

# C44P/C20A, 330 – 1,000 VAC/700 – 2,300 VDC, for PFC & AC Filter

## Overview

The C44P/C20A series is a polypropylene metallized film capacitor with a cylindrical, aluminium can-type design filled with oil. It uses screw terminals, plastic insulator, and an 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

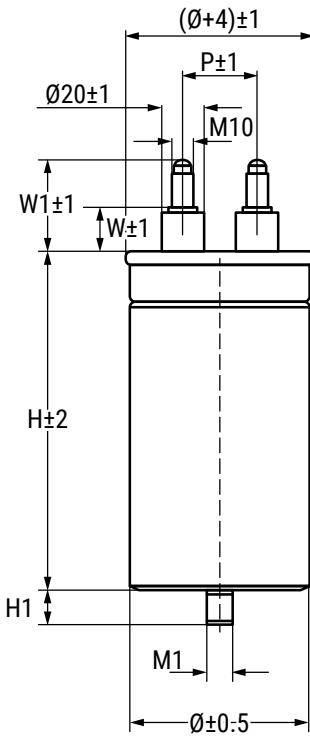


## Part Number System

| C                                     | 44   | P                               | L                               | 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 = 330 – 440 VAC<br>20 = 550 – 1,000 VAC | AC Filter<br>P = C44<br>A = C20 | For C44P:<br>L = 330<br>K = 440 | For C20A:<br>K = 550<br>L = 640<br>Q = 780<br>Z = 1,000 | G = M12 bolt   | R = Male<br>M10       | Digits nine, ten, and eleven indicate the first three digits of capacitance value. Digit 8 indicates the number of zeros to be added. |   |   |               | A = Standard<br>Z = Special |           | J = 5%<br>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<br>UL810 approved                      |
| Dielectric  | Polypropylene film<br>Non-inductive type winding |
| Climatic Category   | 25/70/56 – IEC 60068-1                           |
| Maximum hot spot temperature                                      | +80°C  |
| Endurance Test IEC 61071  | +70°C at 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<br>On 30 days/year permanently 100%.<br>On other days occasionally 90%.<br>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 at $V_{RMS}$ 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)<br>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  |

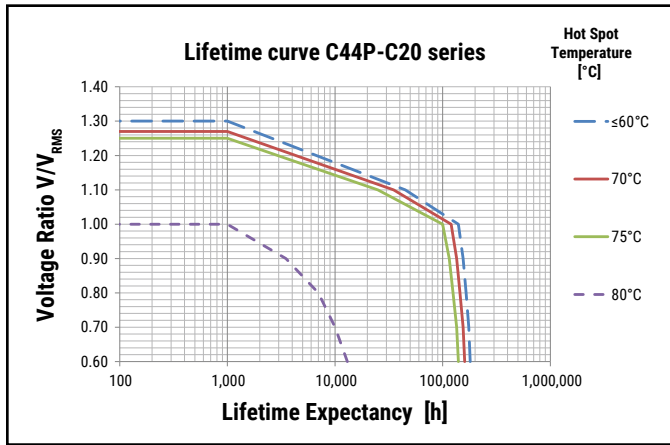
*NOTICE: Care should be taken to ensure that there still is electrical clearance of 15 mm between terminations and other live or earthed parts above the capacitor, in case of safety device activation.*

**Table 1 – Ratings & Part Number Reference**

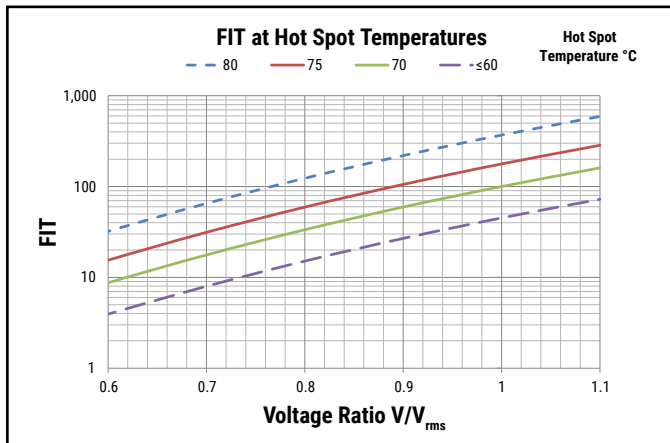
| Cap Value (µF) | V <sub>rms</sub> | Rated Voltage | Surge Voltage | Maximum Dimensions (mm) |     | Ripple Current               | ESR         | ESL  | Thermal Res | dV/dt (V/µs) | Part Number     |
|----------------|------------------|---------------|---------------|-------------------------|-----|------------------------------|-------------|------|-------------|--------------|-----------------|
|                | VAC              | VDC           | VDC           | D                       | H   | 10 kHz 40°C (A) <sup>1</sup> | 10 kHz (mΩ) | (nH) | (°C/W)      |              |                 |
| 100            | 330              | 700           | 1,050         | 65                      | 117 | 25                           | 3.0         | 115  | 8.5         | 12.5         | C44PLGR6100AASJ |
| 200            | 330              | 700           | 1,050         | 65                      | 147 | 43                           | 2.8         | 140  | 5.4         | 12.5         | C44PLGR6200ZASJ |
| 300            | 330              | 700           | 1,050         | 65                      | 247 | 50                           | 2.3         | 150  | 3.6         | 12.5         | C44PLGR6300ZASJ |
| 300            | 330              | 700           | 1,050         | 75                      | 197 | 55                           | 1.4         | 160  | 4.2         | 12.5         | C44PLGR6300AASJ |
| 400            | 330              | 700           | 1,050         | 65                      | 247 | 55                           | 2.0         | 160  | 3.1         | 12.5         | C44PLGR6400ZASJ |
| 500            | 330              | 700           | 1,050         | 75                      | 247 | 58                           | 1.8         | 170  | 2.9         | 12.5         | C44PLGR6500ZASJ |
| 500            | 330              | 700           | 1,050         | 85                      | 197 | 63                           | 1.2         | 160  | 3.4         | 12.5         | C44PLGR6500ZBSJ |
| 600            | 330              | 700           | 1,050         | 85                      | 247 | 65                           | 1.6         | 180  | 2.9         | 12.5         | C44PLGR6600AASJ |
| 600            | 330              | 700           | 1,050         | 85                      | 280 | 75                           | 1.1         | 210  | 2.4         | 12.5         | C44PLGR6600ZASJ |
| 100            | 440              | 1,000         | 1,500         | 75                      | 147 | 30                           | 3.5         | 145  | 5.6         | 20           | C44PKGR6100AASJ |
| 100            | 440              | 1,000         | 1,500         | 65                      | 197 | 50                           | 2.3         | 135  | 4.4         | 20           | C44PKGR6100ZASJ |
| 120            | 440              | 1,000         | 1,500         | 65                      | 197 | 50                           | 1.8         | 165  | 4.2         | 20           | C44PKGR6120AASJ |
| 133            | 440              | 1,000         | 1,500         | 65                      | 247 | 40                           | 3.0         | 155  | 3.7         | 20           | C44PKGR6133AASJ |
| 133            | 440              | 1,000         | 1,500         | 75                      | 197 | 50                           | 1.6         | 170  | 4.0         | 20           | C44PKGR6133ZASJ |
| 150            | 440              | 1,000         | 1,500         | 65                      | 247 | 45                           | 2.8         | 160  | 3.5         | 20           | C44PKGR6150AASJ |
| 200            | 440              | 1,000         | 1,500         | 75                      | 247 | 55                           | 2.4         | 175  | 3.2         | 20           | C44PKGR6200AASJ |
| 250            | 440              | 1,000         | 1,500         | 85                      | 247 | 60                           | 2.0         | 175  | 3.4         | 20           | C44PKGR6250AASJ |
| 300            | 440              | 1,000         | 1,500         | 85                      | 247 | 60                           | 1.9         | 180  | 2.7         | 20           | C44PKGR6300AASJ |
| 400            | 440              | 1,000         | 1,500         | 95                      | 247 | 65                           | 1.7         | 200  | 2.5         | 20           | C44PKGR6400AASK |
| 22             | 550              | 1,280         | 1,900         | 65                      | 117 | 40                           | 2.1         | 125  | 13.3        | 30           | C20AKGR5220AASK |
| 33             | 550              | 1,280         | 1,900         | 75                      | 117 | 45                           | 1.6         | 130  | 10.6        | 30           | C20AKGR5330AASK |
| 47             | 550              | 1,280         | 1,900         | 65                      | 197 | 50                           | 1.4         | 135  | 7.8         | 30           | C20AKGR5470AASK |
| 68             | 550              | 1,280         | 1,900         | 65                      | 247 | 55                           | 1.7         | 145  | 6.2         | 30           | C20AKGR5680AASK |
| 100            | 550              | 1,280         | 1,900         | 75                      | 247 | 60                           | 1.4         | 160  | 5.2         | 30           | C20AKGR6100AASK |
| 120            | 550              | 1,280         | 1,900         | 85                      | 247 | 60                           | 1.3         | 165  | 4.6         | 30           | C20AKGR6120AASK |
| 150            | 550              | 1,280         | 1,900         | 95                      | 247 | 60                           | 1.2         | 180  | 4.4         | 30           | C20AKGR6150AASK |
| 15             | 640              | 1,400         | 2,100         | 65                      | 117 | 35                           | 2.5         | 120  | 14.1        | 30           | C20ALGR5150AASK |
| 22             | 640              | 1,400         | 2,100         | 65                      | 147 | 35                           | 3.0         | 125  | 10.9        | 30           | C20ALGR5220AASK |
| 33             | 640              | 1,400         | 2,100         | 75                      | 147 | 40                           | 2.2         | 135  | 9.1         | 30           | C20ALGR5330AASK |
| 47             | 640              | 1,400         | 2,100         | 65                      | 247 | 55                           | 1.9         | 145  | 6.3         | 30           | C20ALGR5470AASK |
| 68             | 640              | 1,400         | 2,100         | 75                      | 247 | 60                           | 1.6         | 160  | 5.3         | 30           | C20ALGR5680AASK |
| 100            | 640              | 1,400         | 2,100         | 95                      | 247 | 60                           | 1.3         | 170  | 4.4         | 30           | C20ALGR6100AASK |
| 120            | 640              | 1,400         | 2,100         | 95                      | 247 | 60                           | 1.3         | 175  | 4.1         | 30           | C20ALGR6120AASK |
| 150            | 640              | 1,400         | 2,100         | 116                     | 247 | 60                           | 1.2         | 180  | 3.8         | 30           | C20ALGR6150AASK |
| 10             | 780              | 1,700         | 2,500         | 65                      | 117 | 30                           | 3.0         | 130  | 14.1        | 70           | C20AQR5100AASK  |
| 15             | 780              | 1,700         | 2,500         | 75                      | 147 | 35                           | 3.6         | 135  | 10.1        | 70           | C20AQR5150AASK  |
| 22             | 780              | 1,700         | 2,500         | 75                      | 147 | 40                           | 2.7         | 140  | 8.9         | 70           | C20AQR5220AASK  |
| 33             | 780              | 1,700         | 2,500         | 85                      | 147 | 50                           | 2.0         | 150  | 7.6         | 70           | C20AQR5330AASK  |
| 47             | 780              | 1,700         | 2,500         | 75                      | 247 | 55                           | 1.8         | 160  | 5.2         | 70           | C20AQR5470AASK  |
| 68             | 780              | 1,700         | 2,500         | 85                      | 247 | 60                           | 1.5         | 170  | 4.5         | 70           | C20AQR5680AASK  |
| 100            | 780              | 1,700         | 2,500         | 95                      | 247 | 60                           | 1.3         | 180  | 4.0         | 70           | C20AQR6100AASK  |
| 15             | 1,000            | 2,300         | 3,300         | 75                      | 147 | 33                           | 2.5         | 150  | 9.2         | 85           | C20AZGR5150AASK |
| 20             | 1,000            | 2,300         | 3,300         | 75                      | 140 | 40                           | 2.1         | 150  | 8.3         | 85           | C20AZGR5200ZBSK |
| 22             | 1,000            | 2,300         | 3,300         | 75                      | 147 | 35                           | 2.0         | 155  | 8.0         | 85           | C20AZGR5220AASK |
| 33             | 1,000            | 2,300         | 3,300         | 75                      | 247 | 40                           | 1.7         | 165  | 5.3         | 85           | C20AZGR5330AASK |
| 47             | 1,000            | 2,300         | 3,300         | 85                      | 247 | 45                           | 1.4         | 170  | 4.7         | 85           | C20AZGR5470AASK |
| 68             | 1,000            | 2,300         | 3,300         | 95                      | 247 | 55                           | 1.2         | 180  | 4.1         | 85           | C20AZGR5680AASK |
| Cap Value      | VAC              | Rated Voltage | Surge Voltage | D                       | H   | Ripple Current               | ESR         | ESL  | Thermal Res | dV/dt (V/µs) | Part Number     |

<sup>1</sup> 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

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

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:

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

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:

- $\sqrt{\sum_i V(f_i)^2} \leq V_{RMS}$
- $\sqrt{\sum_i I(f_i)^2} \leq I_{RMS}$

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

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 ( $T_{CASE}$ ) ≤ 70°C

### Example of calculation

Part Number: C44PKGR6100AASJ

Rated  $V_{RMS} = 440$  [V<sub>RMS</sub>]

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]

$T_a = 35$ °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]

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

$$V_{RMS} = \sqrt{(440^2 + 6.14^2)} = 440 \leq 440 \rightarrow \text{Admitted}$$

$$P_D(50) = 2 * \pi * 50 * 100 * 10^{-6} * 440^2 * 2 * 10^{-4} = 1.22$$
 [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 at  $T_{HS} = 75$ °C → 100,000 hours (see lifetime curve)

Expected Life at  $T_{HS} = 60$ °C → 140,000 hours (see lifetime curve)

## Marking

|  |                                   |
|--|-----------------------------------|
| KEMET  | Manufacturer Logo                 |
| C20AZGR5200ZBSK  | Part Number                       |
| 20 $\mu$ 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  | Production Date and Batch Number. |

## 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.

## Dissipation Factor

Dissipation factor is a complex function involved with capacitor inefficiency. The  $\tan\delta$  may vary up and down with increased temperature. For more information, refer to Performance Characteristics.

## 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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