C44P-T, 420 – 850 VAC / 950 – 2,000 VDC, Long Lifetime, High Temperature and THB

Overview

The C44P-T capacitor is a polypropylene metallized film capacitor with a cylindrical, aluminium can-type design filled with a soft, vegetable oil-based, polyurethane resin. It uses high current screw terminals, a metal deck with plastic insulators, and an overpressure safety device.

Applications

Typical market segments include renewable energy, artificial intelligence, industrial, traction, and smart grid systems. Typical applications include power conversion, commutation, power factor correction, and uninterruptible power supplies (UPS).

Benefits

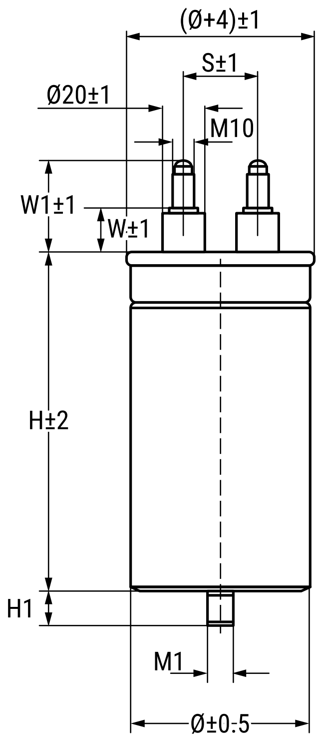
- Long lifetime up to 250,000 hours
- High temperature capability up to 90°C hot spot
- Withstands harsh environmental conditions – 85°C / 85% R.H. at rated voltage for 1,000 hours
- Overpressure safety device via safety groove
- High peak current capability
- High-torque screw terminals with plastic insulator
- Self-healing

Part Number System

C4	4	P	R	G	R	6	1	0	0	T	9	9	K
Series		Application	Rated Voltage	Case Type	Terminal Style	Capacitance Code (pF)				Variants	Case Diameter	Case Height	Tolerance
C4 = MKP Capacitors for Power Applications	4 = Cylindrical types	AC filter	J = 420VAC M = 480VAC P = 550 VAC R = 640 VAC U = 780 VAC W=850 VAC	G = M12 bolt	R = Male M10	Digits nine, ten, and eleven indicate the first three digits of capacitance value. Digit 8 indicates the number of zeros to be added.				T = Standard Other symbol = Special	6 = 65mm 7 = 75mm 8 = 85mm 9 = 95mm A = 116mm	1 … Z	J = ±5% K = ±10%

It is not possible to manufacture every part number which could be created from coding description. Please refer to table of standard part numbers and ask KEMET for other possibilities.

Dimensions – Millimeters



Diameter	S	W	W1	M1	H1
Ø = 65	28	18	40	12	16
Ø ≥ 75	35	21	45	12	16
All dimensions are in mm					

Maximum Driving Torque	
Terminals M10	10 [N*m]
Bolt M12	12 [N*m]

Qualifications

Reference Standards	IEC 61071 - EN 61071
	UL810 approved - E107629
Climatic Category	30/070/56
Damp Heat	IEC 60068-2-78
Change of Temperature	IEC 60068-2-14
Vibration Strength	IEC 60068-2-6

General Technical Data

Dielectric	Polypropylene film
	Non-inductive type winding
Climatic category	30/070/56 - IEC 60068-1
Maximum hot spot temperature	+90°C
Harsh-environmental withstanding	1,000 hours @ Vr, 85°C, 85% Relative Humidity
Enclosure	Aluminium case
	Metal deck with self-extinguishing UL 94-V0 plastic insulators
Leads	High current M10 male terminals
Packaging	Packed in cardboard boxes with protection for the terminals
Installation	Terminals on top (*)

(*) The capacitor can be mounted in horizontal direction, but due to possible performance impact for the capacitor, KEMET highly recommend the capacitor installation to be done with terminals on top.

Electrical Characteristics

Rated Voltage	U_{rms} = (see table) VAC
Surge Voltage	U_s = (see table) VDC for maximum 10 times in lifetime at +25°C ±5°C
Peak Non-Repetitive Current	1.5 x I_{pkr} maximum 1,000 times in lifetime
Over-Voltage (IEC 61071)	1.15 x V_{NDC} for maximum 30 minutes, once per day
	1.3 x V_{NDC} for maximum 1 minute, once per day
Capacitance Tolerance	±5% or ±10%
Dissipation Factor PP Typical (tgδ0)	≤ 0.0002 at 25°C
Storage Temperature Limits	-40 to 85°C

Life Expectancy

Life Expectancy	100,000 hours at V_{RMS} with T_{HS} ≤ 85°C
Capacitance parametrical drop at end of life	≥-3% (typical)
Failure Rate IEC 61709	See FIT graph (*)

(*) Inside the FIT value it is considered capacitor with parametrical failure and activated safety device.

Test Methods

Test Voltage Term to Term (UTT)	1.5 x V_{RMS} for 10 seconds at 25°C
Test Voltage Term to Case (UTC)	4,000 V ~ 50 Hz for 10 seconds (V_{rms} ≤ 480Vac)
	6,000 V ~ 50 Hz for 10 seconds (V_{rms} ≥ 550Vac)

NOTICE: Care should be taken to ensure that there still is electrical clearance of minimum 15 mm between terminations and other live or earthed parts above the capacitor, in case of safety device activation. Flexible cables should be used in order to allow proper safety device activation.

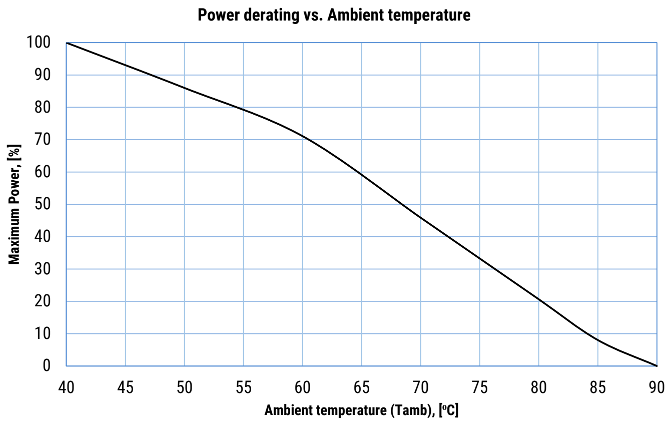
Table 1 – Ratings & Part Number Reference

Cap Value (µF)	V_{rms}	Rated Voltage	Surge Voltage	Maximum Dimensions (mm)		Irms (1)	Pmax (2)	Rs (3)	ESL	Thermal Resistance (4)	dV/dt (V/µs)	SPQ	Part Number
	VAC	VDC	VDC	D	H	(A)1	(W)	(mΩ)	(nH)	(°C/W)		(pcs)	
100	420	950	1,400	75	147	30	3.7	2.7	145	5.7	20	9	C44PJGR6100T74J
100	420	950	1,400	65	197	50	6.1	1.8	135	4.4	20	9	C44PJGR6100T68J
120	420	950	1,400	65	197	45	6.1	2.2	165	4.2	20	9	C44PJGR6120T68K
133	420	950	1,400	65	247	40	5.7	2.5	155	3.7	20	9	C44PJGR6133T69J
133	420	950	1,400	75	197	50	6.4	1.8	170	4.0	20	12	C44PJGR6133T78J
150	420	950	1,400	65	247	45	6.6	2.3	160	3.5	20	9	C44PJGR6150T69J
200	420	950	1,400	75	247	55	8.7	2.0	175	3.2	20	9	C44PJGR6200T79J
250	420	950	1,400	85	247	60	9.4	1.7	175	3.1	20	5	C44PJGR6250T89J
300	420	950	1,400	85	247	60	9.5	1.6	180	2.8	20	5	C44PJGR6300T89K
60	480	1,100	1,650	75	117	35	4.0	2.4	140	6.9	20	9	C44PMGR5600T71J
60	480	1,100	1,650	65	147	30	5.0	4.4	140	5.9	20	9	C44PMGR5600T64J
70	480	1,100	1,650	75	147	50	5.0	1.4	145	5.7	20	9	C44PMGR5700T74J
80	480	1,100	1,650	75	147	50	5.1	1.4	150	5.3	20	9	C44PMGR5800T74J
100	480	1,100	1,650	75	157	50	4.9	1.2	160	5.0	20	9	C44PMGR6100T76J
150	480	1,100	1,650	75	197	50	6.0	1.4	170	5.8	20	12	C44PMGR6150T78K
166	480	1,100	1,650	85	197	55	7.0	1.4	173	5.0	20	5	C44PMGR6166T88J
200	480	1,100	1,650	75	247	50	7.6	1.8	175	4.6	20	9	C44PMGR6200T79K
250	480	1,100	1,650	85	247	50	7.8	1.6	180	4.2	20	5	C44PMGR6250T89J
22	550	1,280	1,900	65	117	34	3.0	2.1	125	11.5	30	9	C44PPGR5220T61K
33	550	1,280	1,900	75	117	40	3.4	1.6	130	10.4	30	9	C44PPGR5330T71K
47	550	1,280	1,900	65	197	50	4.5	1.4	135	7.8	30	9	C44PPGR5470T68K
68	550	1,280	1,900	65	247	50	5.7	1.7	145	6.1	30	9	C44PPGR5680T69K
100	550	1,280	1,900	75	247	57	6.7	1.4	160	5.2	30	9	C44PPGR6100T79K
120	550	1,280	1,900	85	247	60	7.6	1.3	165	4.6	30	5	C44PPGR6120T89K
150	550	1,280	1,900	95	247	60	7.9	1.2	180	4.4	30	4	C44PPGR6150T99K
15	640	1,400	2,100	65	117	30	2.8	2.5	120	12.2	30	9	C44PRGR5150T61K
22	640	1,400	2,100	65	147	30	3.4	3.0	125	10.1	30	9	C44PRGR5220T64K
33	640	1,400	2,100	75	147	36	3.9	2.2	135	9.1	30	9	C44PRGR5330T74K
47	640	1,400	2,100	65	247	45	5.5	1.9	145	5.9	30	9	C44PRGR5470T69K
68	640	1,400	2,100	75	247	55	6.7	1.6	160	5.2	30	9	C44PRGR5680T79K
100	640	1,400	2,100	95	247	60	8.0	1.3	170	4.4	30	4	C44PRGR6100T99K
120	640	1,400	2,100	95	247	60	8.4	1.3	180	4.1	30	4	C44PRGR6120T99K
150	640	1,400	2,100	116	247	60	8.6	1.2	180	3.8	30	4	C44PRGR6150TA9K
10	780	1,700	2,500	65	117	25	2.4	3.0	130	14.2	70	9	C44PUGR5100T61K
15	780	1,700	2,500	75	147	28	3.6	3.6	135	9.7	70	9	C44PUGR5150T74K
22	780	1,700	2,500	75	147	35	4.3	2.7	140	8.1	70	9	C44PUGR5220T74K
33	780	1,700	2,500	85	147	42	4.5	2.0	150	7.1	70	5	C44PUGR5330T84K
47	780	1,700	2,500	75	247	52	6.7	1.8	160	5.2	70	9	C44PUGR5470T79K
68	780	1,700	2,500	85	247	55	7.3	1.5	170	4.8	70	5	C44PUGR5680T89K
100	780	1,700	2,500	95	247	60	8.7	1.3	180	4.0	70	4	C44PUGR6100T99K
23	850	2,000	2,700	75	147	36	4.4	2.5	140	8.0	80	9	C44PWGR5230T74K
30	850	2,000	2,700	85	147	40	4.9	2.1	150	7.1	80	5	C44PWGR5300T84K
42	850	2,000	2,700	75	247	50	6.7	1.8	160	5.2	80	9	C44PWGR5420T79K
56	850	2,000	2,700	85	247	55	7.3	1.4	170	4.4	80	5	C44PWGR5560T89K
75	850	2,000	2,700	95	247	60	8.8	1.4	180	4.0	80	4	C44PWGR5750T99K
Cap Value	VAC	Rated Voltage	Surge Voltage	D	H	I_{rms}	Pmax	R_s	ESL	Thermal Resistance	dV/dt (V/µs)	SPQ	Part Number

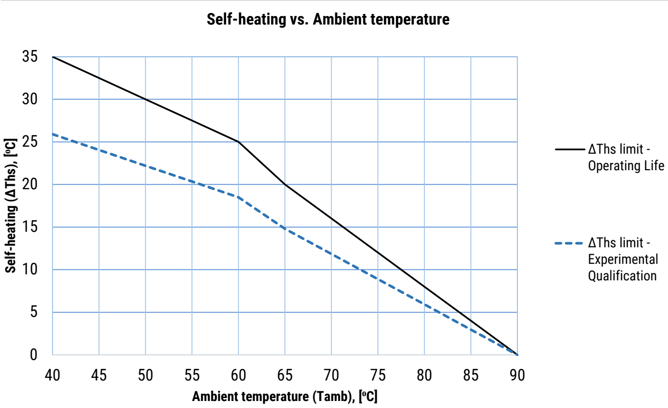
(1) Maximum admissible RMS current, valid with harmonics up to 10kHz. ΔThs max ≤ 35°C.
(2) Maximum admissible capacitor power losses.
(3) Rs at 1kHz (typical value @ 25°C). Can be used for preliminary evaluation of the power losses up to 10kHz. For deeper evaluations of complex spectrum KEMET is available for additional technical support.
(4) Rth value is declared as Temperature Hot-Spot (Ths) to Ambient temperature (Tamb), considering natural convection and altitude up to 2000 meters. The thermal resistance value (Rth) could be influenced by the specific application setup.

Lifetime Expectancy/Failure Quota Graphs

Power derating graph versus Ambient Temperature.



Maximum ΔThs derating graph versus Ambient Temperature.



Note for the Self-heating vs. Ambient temperature graph:
"ΔThs Limit - Operating Life":
- The Customer should fulfill this limit during the whole service life of the capacitors and calculate it from the data available in the catalogue

"ΔThs limit - Experimental Qualification":
- The Customer should fulfill this limit during their experimental tests for the homologation/qualification process

In case the above limits are exceeded, please contact KEMET Technical Team for deeper evaluation

All above considerations are valid for natural convection

Power Losses and Hot Spot Temperature Calculation

At each frequency (*), the power losses are the sum of:
1. Dielectric Power Losses

$P_D(f_i) = 2 * \pi * f_i * C * V(f_i)^2 * tg\delta_0$

which can be alternatively calculated as

$$P_D(f_i) = \frac{I(f_i)^2}{2 * \pi * f_i * C} * tg\delta_0$$

where: $tg\delta_0 = 2 * 10^{-4}$

2. Joule Power Losses:

$P_J(f_i) = Rs * I(f_i)^2$

The Total Power Losses are the sum of the components at each frequency:

$$P_T = \sum_i [P_D(f_i) + P_J(f_i)]$$

(*) Can be used for evaluation of the power losses up to 10kHz. For deeped evaluations of complex specturm, KEMET is available for additional technical support.
The Thermal Jump in the Hot Spot is:
$\Delta T_{HS} = P_T * R_{th\text{-}hs}$

The Hot Spot Temperature is:
$T_{HS} = T_a + \Delta T_{HS}$

Limits for the formulas

The limits listed below should not be exceeded:

1. $\sqrt{\sum_i V(f_i)^2} \le V_{RMS}$

2. $\sqrt{\sum_i I(f_i)^2} \le I_{RMS}$

$T_{HS} = T_a + \Delta T_{HS} \le (T_{HS})_{MAX}$

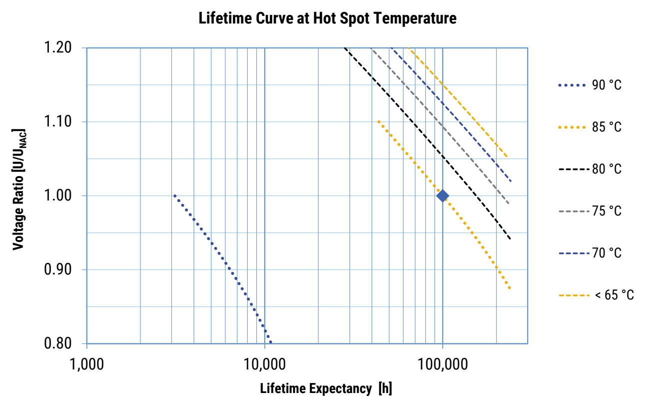
Where T_a *is the ambient temperature (steady state temperature of the cooling air flowing around the capacitor, measured at 100 mm of distance from the capacitor and at a height of 2/3 height of the capacitor).*

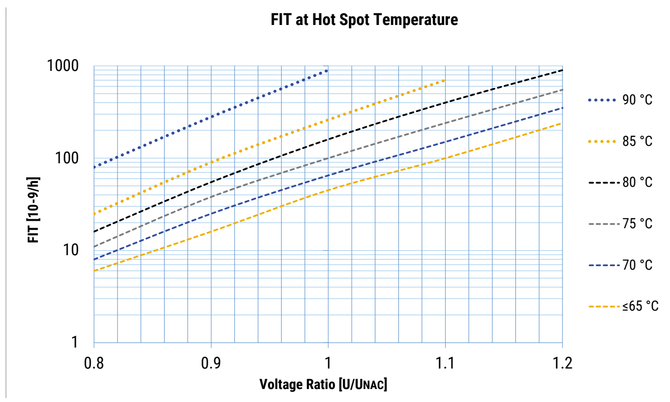
3. Maximum temperature Hot-Spot check

4. Maximum Capacitor Power losses versus Ambient temperature
PT calculated ≤ PT max

5. Maximum Self-heating vs. Ambient temperature validations
ΔThs calculated ≤ ΔThs limit - Operating Life
ΔThs measured ≤ ΔThs limit - Experimental Qualification

Lifetime Expectancy/Failure Quota Graphs cont.



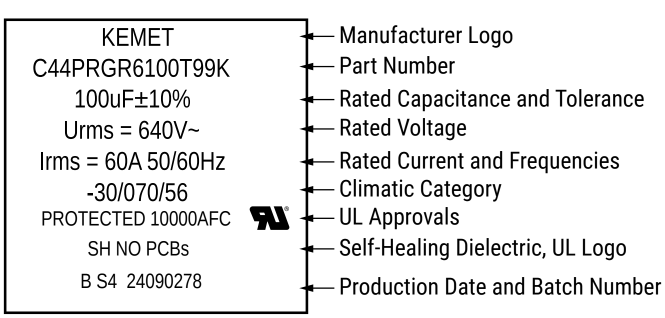


Example of calculation

Part Number: C44PRGR6100T99K
Rated V_{RMS} = 640 [Vrms]
Rated I_{RMS} = 60 [A]
R_s = 1.3 [mΩ]
R_{th} = 4.4 [°C/W]
Pmax = 7.95 [W]
Fundamental Frequency F_1 = 50 [Hz]
Ripple Frequency F_2 = 7,000 (Hz)
Fundamental Voltage V_1 = 590 (V~)
Ripple Current I_2 = 32 [A]
T_a = 55°C
$I_1 = I(50) = 2 * \pi * 50 * 100 * 10^{-6} * 590 = 18.535$ (A)
$V_2 = V(7000) = [32/(2 * \pi * 7000 * 100 * 10^{-6})] = 7.276$ (V)

$I_{RMS} = \sqrt{(18.535^2 + 32^2)} = 36.98 \leq 60$ → Admitted
$V_{RMS} = \sqrt{(440^2 + 6.1^2)} = 440 \leq 440$ → Admitted
$P_D(50) = 2 * \pi * 50 * 100 * 10^{-6} * 590^2 * 2 * 10^{-4} = 2.186$ (W)
$P_D(10{,}000) = [32^2/(2 * \pi * 10000 * 100 * 10^{-6})] * 2 * 10^{-4} = 0.0259$ (W)]
$P_J(50) = 1.3 * 10^{-3} * [(2 * \pi * 50 * 100 * 10^{-6} * 590)^2] = 0.446$ (W)
$P_J(10{,}000) = 1.3 * 10^{-3} * 322 = 1.331$ (W)
$P_T = 2.186 + 0.0259 + 0.446 + 1.331 = 3.9889$ (W)
PT limit (@ Tamb = 55°C): 6.32 (W) → Taken from the Power derating graph
*PT = 4.01 ≤ 6.32 (W) → **Admitted***
*ΔTHS = 4.4*4.01 = 17.64 (°C) → Ok since is less than the maximum admitted at 55°C (see the temperature derating graph)*
THS = Ta + ΔT_{HS}
THS (Operating Life) = 55 + 17.64 = 72.64 (°C) → OK since hot-spot temperature calculated is less than maximum admitted (see the Self-heating vs. Ambient temperature graph)
THS (Experimental Qualification) = To be measured in the real application and to be compared with the self-heating graph (Experimental Qualification curve)
Voltage Ration (V/V_{RMS}) = 590/640 = 0.92
Expected Life @ THS = 72.64°C and 0.92xV_{RMS} ->250,000 hours (see lifetime curve)

Marking



Environmental Compliance

As a leading global supplier of electronic components and an environmentally conscious company, KEMET continually aspires to improve the environmental effects of our manufacturing processes and our finished electronic components.

In Europe (RoHS Directive) and in some other geographical areas such as China (China RoHS), legislation has been enacted to prevent or otherwise limit the use of certain hazardous materials, including lead (Pb), in electronic equipment. KEMET monitors legislation globally to ensure compliance and endeavors to adjust our manufacturing processes and/or electronic components as may be required by applicable law.

For military, medical, automotive, and some commercial applications, the use of lead (Pb) in the termination is necessary and/or required by design. KEMET is committed to communicating RoHS compliance to our customers. Information related to RoHS compliance will be provided in data sheets and using specific identifiers on the packaging labels.

All KEMET power film capacitors are RoHS compliant.

Materials & Environment

The selection of raw materials that KEMET uses for the production of its electronic components is the result of extensive experience. KEMET directs specific attention toward environmental protection. KEMET selects its suppliers according to ISO 9001 standards and performs statistical analyses on raw materials before acceptance for use in manufacturing our electronic components. All materials are, to the best of KEMET’s knowledge, non-toxic and free from cadmium; mercury; chrome and compounds; polychlorine triphenyl (PCB); bromide and chlorinedioxins bromurate clorurate; CFC and HCFC; and asbestos.

Sealing

Hermetically Sealed Capacitors
As the temperature increases, the pressure inside the capacitor increases. If the internal pressure is high enough, it can cause a breach in the capacitor. Such a breach can result in leakage, impregnation, filling fluid, or moisture susceptibility.

Barometric Pressure
The altitude at which hermetically sealed capacitors are operated controls the capacitor's voltage rating. As the barometric pressure decreases, the susceptibility to terminal arc-over increases. Non-hermetic capacitors can be affected by internal stresses due to pressure changes. These effects can be in the form of capacitance changes, dielectric arc-over, and/or low insulation resistance. Altitude can also affect heat transfer. Heat that is generated in an operation cannot be dissipated properly, and high RI2 losses and eventual failure can result.

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