

C44P/C20A Series, 250 – 1,000 VAC, 400 – 1,400 VDC, for PFC and AC Filter

Overview

The C44P/C20A Series are a polypropylene metallized film with cylindrical aluminium can type filled with oil, screw terminals, plastic insulator and overpressure safety device.

Applications

Typical applications include commutation, power factor correction and AC harmonic filtering.

Benefits

- Overpressure safety device
- High peak current capability
- High torque screw terminals with plastic insulator
- Long lifetime
- Self-healing

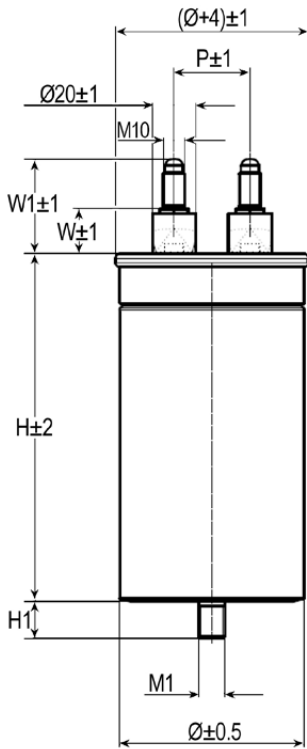


Part Number System

| C | 44 | P | F | G | R | 6 | 1 | 0 | 0 | A | A | S | J | |
|---------------------------------------|--|-------------------------------------|---|---|--------------|----------------|---|--|---|---|-----------------------------|---|----------------|-------------------|
| Series | | Application | Rated Voltage (VAC) | | Case Type | Terminal Style | | Capacitance Code (pF) | | | Internal Code | | Internal Codes | Tolerance |
| MKP Capacitors for Power Applications | 44 = 250/440 V _{ac} 20 = 550/1,000 V _{ac} | AC Filter P = C44 A = C20 | For C44P: F = 250 L = 330 K = 440 | For C20A: K = 550 L = 640 Q = 780 Z = 1000 | G = M12 bolt | R = Male M10 | | Digits 9, 10, & 11 indicate the first 3 digits of capacitance value. Digit 8 indicates the number of zeros that must be added to obtain rated capacitance in pF. | | | A = Standard Z = Special | | | 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 | P | W | W1 | M1 | H1 |
|--------------------------|----|----|----|----|----|
| $\text{Ø} = 65$ | 28 | 18 | 40 | 12 | 16 |
| $\text{Ø} \geq 75$ | 35 | 21 | 45 | 12 | 16 |
| All dimensions are in mm | | | | | |

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

General Technical Data

| | |
|---|--|
| Reference Standards | IEC 61071 UL810 approved |
| Dielectric | Polypropylene film Non-inductive type winding |
| Climatic Category | 25/70/56 – IEC 60068-1 |
| Maximum hot spot temperature | +80°C |
| Endurance Test IEC 61071 | +70°C @ Case Temperature |
| Installation | Whatever position |
| Tinned brass deck with self extinguish UL94 V0 plastic insulators | |

Electrical Characteristics

| | |
|--|--|
| Rated Voltage | Urms = (see table) VAC |
| Surge Voltage | Us = (see table) VDC |
| Capacitance Tolerance | ±5% or ±10% |
| Dissipation Factor PP typical (tgδ0) | ≤ 0.0002 at 25°C |
| Relative Humidity | Annual average ≤ 80% at 24°C On 30 days/year permanently 100%. on other days occasionally 90%. Dewing not admitted |
| Capacitance deviation in temperature range (-40 +50°C) | ±1.5% maximum on capacitance value at 20°C |

Life Expectancy

| | |
|---------------------------------|---|
| Life Expectancy | 100,000 hours @ V_{RMS} with $T_{HS} \leq 75^\circ\text{C}$ |
| Capacitance drop at end of life | - 5% (typical) |
| Failure Rate IEC 61709 | See FIT Graph |

Test Methods

| | |
|---------------------------------|--|
| Test voltage term to term (Utt) | $1.5 \times V_{RMS}$ for 10 seconds at 25°C |
| Test voltage term to case (Utc) | 3,600 V ~ 50 Hz for 10 seconds (C44P) 6,000 V ~ 50 Hz for 10 seconds (C20A) |
| Damp Heat | IEC 60068-2-78 |
| Change of Temperature | IEC 60068-2-14 |
| Vibration Strength | IEC 60068-2-6 |

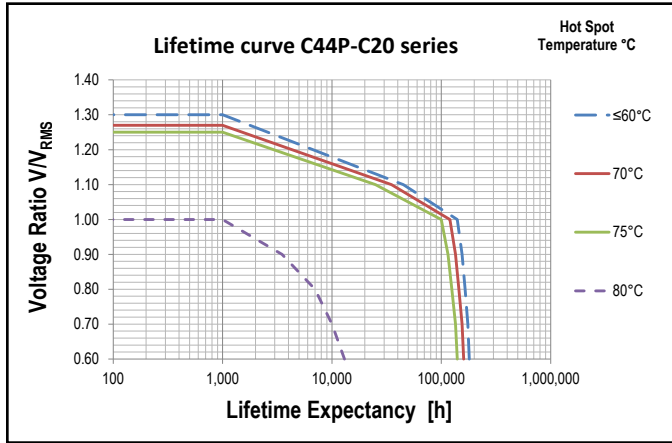
NOTICE: Care should be taken to ensure that there still is electrical clearance of 15 mm between terminations and other live or earthed parts above the capacitor, in case of safety device activation.

Table 1 – Ratings & Part Number Reference

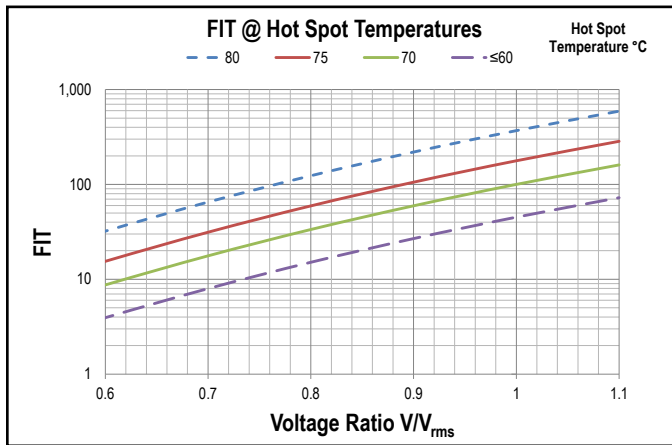
| Cap Value (μF) | V _{rms} | Rated Voltage | Surge Voltage | Maximum Dimensions (mm) | | Ripple Current | ESR | ESL | Thermal Res | dV/dt (V/μs) | Part Number |
|----------------|------------------|---------------|---------------|-------------------------|-----|------------------------------|-------------|------|-------------|--------------|-----------------|
| | VAC | VDC | VDC | D | H | 10 kHz 40°C (A) ¹ | 10 kHz (mΩ) | (nH) | (°C/W) | | |
| 100 | 330 | 700 | 1050 | 65 | 117 | 25 | 3.0 | 115 | 8.5 | 12.5 | C44PLGR6100AASJ |
| 200 | 330 | 700 | 1050 | 65 | 147 | 43 | 2.8 | 140 | 5.4 | 12.5 | C44PLGR6200ZASJ |
| 300 | 330 | 700 | 1050 | 65 | 247 | 50 | 2.3 | 150 | 3.6 | 12.5 | C44PLGR6300ZASJ |
| 300 | 330 | 700 | 1050 | 75 | 197 | 55 | 1.4 | 160 | 4.2 | 12.5 | C44PLGR6300AASJ |
| 400 | 330 | 700 | 1050 | 65 | 247 | 55 | 2.0 | 160 | 3.1 | 12.5 | C44PLGR6400ZASJ |
| 500 | 330 | 700 | 1050 | 75 | 247 | 58 | 1.8 | 170 | 2.9 | 12.5 | C44PLGR6500ZASJ |
| 500 | 330 | 700 | 1050 | 85 | 197 | 63 | 1.2 | 160 | 3.4 | 12.5 | C44PLGR6500ZBSJ |
| 600 | 330 | 700 | 1050 | 85 | 247 | 65 | 1.6 | 180 | 2.9 | 12.5 | C44PLGR6600AASJ |
| 600 | 330 | 700 | 1050 | 85 | 280 | 75 | 1.1 | 210 | 2.4 | 12.5 | C44PLGR6600ZASJ |
| 100 | 440 | 1000 | 1500 | 75 | 147 | 30 | 3.5 | 145 | 5.6 | 20 | C44PKGR6100AASJ |
| 100 | 440 | 1000 | 1500 | 65 | 197 | 50 | 2.3 | 135 | 4.4 | 20 | C44PKGR6100ZASJ |
| 120 | 440 | 1000 | 1500 | 65 | 197 | 50 | 1.8 | 165 | 4.2 | 20 | C44PKGR6120AASJ |
| 133 | 440 | 1000 | 1500 | 65 | 247 | 40 | 3.0 | 155 | 3.7 | 20 | C44PKGR6133AASJ |
| 133 | 440 | 1000 | 1500 | 75 | 197 | 50 | 1.6 | 170 | 4.0 | 20 | C44PKGR6133ZASJ |
| 150 | 440 | 1000 | 1500 | 65 | 247 | 45 | 2.8 | 160 | 3.5 | 20 | C44PKGR6150AASJ |
| 200 | 440 | 1000 | 1500 | 75 | 247 | 55 | 2.4 | 175 | 3.2 | 20 | C44PKGR6200AASJ |
| 250 | 440 | 1000 | 1500 | 85 | 247 | 60 | 2.0 | 175 | 3.4 | 20 | C44PKGR6250AASJ |
| 300 | 440 | 1000 | 1500 | 85 | 247 | 60 | 1.9 | 180 | 2.7 | 20 | C44PKGR6300AASJ |
| 400 | 440 | 1000 | 1500 | 95 | 247 | 65 | 1.7 | 200 | 2.5 | 20 | C44PKGR6400AASK |
| 22 | 550 | 1280 | 1900 | 65 | 117 | 40 | 2.1 | 125 | 13.3 | 30 | C20AKGR5220AASK |
| 33 | 550 | 1280 | 1900 | 75 | 117 | 45 | 1.6 | 130 | 10.6 | 30 | C20AKGR5330AASK |
| 47 | 550 | 1280 | 1900 | 65 | 197 | 50 | 1.4 | 135 | 7.8 | 30 | C20AKGR5470AASK |
| 68 | 550 | 1280 | 1900 | 65 | 247 | 55 | 1.7 | 145 | 6.2 | 30 | C20AKGR5680AASK |
| 100 | 550 | 1280 | 1900 | 75 | 247 | 60 | 1.4 | 160 | 5.2 | 30 | C20AKGR6100AASK |
| 120 | 550 | 1280 | 1900 | 85 | 247 | 60 | 1.3 | 165 | 4.6 | 30 | C20AKGR6120AASK |
| 150 | 550 | 1280 | 1900 | 95 | 247 | 60 | 1.2 | 180 | 4.4 | 30 | C20AKGR6150AASK |
| 15 | 640 | 1400 | 2100 | 65 | 117 | 35 | 2.5 | 120 | 14.1 | 30 | C20ALGR5150AASK |
| 22 | 640 | 1400 | 2100 | 65 | 147 | 35 | 3.0 | 125 | 10.9 | 30 | C20ALGR5220AASK |
| 33 | 640 | 1400 | 2100 | 75 | 147 | 40 | 2.2 | 135 | 9.1 | 30 | C20ALGR5330AASK |
| 47 | 640 | 1400 | 2100 | 65 | 247 | 55 | 1.9 | 145 | 6.3 | 30 | C20ALGR5470AASK |
| 68 | 640 | 1400 | 2100 | 75 | 247 | 60 | 1.6 | 160 | 5.3 | 30 | C20ALGR5680AASK |
| 100 | 640 | 1400 | 2100 | 95 | 247 | 60 | 1.3 | 170 | 4.4 | 30 | C20ALGR6100AASK |
| 120 | 640 | 1400 | 2100 | 95 | 247 | 60 | 1.3 | 175 | 4.1 | 30 | C20ALGR6120AASK |
| 150 | 640 | 1400 | 2100 | 116 | 247 | 60 | 1.2 | 180 | 3.8 | 30 | C20ALGR6150AASK |
| 10 | 780 | 1700 | 2500 | 65 | 117 | 30 | 3.0 | 130 | 14.1 | 70 | C20AQR5100AASK |
| 15 | 780 | 1700 | 2500 | 75 | 147 | 35 | 3.6 | 135 | 10.1 | 70 | C20AQR5150AASK |
| 22 | 780 | 1700 | 2500 | 75 | 147 | 40 | 2.7 | 140 | 8.9 | 70 | C20AQR5220AASK |
| 33 | 780 | 1700 | 2500 | 85 | 147 | 50 | 2.0 | 150 | 7.6 | 70 | C20AQR5330AASK |
| 47 | 780 | 1700 | 2500 | 75 | 247 | 55 | 1.8 | 160 | 5.2 | 70 | C20AQR5470AASK |
| 68 | 780 | 1700 | 2500 | 85 | 247 | 60 | 1.5 | 170 | 4.5 | 70 | C20AQR5680AASK |
| 100 | 780 | 1700 | 2500 | 95 | 247 | 60 | 1.3 | 180 | 4.0 | 70 | C20AQR6100AASK |
| 15 | 1000 | 2300 | 3300 | 75 | 147 | 33 | 2.5 | 150 | 9.2 | 85 | C20AZGR5150AASK |
| 20 | 1000 | 2300 | 3300 | 75 | 140 | 40 | 2.1 | 150 | 8.3 | 85 | C20AZGR5200ZBSK |
| 22 | 1000 | 2300 | 3300 | 75 | 147 | 35 | 2.0 | 155 | 8.0 | 85 | C20AZGR5220AASK |
| 33 | 1000 | 2300 | 3300 | 75 | 247 | 40 | 1.7 | 165 | 5.3 | 85 | C20AZGR5330AASK |
| 47 | 1000 | 2300 | 3300 | 85 | 247 | 45 | 1.4 | 170 | 4.7 | 85 | C20AZGR5470AASK |
| 68 | 1000 | 2300 | 3300 | 95 | 247 | 55 | 1.2 | 180 | 4.1 | 85 | C20AZGR5680AASK |
| Cap Value | VAC | Rated | Surge | D | H | Ripple Current | ESR | ESL | Thermal Res | dV/dt (V/μs) | Part Number |

¹ Maximum admissible RMS current $T_{HS} \leq 75^{\circ}\text{C}$.

Lifetime Expectancy/Failure Quota Graphs



V = Operating Voltage [VAC]
 V_{rms} = Rated Voltage [VAC]



Power Losses and Hot Spot Temperature Calculation

At each frequency, the Power Losses are the sum of:

1. Dielectric Power Losses

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

which can be alternatively calculated as

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

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

2. Joule Power Losses:

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

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

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

The Thermal Jump in the Hot Spot is:

$$\Delta T_{HS} = P_T * R_{th-hs}$$

The Hot Spot Temperature is:

$$T_{HS} = T_a + \Delta T_{HS}$$

Limits for the formulas

The limits listed below should not be exceeded:

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

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

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

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 case temperature (T_{CASE}) $\leq 70^\circ\text{C}$

Example of calculation

Part Number: C44PKGR6100AASJ

Rated $V_{RMS} = 440$ [V_{RMS}]

Rated $I_{RMS} = 30$ [A]

$R_s = 3.5$ [mΩ]

$R_{th} = 5.6$ [°C/W]

Fundamental Frequency $F_1 = 50$ [Hz]

Ripple Frequency $F_2 = 7000$ [Hz]

Fundamental Voltage $V_1 = 440$ [V~]

Ripple Current $I_2 = 27$ [A]

$T_a = 35^\circ\text{C}$

$I_1 = I(50) = 2 * \pi * 50 * 100 * 10^{-6} * 440 = 13.8$ [A]

$V_2 = V(7000) = [27 / (2 * \pi * 7000 * 100 * 10^{-6})] = 6.14$ [V]

$$I_{RMS} = \sqrt{(13.8^2 + 27^2)} = 30 \leq 30 \rightarrow \text{Admitted}$$

$$V_{RMS} = \sqrt{(440^2 + 6.1^2)} = 440 \leq 440 \rightarrow \text{Admitted}$$

$$P_D(50) = 2 * \pi * 50 * 100 * 10^{-6} * 440^2 * 2 * 10^{-4} = 1.22$$
 [W]

$$P_D(7000) = [27^2 / (2 * \pi * 7000 * 100 * 10^{-6})] * 2 * 10^{-4} = 0.03$$
 [W]

$$P_J(50) = 3.5 * 10^{-3} * [(2 * \pi * 50 * 100 * 10^{-6} * 440)^2] = 0.67$$
 [W]

$$P_J(7000) = 3.5 * 10^{-3} * 27^2 = 2.55$$
 [W]

$$P_T = 1.22 + 0.03 + 0.67 + 2.55 = 4.47$$
 [W]

$$\Delta T_{HS} = 5.6 * 4.47 = 25$$
 [°C]



$$T_{HS} = T_a + \Delta T_{HS}$$

$T_{HS} = 35 + 25 = 60$ [°C] → OK since hot spot temperature is less than maximum admitted

Expected Life @ $T_{HS} = 75^\circ\text{C}$ → 100,000 hours (see lifetime curve)

Expected Life @ $T_{HS} = 60^\circ\text{C}$ → 140,000 hours (see lifetime curve)

Marking

| | |
|---|---|
| KEMET | → Manufacturer Logo |
| C20AZGR5200ZBSK | → Part Number |
| 20 μ F \pm 10% | → Rated Capacitance and Tolerance |
| Urms=1000V~ | → Rated Voltage |
| Irms=50A 50/60Hz | → Rated Current and Frequencies |
| -25/70/56 | → Climatic Category |
| PROTECTED 1000AFC | → UL Approvals |
| SH NO PCBs  | → Self-Healing Dielectric. UL Logo. |
|  B4 11374275 | → CE Logo. Production Date and Batch Number |

Dissipation Factor

Dissipation factor is a complex function involved with the inefficiency of the capacitor. The $\text{tg}\delta$ may change up and down with increased temperature. For more information, please refer to Performance Characteristics.

Sealing

Hermetically Sealed Capacitors

When the temperature increases, the pressure inside the capacitor increases. If the internal pressure is high enough, it can cause a breach in the capacitor which can result in leakage, impregnation, filling fluid or moisture susceptibility.

Resin Encased/Wrap & Fill Capacitors

The resin seals on resin encased and wrap and fill capacitors will withstand short-term exposure to high humidity environments without degradation. Resins and plastic tapes will form a pseudo-impervious barrier to humidity and chemicals. These case materials are somewhat porous and through osmosis can cause contaminants to enter the capacitor. The second area of contaminated absorption is the lead-wire/resin interface. Since resins cannot bond 100% to tinned wires, there can be a path formed up to the lead wire into the capacitor section. Aqueous cleaning of circuit boards can aggravate this condition.

Barometric Pressure

The altitude at which hermetically sealed capacitors are operated controls the voltage rating of the capacitor. 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. This can be in the form of capacitance changes or dielectric arc-over as well as low insulation resistance. Heat transfer can also be affected by altitude operation. Heat generated in operation cannot be dissipated properly and can result in high RI2 losses and eventual failure.

Radiation

Radiation capabilities of capacitors must be taken into consideration. Electrical degradation in the form of dielectric embitterment can take place causing shorts or opens.

Environmental Compliance

As an environmentally conscious company, KEMET is working continuously with improvements concerning the environmental effects of both our capacitors and their production.

In Europe (RoHS Directive) and in some other geographical areas like China, legislation has been put in place to prevent the use of some hazardous materials, like Lead (Pb), in electronic equipment. All products in this catalog are produced to help our customers' obligations to guarantee their products to fulfill these legislative requirements. The only material of concern in our products has been Lead (Pb), which has been removed from all designs to fulfill the requirement of containing less than 0.1% of Lead in any homogeneous material.

KEMET will closely follow any changes in legislation world wide and makes any necessary changes in its products, whenever needed. Some customer segments like Medical, Military and Automotive Electronics may still require the use of Lead in electrode coatings. To clarify the situation and distinguish products from each other, a special symbol is used on the packaging labels for RoHS compatible capacitors.

Because of customer requirements there may appear additional markings like LF = Lead Free or LFW = Lead Free Wires on the label.

All KEMET power film products are RoHS Compliant.



RoHS Compliant

Materials & Environment

The selection of materials used by KEMET for the production of capacitors is the result of extensive experience and constant attention to environmental protection. KEMET selects its suppliers according to ISO 9001 standards and carries out statistical analysis on the materials purchased before acceptance. All materials are, to the company's present knowledge, non-toxic and free from Cadmium, Mercury, Chrome and compounds, PCB (Polychlorine Triphenyl), Bromide and Chlorine Dioxins Bromurate Chlorurate, CFC and HCFC and Asbestos.

Green Products

All KEMET power film products are ROHS Compliant.

Insulation Resistance

When the capacitor temperature increases, the insulation resistance decreases. This is due to increased electron activity. Low insulation resistance can also be the result of moisture trapped in the windings, caused by a prolonged exposure to excessive humidity.

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Prototype Sample Disclaimer

The Customer acknowledges the following limitations of the prototype samples:

- (1) Prototype samples are manufactured from preliminary designs and manufacturing processes; may not represent final designs; have not been released for commercial use and are not subject to the same quality control procedures applicable to released products.*
- (2) Prototype samples are not qualified parts and are provided “as-is” by KEMET Electronics Corporation, which specifically disclaims any and all warranties and guarantees, explicit or implied, including, without limitation, the warranties of merchantability and fitness for a particular purpose or use.*
- (3) Prototype samples are not intended for commercial use; are provided for engineering evaluation only and are not recommended for use in the Customer’s production line.*
- (4) The Customer assumes the risk of any and all uses that the Customer makes of the prototype samples.*

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