERATURE RISE

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 component temperature rise (ΔT) can be measured or calculated by $\Delta T = P/G$:

- ΔT = component temperature rise ($^{\circ}\text{C}$) with a maximum of $15\text{ }^{\circ}\text{C}$
- P = power dissipation of the component (mW)
- G = heat conductivity of the component (mW/ $^{\circ}\text{C}$)

MEASURING THE COMPONENT TEMPERATURE



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

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

To avoid thermal radiation or convection, the capacitor must be tested in a closed area from air circulation.



APPLICATION NOTES AND LIMITING CONDITIONS

These capacitors are not suitable for mains applications as across-the-line capacitors without additional protection. These mains applications are strictly regulated in safety standards and therefore electromagnetic interference suppression capacitors conforming to 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 $\sqrt{2} \times U_{RMS}$
2. The peak-to-peak ripple voltage (U_{pp}) shall not be greater than $2 \times \sqrt{2} \times U_{RMS}$ (for U_{RMS} consult graph "Maximum RMS Voltage as Function of Frequency")
3. The voltage pulse slope (dU/dt) shall not exceed the rated pulse slope at the DC voltage rating.
If the pulse voltage is lower than the rated DC voltage, the rated voltage pulse slope may be multiplied by U_{NDC} and divided by the applied voltage.

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

T is the pulse duration

4. The maximum component surface temperature must be lower than 105 °C and maximum temperature rise between case and free air ambient shall be lower than 15 °C.
5. For continuous operation, 24 hours per day for several years, please refer to application note: www.vishay.com/doc?28245

INSPECTION REQUIREMENTS				
SUB-CLAUSE NUMBER AND TEST	CONDITIONS		PERFORMANCE REQUIREMENTS	
ROUTINE TEST - FINAL INSPECTION				
5.14.2-1 External inspection, visual examination			Legible marking as specified	
5.14.2-2 Dimensions			See specification drawing	
5.3-1 Capacitance	1 kHz at room temperature		See specific reference data	
5.3-2 tan δ	10 kHz at room temperature		See specific reference data	
5.5.1-2 Voltage test between terminals	1.5 x U_{NDC} at T_{amb} Duration: 2 s		No visible damage or puncture No flashover	
5.7 Insulation resistance	Measuring voltage 500 V at room temperature Duration: 1 min		See specific reference data	
TYPE TESTS				
5.14.2 External inspection	Check for finish, marking, and overall dimensions		Legible marking and finish as specified Dimensions: see specification drawing	
5.14.0 Initial measurements	Capacitance at 1 kHz tan δ at 10 kHz			
5.14.1-1/4 Robustness of terminations IEC 60068-2-21	Tensile U_{a1}			
	Wire diameter	Section		Load
	$d \leq 0.80$ mm	$S \leq 0.5$ mm ²		10 N (± 10 %)
	$d \leq 1.25$ mm	$S \leq 1.2$ mm ²		20 N (± 10 %)
	Duration: 10 s ± 1 s			
	Bending, U_b method 1			
Wire diameter	Section modulus	Load		
$d \leq 0.80$ mm	$Z_x \leq 0.05$ mm ³	5 N (10 %)		
$d \leq 1.25$ mm	$Z_x \leq 0.019$ mm ³	10 N (± 10 %)		
4 x 90°, duration: 2 s to 3 s/bend				
5.14.1-6 Resistance to soldering heat IEC 60068-2-20	No pre-drying, method 1A Solder bath: 280 °C ± 5 °C Duration: 10 s ± 1 s			
5.14.4 Final measurements	Capacitance tan δ		$ \Delta C/C \leq 0.5$ % Increase of tan δ ≤ 0.0050 compared to the values measured in 5.14.0	



INSPECTION REQUIREMENTS		
SUB-CLAUSE NUMBER AND TEST	CONDITIONS	PERFORMANCE REQUIREMENTS
5.14.0 Initial measurements 5.14.3-1 Vibration IEC 60068-2-6 5.14.3-2 Shock or impact IEC 60068-2-6 5.14.4 Final measurements	Capacitance at 1 kHz tan δ at 10 kHz Insulation resistance 10 Hz to 55 Hz; $a = \pm 0.35$ mm or acceleration 98 m/s ² Test duration: 10 frequency cycles (3 axes offset from each other by 90°) 1 octave/min Visual examination Pulse shape: half sine Acceleration: 490 m/s ² Duration of pulse: 11 ms Visual examination Capacitance tan δ Insulation resistance	No visible damage No visible damage $ \Delta C/C \leq 0.5\%$ Increase of tan $\delta \leq 0.0050$ compared to the values measured in 5.14.0 Insulation resistance $\geq 50\%$ of specified values
5.5.3-1 Initial measurements 5.5.3-2 DC voltage test between terminals 5.5.3-3 Final measurements	Capacitance at 1 kHz tan δ at 10 kHz Insulation resistance 1.5 x U _{NDC} at T _{amb} Duration: 10 s Capacitance tan δ Insulation resistance	$ \Delta C/C \leq 0.5\%$ Increase of tan $\delta \leq 0.0050$ Insulation resistance $\geq 50\%$ of specified values
5.9-1 Initial measurements 5.9-2 Surge discharge test 5.9-2 DC voltage test between terminals 5.9-3 Final measurements	Capacitance at 1 kHz tan δ at 10 kHz Insulation resistance 1.1 x U _{NDC} Number of discharges: 5 Time lapse: every 2 min (10 min total) Within 5 min after the surge discharge test Duration: 10 s 1.5 x U _{NDC} at T _{amb} Capacitance tan δ Insulation resistance	$ \Delta C/C \leq 1.0\%$ tan $\delta \leq 1.2 \times$ initial tan $\delta + 0.0001$ compared to the values measured in 5.9-1 Insulation resistance $\geq 50\%$ of specified values
5.11-1 Initial measurements 5.11-2 Self healing test 5.11-3 Final measurements	Capacitance at 1 kHz tan δ at 10 kHz Insulation resistance 1.5 x U _{NDC} , duration: 10 s Increase the voltage at 100 V/s till 5 clearings occur or until voltage reach max. of 2.5 x U _{NDC} for a duration of 10 s Capacitance tan δ Insulation resistance	Number of clearings ≤ 5 Clearing = voltage drop of 5 % $ \Delta C/C \leq 0.5\%$ tan $\delta \leq 1.2 \times$ initial tan $\delta + 0.0001$ compared to the values measured in 5.11-1 Insulation resistance $\geq 50\%$ of specified values



INSPECTION REQUIREMENTS		
SUB-CLAUSE NUMBER AND TEST	CONDITIONS	PERFORMANCE REQUIREMENTS
5.13-0 Initial measurements 5.13-1 Change of temperature according to IEC 60068-2-14 5.13-2 Damp heat steady state according to IEC 60068-2-78 5.5.3-2 DC voltage test between terminals 5.13-3 Final measurements	Capacitance at 1 kHz tan δ at 10 kHz Insulation resistance Test Nb $T_{max.} = +105\text{ }^{\circ}\text{C}$ $T_{min.} = -40\text{ }^{\circ}\text{C}$ Transition time: 1 h, equivalent to 1 $^{\circ}\text{C}/\text{min}$. 5 cycles Test Ca $T = 40\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ $\text{RH} = 93\text{ } \% \pm 3\text{ } \%$ Duration: 56 days 1.5 x U_{NDC} at ambient temperature Duration: 10 s Visual examination Capacitance tan δ Insulation resistance	No puncturing or flashover Self healing punctures are permitted $ \Delta C/C \leq 2.0\text{ } \%$ Increase of tan $\delta \leq 0.0150$ compared to the values measured in 5.13-0 Insulation resistance $\geq 50\text{ } \%$ of specified values
5.13A-0 Initial measurements 5.13A.2 Damp heat steady state with load 5.13.3 Final measurements	Capacitance at 1 kHz tan δ at 1 kHz Insulation resistance $T = 85\text{ }^{\circ}\text{C}$ $\text{RH} = 85\text{ } \%$ at U_N Duration: 1000 h Capacitance at 1 kHz tan δ Insulation resistance	$ \Delta C/C < 10\text{ } \%$ Increase of tan δ : ≤ 0.008 for: $C \leq 10\text{ } \mu\text{F}$ or ≤ 0.005 for: $C > 10\text{ } \mu\text{F}$ Compared to the values measured in 5.13A-0 Insulation resistance $\geq 50\text{ } \%$ of specified values
5.10-0 Initial measurements 5.10-1 Thermal stability test under overload conditions 5.10-2 Final measurements	Capacitance at 1 kHz tan δ at 10 kHz Insulation resistance Natural cooling $T_{amb} \pm 5\text{ }^{\circ}\text{C}$ $1.21 \times P_{max.} = 1.21 \times (I_{RMS}^2/w \times C) \times \tan \delta(f)$ with $w = 2 \times \pi \times f$ For I_{RMS} see specific reference data $f = 10\text{ kHz}$ Duration: 48 h Measure the temperature every 1.5 h during the last 6 h Capacitance tan δ at 10 kHz Insulation resistance	Temperature rise $< 1\text{ }^{\circ}\text{C}$ $ \Delta C/C \leq 2.0\text{ } \%$ Increase of tan $\delta \leq 0.0150$ Insulation resistance $\geq 50\text{ } \%$ of specified values



INSPECTION REQUIREMENTS		
SUB-CLAUSE NUMBER AND TEST	CONDITIONS	PERFORMANCE REQUIREMENTS
5.12 Resonance frequency measurement	Impedance analyzer at T _{amb}	> 0.9 times the value as specified in typical curve “Resonant frequency” of this specification
5.15-0 Initial measurements	Capacitance at 1 kHz tan δ at 10 kHz Insulation resistance	ΔC/C ≤ 3.0 % Increase of tan δ ≤ 0.0150 compared to the values measured in 5.15-0 Insulation resistance ≥ 50 % of specified values
5.15-1 Endurance test between terminals	Sequence: 1.25 x (U _{RMS} at 85 °C) at T _{max.} = 85 °C 1.25 x (U _{OPAC} at 105 °C) at T _{max.} = 105 °C Duration: 500 h 1000 x discharge at 1.4 x \hat{i} (maximum peak current) 1.25 x (U _{RMS} at 85 °C) at T _{max.} = 85 °C 1.25 x (U _{OPAC} at 105 °C) at T _{max.} = 105 °C Duration: 500 h	
5.15-2 Final measurement	Capacitance tan δ Insulation resistance	
5.16.3-0 Initial measurements	Capacitance at 1 kHz	DC power supply capable of obtaining the desired breakdown voltage No burning of the cheese cloth The dielectric must withstand the test sequence conducted
5.16.3-1 Destruction test sequence for segmented film	The capacitors must be put in an oven at T _{max.} = 105 °C/2 h and cooled down Product enveloped with cheese cloth	
High DC voltage test (limited to 200 mA)	3 x U _{NDC} with minimum 2000 V _{DC} , duration = 1 min Discharge the capacitor, duration = 1 min	
High AC voltage test	AC _{RMS} voltage = 1 x U _N , duration = 15 s The above sequence shall be repeated until the test sample capacitance loss 10 % of its initial measurement in 5.16.3B-0	
5.16.3-2 Final measurements	Visual examination Capacitance at 1 kHz	

Note

- Sub-clause numbers of tests and performance requirements refer to the “Sectional Specification, Publication IEC 61071”



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