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

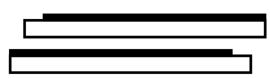
FEATURES

- 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

Pb-free
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	Mono construction  $\leq$ 310 V_{AC} < Series construction 
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 $\leq$ 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.

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

MKP	1847H	6	20	25	J	P	2

- MKP: METALLIZED POLYPROPYLENE
- 1847H: TYPE CONSTRUCTION
- 6: MULTIPLIER (nF)
- 20: CAPACITANCE (numerically)
- 25: VOLTAGE
- J: TOLERANCE
- P: PITCH CODE
- 2: SPECIAL CODE FOR TERMINAL

MULTIPLIER (nF)	
100	5
1000	6
10 000	7

CAPACITANCE (numerically)

Example		
512	1200 nF	1.2 µF
620	20 000 nF	20 µF
680	80 000 nF	80 µF

P1 (mm)	PITCH CODE
27.5	K
37.5	P
52.5	Y

VOLTAGE
U_N = 25 = 250 V_{AC}
U_N = 31 = 310 V_{AC}
U_N = 35 = 350 V_{AC}
U_N = 48 = 480 V_{AC}

TOLERANCE	
J	± 5 %
K	± 10 %

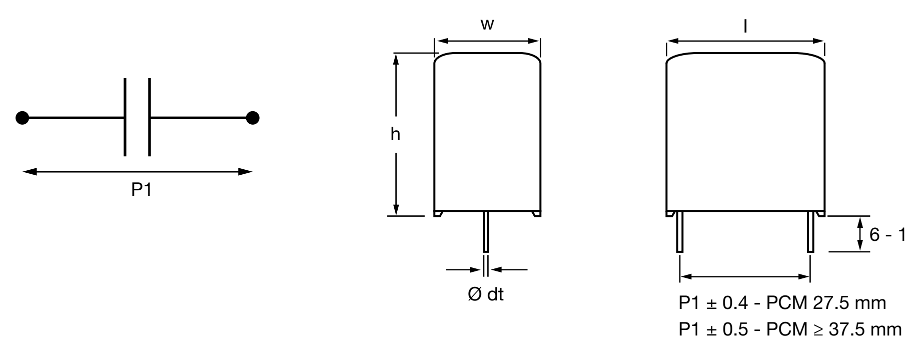
SPECIAL CODE FOR TERMINAL	
2	2 pins
4	4 pins P2 = 10.2 mm
5	4 pins P2 = 20.3 mm
(1)	Customized

Note

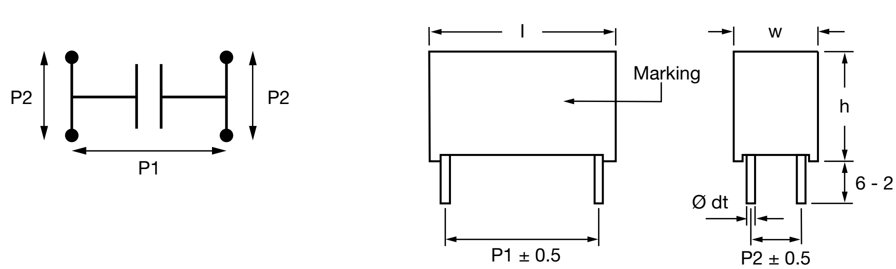
(1) Tabs terminals or customized terminals are available on request

DIMENSIONS in millimeters

2 PINS



4 PINS



Note

- Ø dt ± 10 % of standard diameter specified

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	13.0	23.0	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	13.0	23.0	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+P*
	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*

Table: ELECTRICAL DATA AND ORDERING CODE

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	13.0	23.0	32.0	0.8	MKP1847H51025+K2	11	115
		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	13.0	23.0	32.0	0.8	MKP1847H51031+K2	10	115
		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	Pending	www.vishay.com/doc?

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:

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

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

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

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

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

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

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

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

SPACE REQUIREMENTS ON PRINTED-CIRCUIT BOARD

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

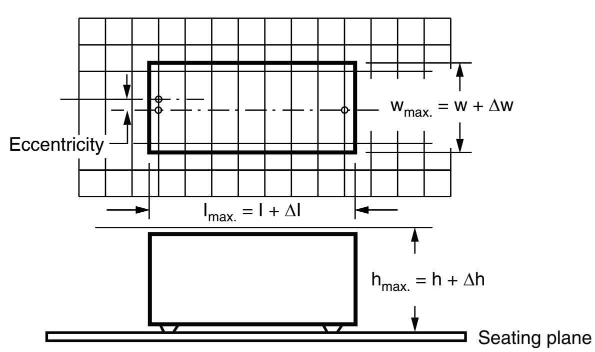
For 2 pins:

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

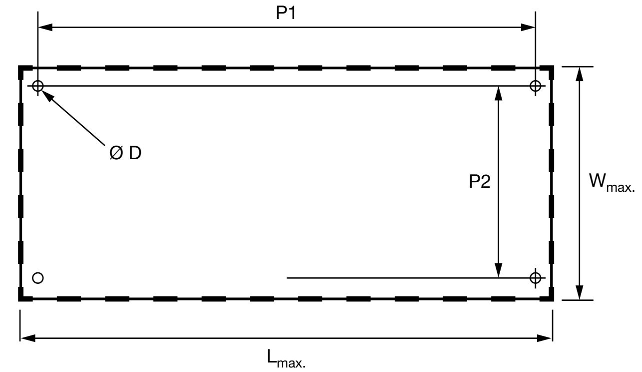
Eccentricity defined as in drawing. The maximum eccentricity is smaller than or equal to the lead diameter of the product concerned.

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

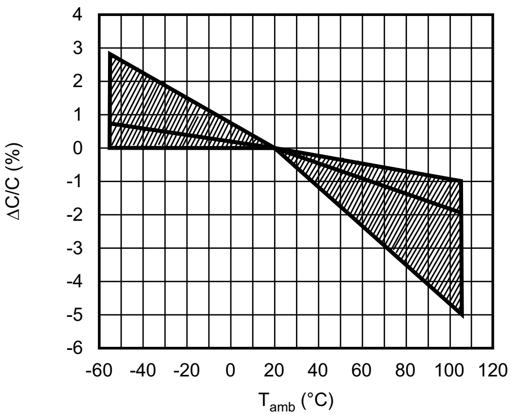
T_{stg} = -25 °C to +35 °C with relative humidity of maximum 75 % without condensation

RATINGS AND CHARACTERISTICS REFERENCE CONDITIONS

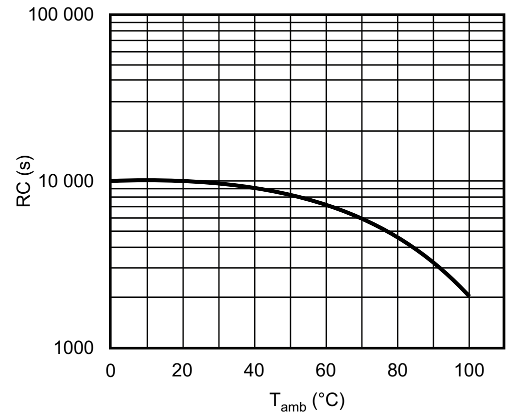
Unless otherwise specified, all electrical values apply to an ambient temperature of 23 °C ± 1 °C, an atmospheric pressure of 86 kPa to 106 kPa and a relative humidity of 50 % ± 2 %.

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 %.

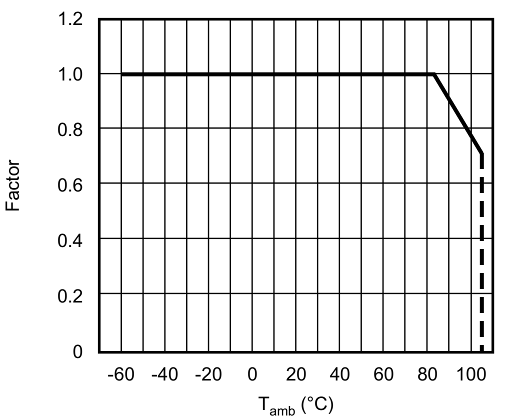
CHARACTERISTICS



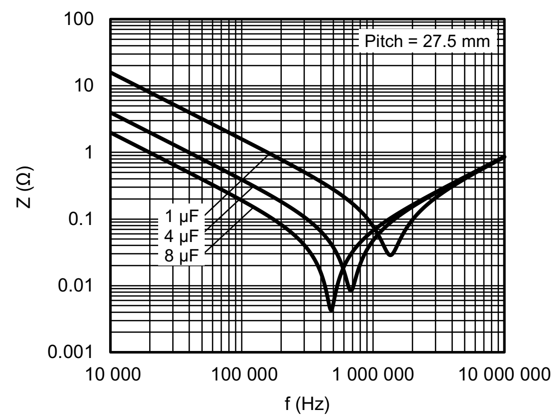
Capacitance as a function of ambient temperature (typical)



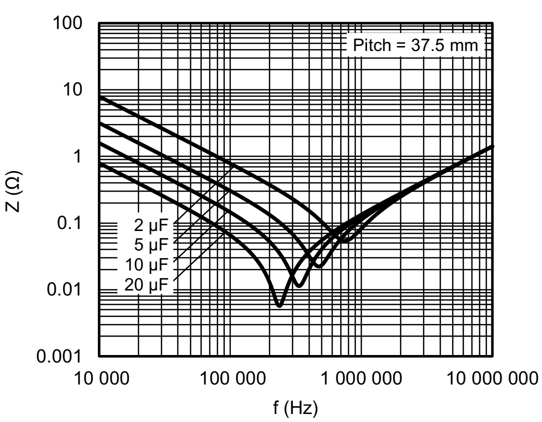
Insulation resistance as a function of ambient temperature (typical)



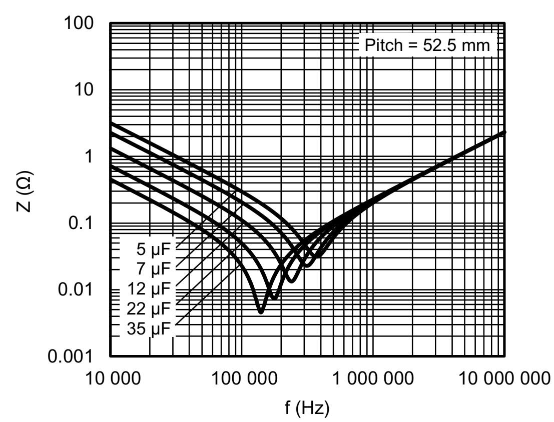
RMS voltage in function of temperature



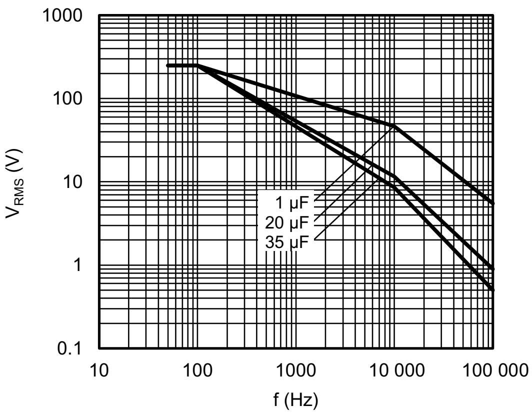
Impedance vs. Frequency (typical)



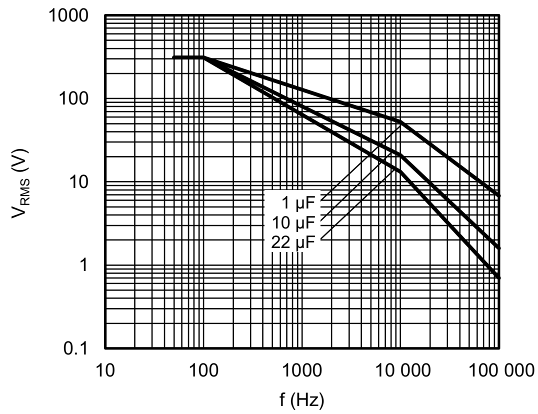
Impedance vs. Frequency (typical)



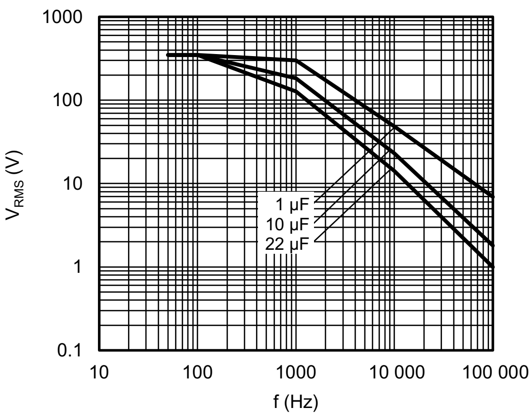
Impedance vs. Frequency (typical)



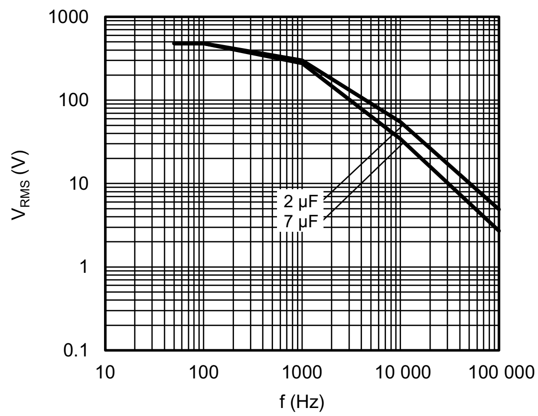
Maximum RMS voltage as function of frequency
$T_{amb} \leq 85\ °C$; $U_n = 250\ V_{AC}$



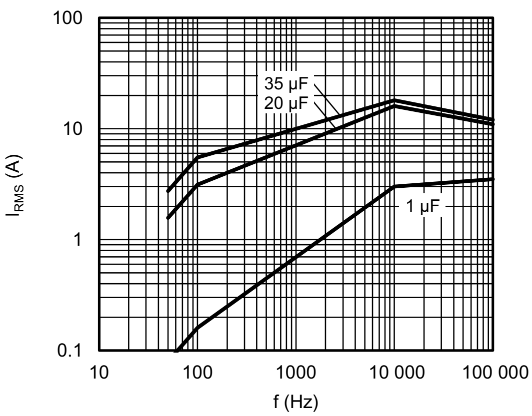
Maximum RMS voltage as function of frequency
$T_{amb} \leq 85\ °C$; $U_n = 310\ V_{AC}$



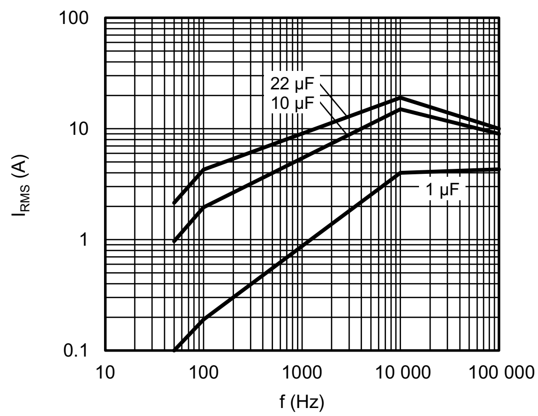
Maximum RMS voltage as function of frequency
$T_{amb} \leq 85\ °C$; $U_n = 350\ V_{AC}$



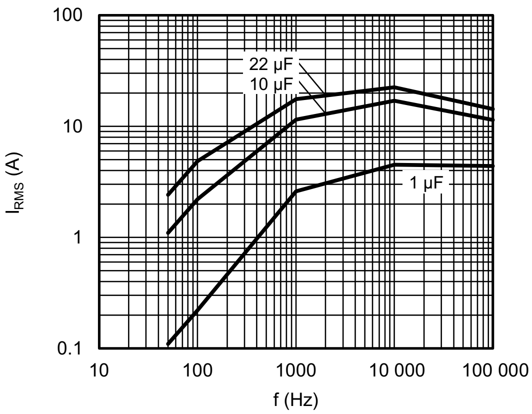
Maximum RMS voltage as function of frequency
$T_{amb} \leq 85\ °C$; $U_n = 480\ V_{AC}$



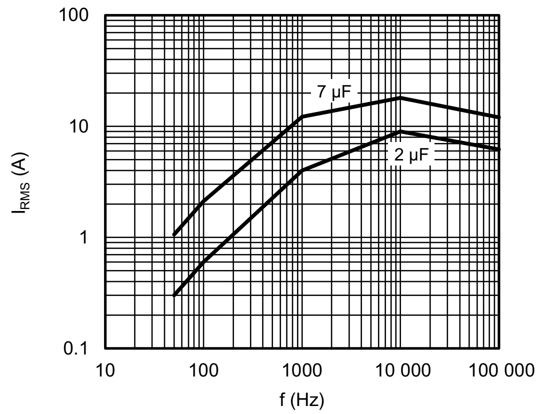
Maximum RMS current as function of frequency
$T_{amb} \leq 85\ °C$; $U_n = 250\ V_{AC}$



Maximum RMS current as function of frequency
$T_{amb} \leq 85\ °C$; $U_n = 310\ V_{AC}$



Maximum RMS current as function of frequency
$T_{amb} \leq 85$ °C; $U_n = 350$ V_{AC}



Maximum RMS current as function of frequency
$T_{amb} \leq 85$ °C; $U_n = 480$ 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

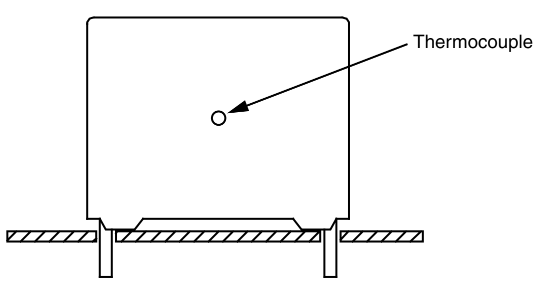
POWER DISSIPATION AND MAXIMUM COMPONENT TEMPERATURE RISE

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 (°C) with a maximum of 15 °C
- P = power dissipation of the component (mW)
- G = heat conductivity of the component (mW/°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 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

<table>
<tr><th colspan="3">INSPECTION REQUIREMENTS</th></tr>
<tr><th>SUB-CLAUSE NUMBER AND TEST</th><th>CONDITIONS</th><th>PERFORMANCE REQUIREMENTS</th></tr>
<tr><th colspan="3">ROUTINE TEST - FINAL INSPECTION</th></tr>
<tr><td>5.14.2-1
External inspection, visual examination</td><td></td><td>Legible marking as specified</td></tr>
<tr><td>5.14.2-2
Dimensions</td><td></td><td>See specification drawing</td></tr>
<tr><td>5.3-1
Capacitance</td><td>1 kHz at room temperature</td><td>See specific reference data</td></tr>
<tr><td>5.3-2
tan δ</td><td>10 kHz at room temperature</td><td>See specific reference data</td></tr>
<tr><td>5.5.1-2
Voltage test between terminals</td><td>1.5 x U_{NDC} at T_{amb}
Duration: 2 s</td><td>No visible damage or puncture
No flashover</td></tr>
<tr><td>5.7
Insulation resistance</td><td>Measuring voltage 500 V at room temperature
Duration: 1 min</td><td>See specific reference data</td></tr>
<tr><th colspan="3">TYPE TESTS</th></tr>
<tr><td>5.14.2
External inspection</td><td>Check for finish, marking, and overall dimensions</td><td>Legible marking and finish as specified
Dimensions: see specification drawing</td></tr>
<tr><td>5.14.0
Initial measurements</td><td>Capacitance at 1 kHz
tan δ at 10 kHz</td><td></td></tr>
<tr><td>5.14.1-1/4
Robustness of terminations
IEC 60068-2-21</td><td>Tensile Ua1
<table>
<tr><th>Wire diameter</th><th>Section</th><th>Load</th></tr>
<tr><td>d ≤ 0.80 mm</td><td>S ≤ 0.5 mm²</td><td>10 N
(± 10 %)</td></tr>
<tr><td>d ≤ 1.25 mm</td><td>S ≤ 1.2 mm²</td><td>20 N
(± 10 %)</td></tr>
</table>
Duration: 10 s ± 1 s

Bending, Ub method 1
<table>
<tr><th>Wire diameter</th><th>Section modulus</th><th>Load</th></tr>
<tr><td>d ≤ 0.80 mm</td><td>Z_x ≤ 0.05 mm³</td><td>5 N
(10 %)</td></tr>
<tr><td>d ≤ 1.25 mm</td><td>Z_x ≤ 0.019 mm³</td><td>10 N
(± 10 %)</td></tr>
</table>
4 x 90°, duration: 2 s to 3 s/bend</td><td></td></tr>
<tr><td>5.14.1-6
Resistance to soldering heat
IEC 60068-2-20</td><td>No pre-drying, method 1A
Solder bath: 280 °C ± 5 °C
Duration: 10 s ± 1 s</td><td></td></tr>
<tr><td>5.14.4
Final measurements</td><td>Capacitance
tan δ</td><td>|ΔC/C| ≤ 0.5 %
Increase of tan δ ≤ 0.0050
compared to the values measured in 5.14.0</td></tr>
</table>

INSPECTION REQUIREMENTS		
SUB-CLAUSE NUMBER AND TEST	CONDITIONS	PERFORMANCE REQUIREMENTS
5.14.0 Initial measurements	Capacitance at 1 kHz tan δ at 10 kHz Insulation resistance	
5.14.3-1 Vibration IEC 60068-2-6	10 Hz to 55 Hz; a = ± 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	No visible damage
5.14.3-2 Shock or impact IEC 60068-2-6	Pulse shape: half sine Acceleration: 490 m/s^2 Duration of pulse: 11 ms	
5.14.4 Final measurements	Visual examination	No visible damage
	Capacitance tan δ	|ΔC/C| ≤ 0.5 % Increase of tan δ ≤ 0.0050 compared to the values measured in 5.14.0
	Insulation resistance	Insulation resistance ≥ 50 % of specified values
5.5.3-1 Initial measurements	Capacitance at 1 kHz tan δ at 10 kHz Insulation resistance	
5.5.3-2 DC voltage test between terminals	1.5 x U_{NDC} at T_{amb} Duration: 10 s	
5.5.3-3 Final measurements	Capacitance tan δ Insulation resistance	|ΔC/C| ≤ 0.5 % Increase of tan δ ≤ 0.0050 Insulation resistance ≥ 50 % of specified values
5.9-1 Initial measurements	Capacitance at 1 kHz tan δ at 10 kHz Insulation resistance	
5.9-2 Surge discharge test	1.1 x U_{NDC} Number of discharges: 5 Time lapse: every 2 min (10 min total)	
5.9-2 DC voltage test between terminals	Within 5 min after the surge discharge test Duration: 10 s 1.5 x U_{NDC} at T_{amb}	
5.9-3 Final measurements	Capacitance tan δ	|ΔC/C| ≤ 1.0 % tan δ ≤ 1.2 x initial tan δ + 0.0001 compared to the values measured in 5.9-1
	Insulation resistance	Insulation resistance ≥ 50 % of specified values
5.11-1 Initial measurements	Capacitance at 1 kHz tan δ at 10 kHz Insulation resistance	
5.11-2 Self healing test	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	Number of clearings ≤ 5 Clearing = voltage drop of 5 %
5.11-3 Final measurements	Capacitance tan δ	|ΔC/C| ≤ 0.5 % tan δ ≤ 1.2 x initial tan δ + 0.0001 compared to the values measured in 5.11-1
	Insulation resistance	Insulation resistance ≥ 50 % of specified values

INSPECTION REQUIREMENTS		
SUB-CLAUSE NUMBER AND TEST	CONDITIONS	PERFORMANCE REQUIREMENTS
5.13-0 Initial measurements	Capacitance at 1 kHz tan δ at 10 kHz Insulation resistance	
5.13-1 Change of temperature according to IEC 60068-2-14	Test Nb $T_{max.}$ = +105 °C $T_{min.}$ = -40 °C Transition time: 1 h, equivalent to 1 °C/min. 5 cycles	
5.13-2 Damp heat steady state according to IEC 60068-2-78	Test Ca T = 40 °C ± 2 °C RH = 93 % ± 3 % Duration: 56 days	
5.5.3-2 DC voltage test between terminals	1.5 x U_{NDC} at ambient temperature Duration: 10 s	
5.13-3 Final measurements	Visual examination	No puncturing or flashover Self healing punctures are permitted
	Capacitance tan δ Insulation resistance	$\|\Delta C/C\| \leq 2.0$ % Increase of tan δ ≤ 0.0150 compared to the values measured in 5.13-0 Insulation resistance ≥ 50 % of specified values
5.13A-0 Initial measurements	Capacitance at 1 kHz tan δ at 1 kHz Insulation resistance	
5.13A.2 Damp heat steady state with load	T = 85 °C RH = 85 % at U_N Duration: 1000 h	
5.13.3 Final measurements	Capacitance at 1 kHz tan δ Insulation resistance	$\|\Delta C/C\| < 10$ % Increase of tan δ: ≤ 0.008 for: C ≤ 10 μF or ≤ 0.005 for: C > 10 μF Compared to the values measured in 5.13A-0 Insulation resistance ≥ 50 % of specified values
5.10-0 Initial measurements	Capacitance at 1 kHz tan δ at 10 kHz Insulation resistance	
5.10-1 Thermal stability test under overload conditions	Natural cooling T_{amb} ± 5 °C 1.21 x $P_{max.}$ = 1.21 x (I^2_{RMS}/w x C) x tan δ(f) with w = 2 x π x f For I_{RMS} see specific reference data f = 10 kHz Duration: 48 h	
5.10-2 Final measurements	Measure the temperature every 1.5 h during the last 6 h	Temperature rise < 1 °C
	Capacitance tan δ at 10 kHz Insulation resistance	$\|\Delta C/C\| \leq 2.0$ % Increase of tan δ ≤ 0.0150 Insulation resistance ≥ 50 % 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	
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	|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
5.16.3-0 Initial measurements	Capacitance at 1 kHz	
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	DC power supply capable of obtaining the desired breakdown voltage
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	No burning of the cheese cloth
5.16.3-2 Final measurements	Visual examination Capacitance at 1 kHz	The dielectric must withstand the test sequence conducted

Note

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

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