# C4AF, Radial, 2 or 4 Leads, 250 – 500 VAC, for Harsh Environment AC Filtering (Automotive Grade)

KEMET a YAGEO company

## Overview

The C4AF capacitor is a polypropylene metallized film capacitor with a rectangular, plastic box-type design (white or grey in color) filled with resin, and uses 2 or 4 tinned wires. These capacitors are intended to withstand harsh environmental conditions.

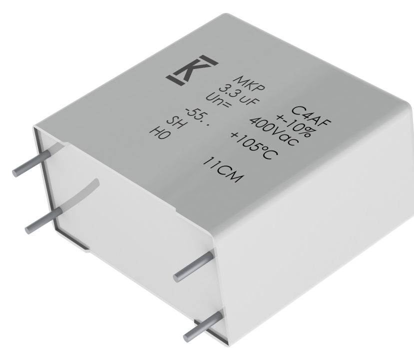
Automotive grade devices meet the demanding Automotive Electronics Council's AEC–Q200 qualification requirements.

## Applications

Typical applications include AC and harmonic filtering in UPS systems, motor drives, renewable energy, and automotive systems.

## Benefits

- Self-healing
- Low loss
- High ripple current
- High contact reliability
- Optimized AC voltage performance
- Suitable for high frequency applications
- Able to withstand harsh environmental conditions
- Automotive grades (AEC–Q200)



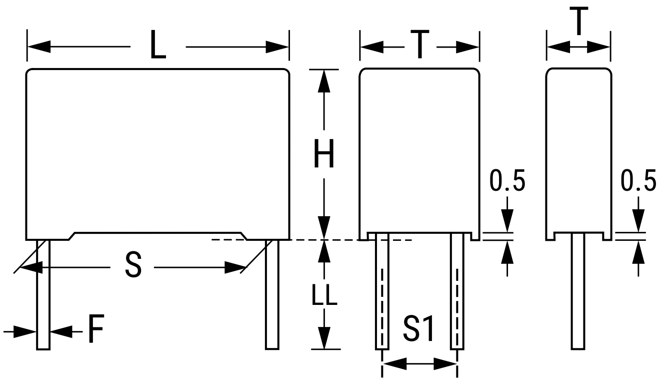

Click image above for interactive 3D content

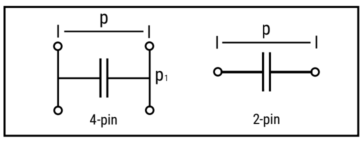
*Open PDF in Adobe Reader for full functionality*

## Part Number System

| C4 | A | F | 1 | B | W | 5330 | T | 3 | N | J |
|---|---|---|---|---|---|---|---|---|---|---|
| Series | Type | Application | Rated Voltage (VAC) | Case | Terminals Code | Capacitance Code (pF) | Release | Lead Diameter (mm) | Size Code: B x H x L (mm) | Tolerance |
| C4 = MKP Power Capacitors | A = Box, wire terminals | F = AC filtering | 1 = 250<br>9 = 310<br>7 = 350<br>3 = 400<br>A = 500 | B, E = Box plastic case | U = 2 pins<br>W = 4 pins | Digits 2 – 4 indicate the first three digits of the capacitance value. First digit indicates the number of zeros to be added. | A = THB 500 hours 85°C/85% R.H. (Not for new design)<br>T = THB 1,000 hours 85°C/85% R.H. | 1 = 0.8<br>3 = 1.2 | Digit 6 = B<br>W = 11 x 20 x 31.5<br>X = 13 x 25 x 31.5<br>Y = 14 x 28 x 31.5<br>1 = 19 x 29 x 31.5<br>2 = 22 x 37 x 31.5<br>F = 20 x 40 x 42<br>J = 28 x 37 x 42<br>L = 30 x 45 x 42<br>M = 3 0 x 45 x 57.5<br>N = 35 x 50 x 57.5<br><br>Digit 6 = E<br>A = 45 x 56 x 57.5<br>B = 45 x 65 x 57.5 | J = 5%<br>K = 10% |

## Dimensions – Millimeters




| Size Code | | S | | S1 | | T | | H | | L | | LL | | F | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Digit 6 | Digit 14 | Nominal | Tolerance | Nominal | Tolerance | Nominal | Tolerance | Nominal | Tolerance | Nominal | Tolerance | Nominal | Tolerance | Nominal | Tolerance |
| B | W | 27.5 | ±0.4 | - | - | 11.0 | +0.3/−0.7 | 20.0 | +0.2/−0.7 | 31.5 | +0.5/−0.7 | 6 | +0/−2 | 0.8 | ±0.05 |
| B | X | 27.5 | ±0.4 | - | - | 13.0 | +0.3/−0.7 | 25.0 | +0.2/−0.7 | 31.5 | +0.5/−0.7 | 6 | +0/−2 | 0.8 | ±0.05 |
| B | Y | 27.5 | ±0.4 | - | - | 14.0 | +0.3/−0.7 | 28.0 | +0.2/−0.7 | 31.5 | +0.5/−0.7 | 6 | +0/−2 | 0.8 | ±0.05 |
| B | 1 | 27.5 | ±0.4 | - | - | 19.0 | +0.3/−0.7 | 29.0 | +0.2/−0.7 | 31.5 | +0.5/−0.7 | 6 | +0/−2 | 0.8 | ±0.05 |
| B | 2 | 27.5 | ±0.4 | - | - | 22.0 | +0.3/−0.7 | 37.0 | +0.2/−0.7 | 31.5 | +0.5/−0.7 | 6 | +0/−2 | 0.8 | ±0.05 |
| B | F | 37.5 | ±0.4 | 5.1/10.2 | ±0.4 | 20.0 | +0.4/−0.7 | 40.0 | +0.2/−0.7 | 42.0 | +0.6/−0.7 | 6 | +0/−2 | 1.2 | ±0.05 |
| B | J | 37.5 | ±0.4 | 10.2 | ±0.4 | 28.0 | +0.4/−0.7 | 37.0 | +0.2/−0.7 | 42.0 | +0.6/−0.7 | 6 | +0/−2 | 1.2 | ±0.05 |
| B | L | 37.5 | ±0.4 | 20.3 | ±0.4 | 30.0 | +0.4/−0.7 | 45.0 | +0.2/−0.7 | 42.0 | +0.6/−0.7 | 6 | +0/−2 | 1.2 | ±0.05 |
| B | O | 37.5 | ±0.4 | 20.3 | ±0.4 | 35.0 | +0.4/−0.7 | 50.0 | +0.2/−0.7 | 42.0 | +0.6/−0.7 | 6 | +0/−2 | 1.2 | ±0.05 |
| B | M | 52.5 | ±0.4 | 20.3 | ±0.4 | 30.0 | +0.5/−0.7 | 45.0 | +0.3/−0.7 | 57.5 | +0.6/−0.7 | 6 | +0/−2 | 1.2 | ±0.05 |
| B | N | 52.5 | ±0.4 | 20.3 | ±0.4 | 35.0 | +0.5/−0.7 | 50.0 | +0.3/−0.7 | 57.5 | +0.8/−0.7 | 6 | +0/−2 | 1.2 | ±0.05 |
| E | A | 52.5 | ±0.4 | 20.3 | ±0.4 | 45.0 | +0.5/−0.7 | 56.0 | +0.3/−0.7 | 57.5 | +0.8/−0.7 | 6 | +0/−2 | 1.2 | ±0.05 |
| E | B | 52.5 | ±0.4 | 20.3 | ±0.4 | 45.0 | +0.5/−0.7 | 65.0 | +0.3/−0.7 | 57.5 | +0.8/−0.7 | 6 | +0/−2 | 1.2 | ±0.05 |

## Qualification

| | |
|---|---|
| Reference Standards | IEC 61071, EN 61071, VDE0560 |
| Climatic Category | 55/105/56 according to IEC 60068−1 |

*Automotive grade products meet or exceed the requirements outlined by the Automotive Electronics Council. Details regarding test methods and conditions are referenced in document AEC−Q200, Stress Test Qualification for Passive Components. For additional information regarding the Automotive Electronics Council and AEC−Q200, please visit their website at www.aecouncil.com.*

## General Technical Data

| | |
|---|---|
| Dielectric | Polypropylene metallized film, non-inductive type, self-healing property |
| Application | AC Filtering (250 VAC, 310 VAC, 350 VAC, 400 VAC, 500 VAC)<br>250 VAC rating reccomended ONLY for controlled output filtering |
| Special Features | AEC-Q200 qualified |
| Climatic Category | 55/105/56 IEC 60068-1 |
| Maximum Operating Temperature | 105 °C |
| Lower Operating Temperature | −55°C |
| Standard | IEC 61071, EN 61071, VDE0560, AEC-Q200 |
| Protection | Solvent resistant plastic case UL 94 V-0 compliant<br>Thermosetting resin sealing UL 94 V-0 compliant |
| Installation | Any position |
| Leads | Tinned wires - standard lead wire length 6 (+0/−2) mm |
| Packaging | Packed in cardboard trays with protection for the terminals |
| RoHS Compliance | Compliant with Directive 2002/95/EC and Directive 2011/65/EU of the European Parliament and of the Council on 8 June 2011, including Commission Delegated Directive (EU) 2015/863 amending Annex II to Directive 2011/65/EU. |

## Electrical Characteristics

| | |
|---|---|
| Rated Capacitance Range | 1 to 62 µF |
| Rated Voltage (VNAC) Range | 250 to 500 VAC (50/60 Hz) |
| Capacitance Tolerance | ±5% (J) or ±10% (K) measured at T = +25°C ±5°C |
| Dissipation Factor PP Maximum (tgδ0) | ≤ 0.0007 with T = 25°C ±5°C |
| Surge Voltage | 1.5 * $V_{NDC}$ for maximum 10 times in lifetime at T = 25°C ±5°C |
| Overvoltage (IEC 61071) | 1.15 * $V_{NDC}$ for maximum 30 minutes, once per day<br>1.3 * $V_{NDC}$ for maximum 1 minute, once per day |
| Peak Non-Repetitive Current | 1.5 * $I_{PKR}$, for maximum 1,000 times in lifetime |
| Insulation Resistance | IR x C ≥ 30,000 seconds at 100 VDC 1 minute at T = +25°C, ±5°C |
| Capacitance Deviation in the operating temperature range −55 to 105°C | ±2.5% maximum on capacitance value measured at T = +25°C, ±5°C |
| Temperature Storage | −40 to +80°C |
| Storage time | ≤ 36 months from the date marked on the label glued to the package |
| Permissible Relative Humidity - Storage | Annual average ≤ 70%, 85% on 30 days/year randomly distributed throughout year. Dewing not admissible. |

## Life Expectancy

| | |
|---|---|
| Life Expectancy | ≥ 60,000 hours at $V_{NAC}$ and $T_{HS}$ = +85°C |
| Capacitance Drop at End of Life | −5% (typical) |
| Failure Rate | See Life Expectancy/Failure Quota Graphs |

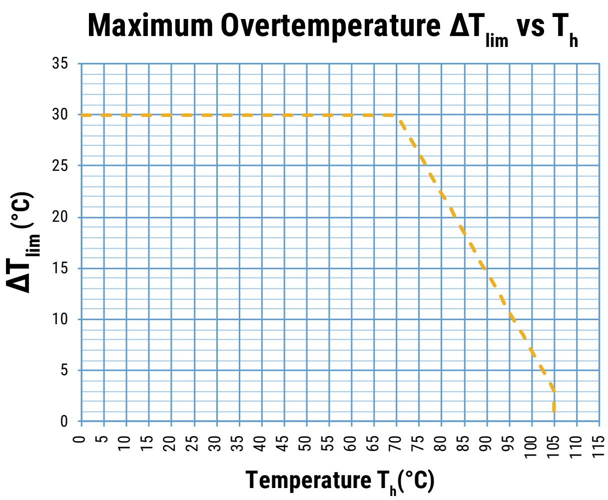
## Test Method

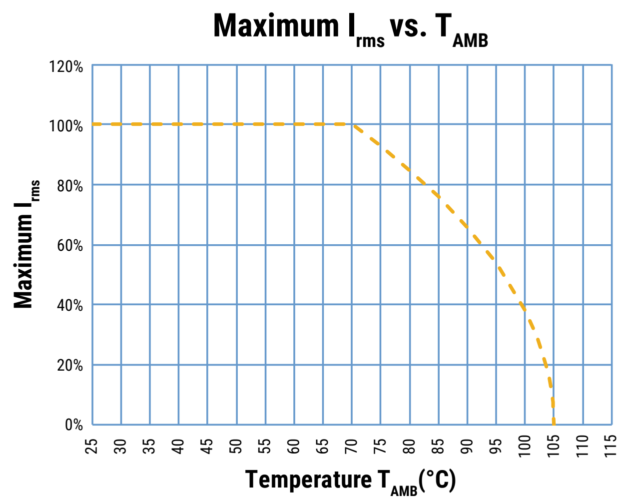
| | |
|---|---|
| Peak Non-Repetitive Maximum Current | $I_{PKR}$ x 1.5 |
| Test Voltage Terminal to Terminal $V_{TT}$ | 1.5 * $V_{NDC}$ for 10 seconds |
| Test Voltage Terminal to Case $V_{TC}$ | 2 k VAC – 50/60 Hz for 60 seconds |
| Endurance Test | 500 hours + 500 hours at 1.25 x rated voltage at 85°C |
| | 500 hours + 500 hours at 1.25 x operative voltage at 105°C |
| Damp Heat | IEC 60068-2-78 |
| THB Test 85/85 with Voltage<br>Release "A": 500 hours<br>Release "T": 1,000 hours | Test Voltages: |
| | 250 and 310 $V_{NA}$C version: 240 VAC<br>350 and 400 $V_{NAC}$ version: 310 VAC<br>500 $V_{NAC}$ version: 410 VAC |
| | Performance: |
| | \|ΔC/C\| <10%<br>\|ΔTg\| < 3*10-3 at 1 kHz Release "A"<br>\|ΔTg\| < 5*10-3 at 1 kHz Release "T"<br>IR ≥ 50% initial limit |
| Change of Temperature | IEC 60068–2–14 |

## Operative Voltage Derating

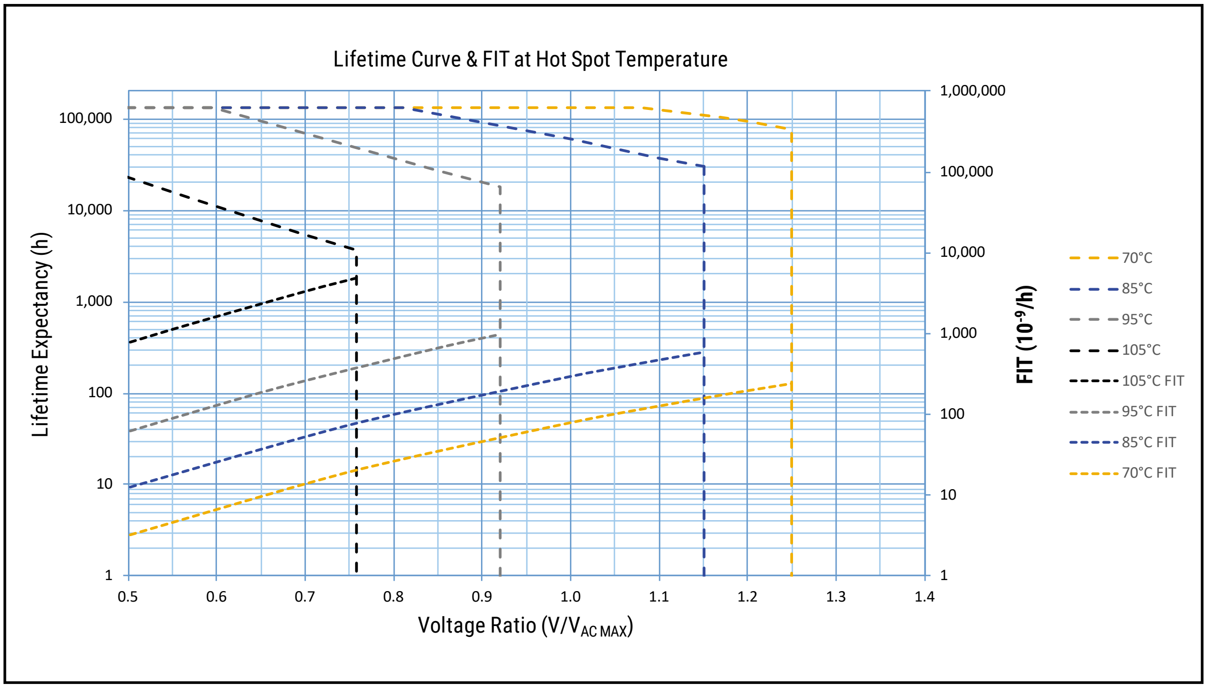
| | Voltage (VAC) | | | | |
|---|---|---|---|---|---|
| Operating Voltage | 250 | 310 | 350 | 400 | 500 |
| Rated Voltage at 85°C ($T_{HS}$) | 250 | 310 | 350 | 400 | 500 |
| Operating Voltage at 105°C ($T_{HS}$) | 175 | 217 | 245 | 280 | 350 |

KEMET defines maximum ripple current, based on hot spot/ambient self-heating temperature. For C4AF, maximum allowed self-heating is 30°C, with ambient temperature up to 70°C. DT is reduced linearly with increasing ambient temperature, down to 3°C (caused by the fundamental frequency current, no ripple current) at 105°C:



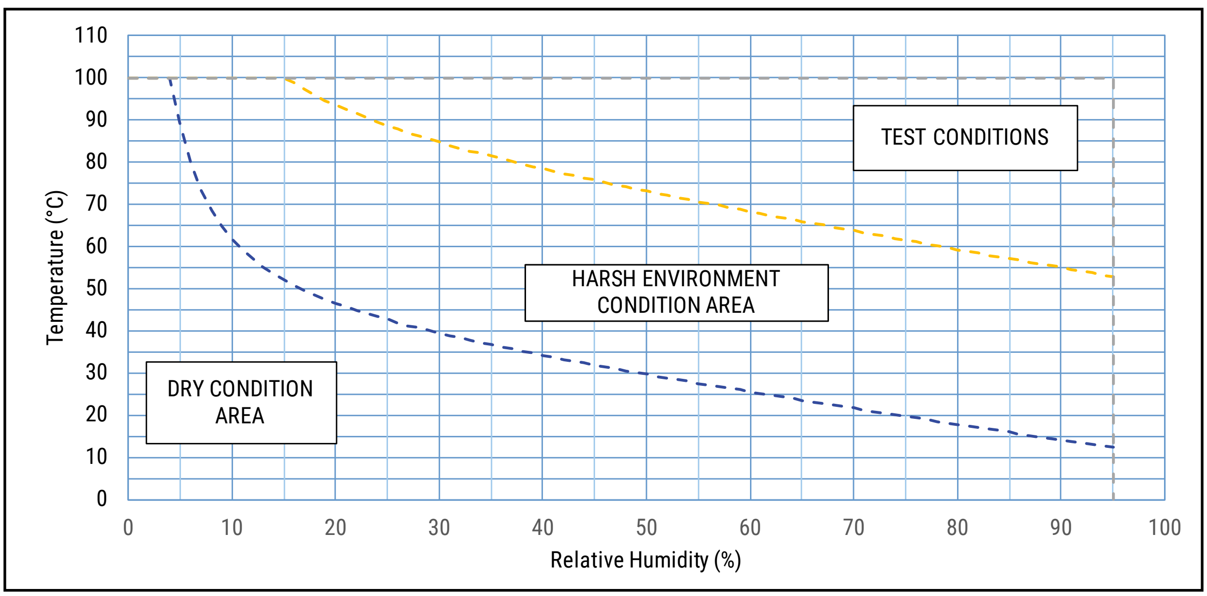



## Life Expectancy/Failure Quota* Graphs




** Evaluated considering an environmental conditions as dry condition.*

### Environmental Condition Reference




*The dry condition area is defined as the range of temperature and relative humidity to validate the life time and $V_{rms}/I_{rms}$ graphs.*
*The separation line between harsh environment conditions and test conditions area is calculated for a life time of one year at operating voltage.*

## Power Losses & Hot Spot Temperature Calculation

At each frequency, the power lossess 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:

$$tgd_0 = 7 * 10^{-4} \text{ (maximum value)}$$

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:

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

The thermal jump in the hot spot is:

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

The hot spot temperature is:

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

## Power Losses & Hot Spot Temperature Calculation cont.

### Limits for the formulas

The limits listed below should not be exceeded:

$$1.\quad \sqrt{\sum_i V(f_i)^2} \leq VAC_{MAX}$$

$$2.\quad \sqrt{\sum_i I(f_i)^2} \leq I_{RMS_{MAX}}$$

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

where Ta 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).

### Example of calculation

| | |
|---|---|
| P/N: C4AF9BW5100T3JK | $P_D(50) = 2 * \pi * 50 * 10 * 10^{-6} * 310^2 * 7 * 10^{-4} = 0.211$ [W] |
| Rated $V_{RMS} = 310$ [$V_{RMS}$] | $P_D(15{,}000) = [7.9^2/(2 * \pi * 15{,}000 * 10 * 10^{-6})] * 7 * 10^{-4} = 0.0463$ [W] |
| Rated $I_{RMS\ MAX} = 16.6$ [A] | $P_J(50) = 4.2 * 10^{-3} * [(2 * \pi * 50 * 10 * 10^{-6} * 310)^2] = 0.00398$ [W] |
| $R_s = 4.2$[mΩ] | $P_J(15000) = 4.2 * 10^{-3} * 7.9^2 = 0.262$ [W] |
| $R_{th} = 18$ [°C/W] | $P_T = 0.211+0.0463+0.00398+0.262 = 0.523$ [W] |
| Fundamental Frequency $F_1 = 50$ [Hz] | $\Delta T_{HS} = 18 * 0.523 = 9.4$ [°C] |
| Ripple Frequency $F_2 = 15{,}000$ [Hz] | $T_{HS} = Ta + \Delta T_{HS}$ |
| Fundamental Voltage $V_1 = 310$ [V~] | $T_{HS} = 75 + 9.4 = 84.4$ [°C] » OK since hot spot temperature is less than maximum admitted |
| Ripple Current $I_2 = 7.9$ [A] | Expected Life at $T_{HS} = 85$°C » 60,000 hours (see lifetime curve) |
| $T_a = 75$°C | |
| $I_1 = I(50) = 2 * \pi * 50 * 10 * 10^{-6} * 310 = 0.973$ [A] | |
| $V_2 = V(15{,}000) = [7.9/(2 * \pi * 15{,}000 * 10 * 10^{-6})] = 8.4$ [V] | |

## 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 tgδ 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 $RI^2$ losses and eventual failure can result.

## Table 1 – Ratings & Part Number Reference

| Cap Value (µF) | $V_{NAC}$ | $V_{NDC}$ | Dimensions (mm) | | | | | dV/dt | Ipkr | ESL | $R_S$ | $I_{rms}$ maximum (*) | Rth (HS/Amb) | Packaging Quantity | PART NUMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | T | H | L | S | S1 | V/µs | Apk | nH | mΩ | $A_{rms}$ | (°C/W) | | |
| $V_{NAC}$ at 85°C = 250 VAC; $V_{OPAC}$ at 105°C = 175 VAC | | | | | | | | | | | | | | | |
| 1 | 250 | 500 | 11 | 20 | 31.5 | 27.5 | \ | 38 | 38 | 17 | 22 | 4.5 | 44 | 256 | C4AF1BU4100T1WK |
| 1.5 | 250 | 500 | 11 | 20 | 31.5 | 27.5 | \ | 38 | 56 | 17 | 15.6 | 5.4 | 44 | 256 | C4AF1BU4150T1WK |
| 2.2 | 250 | 500 | 13 | 25 | 31.5 | 27.5 | \ | 38 | 83 | 22 | 11.8 | 6.9 | 36 | 234 | C4AF1BU4220T1XK |
| 3.3 | 250 | 500 | 19 | 29 | 31.5 | 27.5 | \ | 38 | 125 | 25 | 9 | 8.9 | 29 | 72 | C4AF1BU4330T11K |
| 4.7 | 250 | 500 | 19 | 29 | 31.5 | 27.5 | \ | 38 | 179 | 25 | 7.4 | 10 | 29 | 72 | C4AF1BU4470T11K |
| 6.8 | 250 | 500 | 22 | 37 | 31.5 | 27.5 | \ | 38 | 259 | 28 | 6.6 | 12.1 | 23 | 64 | C4AF1BU4680T12K |
| 7.5 | 250 | 500 | 22 | 37 | 31.5 | 27.5 | \ | 38 | 285 | 28 | 6.4 | 12.3 | 23 | 64 | C4AF1BU4750T12K |
| 10 | 250 | 500 | 20 | 40 | 42 | 37.5 | 10.2 | 27 | 272 | 12 | 4.8 | 15.2 | 20 | 58 | C4AF1BW5100T3FK |
| 15 | 250 | 500 | 30 | 45 | 42 | 37.5 | 20.3 | 27 | 400 | 13 | 3.4 | 20.8 | 15 | 36 | C4AF1BW5150T3LK |
| 22 | 250 | 500 | 35 | 50 | 42 | 37.5 | 20.3 | 27 | 587 | 14 | 2.6 | 25.4 | 13 | 30 | C4AF1BW5220T3OK |
| 24.5 | 250 | 500 | 35 | 50 | 42 | 37.5 | 20.3 | 27 | 654 | 14 | 2.4 | 26.3 | 13 | 30 | C4AF1BW5245T3OK |
| 33 | 250 | 500 | 35 | 50 | 57.5 | 52.5 | 20.3 | 18 | 587 | 15 | 3.4 | 26.1 | 10 | 23 | C4AF1BW5330T3NK |
| 47 | 250 | 500 | 45 | 56 | 57.5 | 52.5 | 20.3 | 18 | 837 | 17 | 2.8 | 32 | 8 | 18 | C4AF1EW5470T3AK |
| 55 | 250 | 500 | 45 | 56 | 57.5 | 52.5 | 20.3 | 18 | 960 | 17 | 2.4 | 33.9 | 8 | 18 | C4AF1EW5550T3AK |
| 62 | 250 | 500 | 45 | 65 | 57.5 | 52.5 | 20.3 | 18 | 1116 | 19 | 2.4 | 36.5 | 7 | 18 | C4AF1EW5620T3BK |
| $V_{NAC}$ at 85°C = 310 VAC; $V_{OPAC}$ at 105°C = 215 VAC | | | | | | | | | | | | | | | |
| 1 | 310 | 630 | 11 | 20 | 31.5 | 27.5 | \ | 45 | 45 | 17 | 20.8 | 4.5 | 44 | 256 | C4AF9BU4100T1WK |
| 1.5 | 310 | 630 | 13 | 25 | 31.5 | 27.5 | \ | 45 | 68 | 22 | 15 | 6 | 36 | 234 | C4AF9BU4150T1XK |
| 2.2 | 310 | 630 | 14 | 28 | 31.5 | 27.5 | \ | 45 | 99 | 24 | 11.4 | 7.2 | 33 | 96 | C4AF9BU4220T1YK |
| 3.3 | 310 | 630 | 19 | 29 | 31.5 | 27.5 | \ | 45 | 149 | 25 | 8.6 | 9 | 29 | 72 | C4AF9BU4330T11K |
| 4.7 | 310 | 630 | 22 | 37 | 31.5 | 27.5 | \ | 45 | 212 | 28 | 7.6 | 11 | 23 | 64 | C4AF9BU4470T12K |
| 6.8 | 310 | 630 | 20 | 40 | 42 | 37.5 | 10.2 | 32 | 218 | 12 | 5.8 | 13.5 | 20 | 58 | C4AF9BW4680T3FK |
| 10 | 310 | 630 | 28 | 37 | 42 | 37.5 | 10.2 | 32 | 320 | 10 | 4.2 | 16.6 | 18 | 36 | C4AF9BW5100T3JK |
| 15 | 310 | 630 | 35 | 50 | 42 | 37.5 | 20.3 | 32 | 480 | 14 | 3 | 23.1 | 13 | 30 | C4AF9BW5150T3OK |
| 17 | 310 | 630 | 35 | 50 | 42 | 37.5 | 20.3 | 32 | 560 | 14 | 2.8 | 23.8 | 13 | 30 | C4AF9BW5170T3OK |
| 22 | 310 | 630 | 35 | 50 | 57.5 | 52.5 | 20.3 | 21 | 462 | 15 | 4.2 | 23.2 | 10 | 23 | C4AF9BW5220T3NK |
| 33 | 310 | 630 | 45 | 56 | 57.5 | 52.5 | 20.3 | 21 | 693 | 17 | 3 | 30.3 | 8 | 18 | C4AF9EW5330T3AK |
| 37.5 | 310 | 630 | 45 | 56 | 57.5 | 52.5 | 20.3 | 21 | 788 | 17 | 2.8 | 30.9 | 8 | 18 | C4AF9EW5375T3AK |
| 42 | 310 | 630 | 45 | 65 | 57.5 | 52.5 | 20.3 | 21 | 882 | 19 | 2.6 | 34.5 | 7 | 18 | C4AF9EW5420T3BK |
| Cap Value (µF) | $V_{NAC}$ | $V_{NDC}$ | T | H | L | S | S1 | V/µs | Apk | nH | mΩ | $A_{rms}$ | (°C/W) | Packaging Quantity | PART NUMBER |
| | | | Dimensions (mm) | | | | | dV/dt | Ipkr | ESL | $R_S$ | $I_{rms}$ maximum (*) | Rth (HS/Amb) | | |

*For Packaging quantites not listed, please contact KEMET.*
*(*) Current corresponding to 30°C of self-heating in dry conditions and composed by nominal 50 Hz current at rated VAC plus 10 kHz overlapped harmonics. For Expected Life and FIT performances, please refer always to the Curves reported inside the datasheet based on working voltage and hot spot temperatures.*

KEMET
a YAGEO company

## Table 1 – Ratings & Part Number Reference cont.

| Cap Value (µF) | $V_{NAC}$ | $V_{NDC}$ | Dimensions (mm) | | | | | dV/dt | Ipkr | ESL | $R_S$ | $I_{rms}$ maximum (*) | Rth (HS/Amb) | Packaging Quantity | PART NUMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | T | H | L | S | S1 | V/µs | Apk | nH | mΩ | $A_{rms}$ | (°C/W) | | |
| $V_{NAC}$ at 85°C = 350 VAC; $V_{OPAC}$ at 105°C = 245 VAC | | | | | | | | | | | | | | | |
| 1 | 350 | 700 | 13 | 25 | 31.5 | 27.5 | \ | 115 | 115 | 22 | 10.6 | 6.1 | 36 | 234 | C4AF7BU4100T1XK |
| 1.5 | 350 | 700 | 14 | 28 | 31.5 | 27.5 | \ | 115 | 173 | 24 | 8.2 | 7.5 | 33 | 96 | C4AF7BU4150T1YK |
| 2.2 | 350 | 700 | 19 | 29 | 31.5 | 27.5 | \ | 115 | 253 | 25 | 6.6 | 9.1 | 29 | 72 | C4AF7BU4220T11K |
| 3.3 | 350 | 700 | 22 | 37 | 31.5 | 27.5 | \ | 115 | 380 | 28 | 6 | 11.4 | 23 | 64 | C4AF7BU4330T12K |
| 3.7 | 350 | 700 | 22 | 37 | 31.5 | 27.5 | \ | 115 | 426 | 28 | 5.8 | 11.7 | 23 | 64 | C4AF7BU4370T12K |
| 4.7 | 350 | 700 | 20 | 40 | 42 | 37.5 | 10.2 | 75 | 353 | 12 | 4 | 14.7 | 20 | 58 | C4AF7BW4470T3FK |
| 6.8 | 350 | 700 | 28 | 37 | 42 | 37.5 | 10.2 | 75 | 510 | 10 | 2.8 | 18.3 | 18 | 36 | C4AF7BW4680T3JK |
| 10 | 350 | 700 | 35 | 50 | 42 | 37.5 | 20.3 | 75 | 750 | 14 | 2.2 | 24.8 | 13 | 30 | C4AF7BW5100T3OK |
| 12.5 | 350 | 700 | 35 | 50 | 42 | 37.5 | 20.3 | 75 | 938 | 14 | 2 | 26.1 | 13 | 30 | C4AF7BW5125T3OK |
| 15 | 350 | 700 | 35 | 50 | 57.5 | 52.5 | 20.3 | 50 | 750 | 15 | 2.8 | 27.1 | 10 | 23 | C4AF7BW5150T3NK |
| 22 | 350 | 700 | 45 | 56 | 57.5 | 52.5 | 20.3 | 50 | 1100 | 17 | 2.2 | 34.2 | 8 | 18 | C4AF7EW5220T3AK |
| 27 | 350 | 700 | 45 | 56 | 57.5 | 52.5 | 20.3 | 50 | 1350 | 17 | 2.0 | 35.4 | 8 | 18 | C4AF7EW5270T3AK |
| 32 | 350 | 700 | 45 | 65 | 57.5 | 52.5 | 20.3 | 50 | 1600 | 19 | 1.8 | 39.9 | 7 | 18 | C4AF7EW5320T3BK |
| $V_{NAC}$ at 85°C = 400 VAC; $V_{OPAC}$ at 105°C = 280 VAC | | | | | | | | | | | | | | | |
| 1 | 400 | 800 | 14 | 28 | 31.5 | 27.5 | \ | 141 | 141 | 24 | 9.8 | 6.5 | 33 | 96 | C4AF3BU4100T1YK |
| 1.5 | 400 | 800 | 19 | 29 | 31.5 | 27.5 | \ | 141 | 212 | 25 | 7.6 | 8.1 | 29 | 72 | C4AF3BU4150T11K |
| 2.2 | 400 | 800 | 22 | 37 | 31.5 | 27.5 | \ | 141 | 310 | 28 | 6.8 | 10.2 | 23 | 64 | C4AF3BU4220T12K |
| 2.5 | 400 | 800 | 22 | 37 | 31.5 | 27.5 | \ | 141 | 353 | 28 | 6.4 | 10.6 | 23 | 64 | C4AF3BU4250T12K |
| 3.3 | 400 | 800 | 20 | 40 | 42 | 37.5 | 10.2 | 90 | 297 | 12 | 4.8 | 13 | 20 | 58 | C4AF3BW4330T3FK |
| 4.7 | 400 | 800 | 28 | 37 | 42 | 37.5 | 10.2 | 90 | 423 | 10 | 3.4 | 16.1 | 18 | 36 | C4AF3BW4470T3JK |
| 6.8 | 400 | 800 | 30 | 45 | 42 | 37.5 | 20.3 | 90 | 612 | 13 | 2.6 | 20.4 | 15 | 36 | C4AF3BW4680T3LK |
| 9 | 400 | 800 | 35 | 50 | 42 | 37.5 | 20.3 | 90 | 810 | 14 | 2.2 | 24.1 | 13 | 30 | C4AF3BW4900T3OK |
| 10 | 400 | 800 | 30 | 45 | 57.5 | 52.5 | 20.3 | 61 | 610 | 13 | 3.4 | 21.8 | 12 | 27 | C4AF3BW5100T3MK |
| 15 | 400 | 800 | 45 | 56 | 57.5 | 52.5 | 20.3 | 61 | 915 | 17 | 2.6 | 31.1 | 8 | 18 | C4AF3EW5150T3AK |
| 20 | 400 | 800 | 45 | 56 | 57.5 | 52.5 | 20.3 | 61 | 1220 | 17 | 2.2 | 33.3 | 8 | 18 | C4AF3EW5200T3AK |
| 22.5 | 400 | 800 | 45 | 65 | 57.5 | 52.5 | 20.3 | 61 | 1373 | 19 | 2 | 37.4 | 7 | 18 | C4AF3EW5225T3BK |
| Cap Value (µF) | $V_{NAC}$ | $V_{NDC}$ | T | H | L | S | S1 | V/µs | Apk | nH | mΩ | $A_{rms}$ | (°C/W) | Packaging Quantity | PART NUMBER |
| | | | Dimensions (mm) | | | | | dV/dt | Ipkr | ESL | $R_S$ | $I_{rms}$ maximum (*) | Rth (HS/Amb) | | |

*For Packaging quantites not listed, please contact KEMET.*
*(*) Current corresponding to 30°C of self-heating in dry conditions and composed by nominal 50 Hz current at rated VAC plus 10 kHz overlapped harmonics. For Expected Life and FIT performances, please refer always to the Curves reported inside the data-sheet based on working voltage and hot spot temperatures*

## Soldering Process

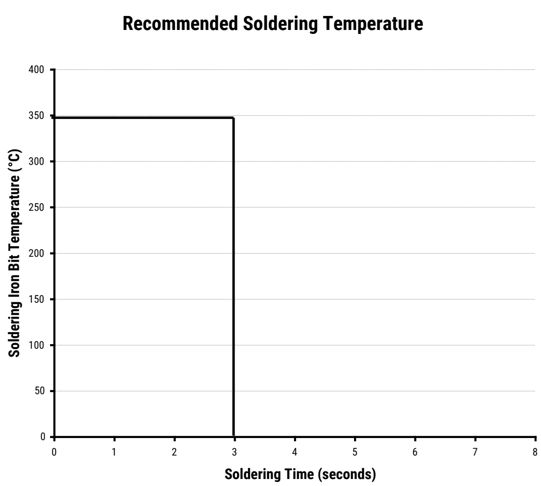
The implementation of the RoHS directive has resulted in the selection of SnAuCu (SAC) alloys, or SnCu alloys, as the primary solder material. This has increased the liquidus temperature from 183°C for a SnPb eutectic alloy to 217 – 221°C for new alloys. As a result, the heat stress to the components, even in wave soldering, has increased considerably due to higher pre-heat and wave temperatures. Polypropylene capacitors are especially sensitive to heat (the melting point of polypropylene is 160 – 170°C). Wave soldering can be destructive, especially for mechanically small polypropylene capacitors (with lead spacing of 5 – 15 mm), and great care must be taken during soldering. The recommended solder profiles from KEMET should be used. Contact KEMET with any questions. In general, the wave soldering curve from IEC Publication 61760–1 Edition 2 serves as a solid guideline for successful soldering. See Figure 1.

Reflow soldering is not recommended for through-hole film capacitors. Exposing capacitors to a soldering profile in excess of the recommended limits may result in degradation or permanent damage to the capacitors.

Do not place the polypropylene capacitor through an adhesive curing oven to cure resin for surface mount components. Insert through-hole parts after curing the surface mount parts. Contact KEMET to discuss the actual temperature profile in the oven, if through-hole components must pass through the adhesive curing process. A maximum two soldering cycles is recommended. Allow time for the capacitor surface temperature to return to normal before the second soldering cycle.

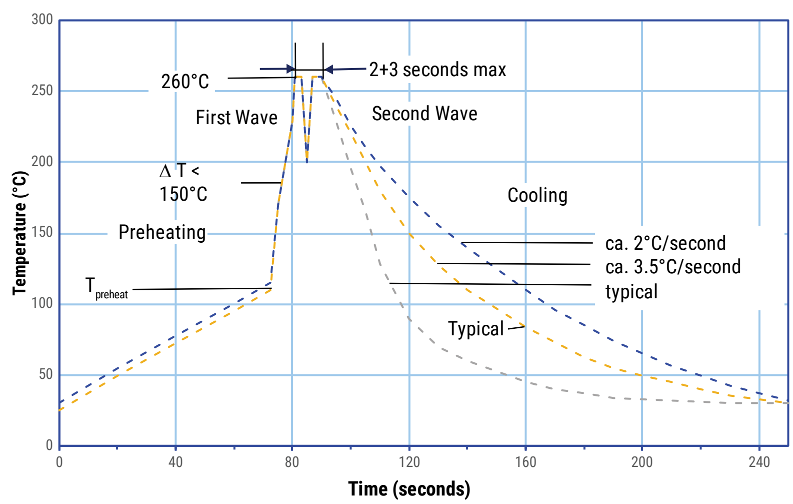
### Manual Soldering Recommendations

Following is the recommendation for manual soldering with a soldering iron.




The soldering iron tip temperature should be set at 350°C (+10°C) maximum with the soldering duration not to exceed more than 3 seconds.

### Wave Soldering Recommendations



## Soldering Process cont.

**Wave Soldering Recommendations cont.**

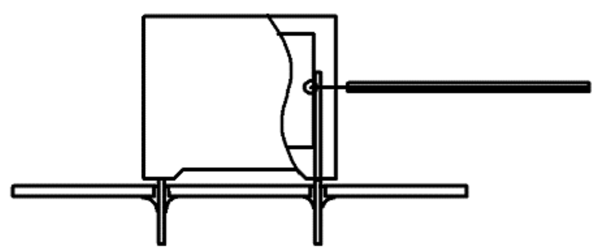
1. The tables indicates the maximum set-up temperature of the soldering process

| Dielectric Film Material | Maximum Preheat Temperature | | Maximum Peak Soldering Temperature | |
|---|---|---|---|---|
| | Capacitor Pitch ≤ 15 mm | Capacitor Pitch > 15 mm | Capacitor Pitch ≤ 15 mm | Capacitor Pitch > 15 mm |
| Polyester | 130°C | 130°C | 270°C | 270°C |
| Polypropylene | 110°C | 130°C | 260°C | 270°C |
| Paper | 130°C | 140°C | 270°C | 270°C |
| Polyphenylene Sulphide | 150°C | 160°C | 270°C | 270°C |

2. The maximum temperature measured inside the capacitor: set the temperature so that inside the element the maximum temperature is below the limit.

| Dielectric Film Material | Maximum Temperature Measured Inside the Element |
|---|---|
| Polyester | 160°C |
| Polypropylene | 110°C |
| Paper | 160°C |
| Polyphenylene Sulphide | 160°C |

*Temperature monitored inside the capacitor.*



**Selective Soldering Recommendations**

Selective dip soldering is a variation of reflow soldering. In this method, the printed circuit board with through-hole components to be soldered is pre-heated and transported over the solder bath, as in normal flow soldering, without touching the solder. When the board is over the bath, it is stopped. Pre-designed solder pots are lifted from the bath with molten solder, only at the places of the selected components, and pressed against the lower surface of the board to solder the components.

The temperature profile for selective soldering is similar to the double wave flow soldering outlined in this document. However, instead of two baths, there is only one with a time from 3 – 10 seconds. In selective soldering, the risk of overheating is greater than in double wave flow soldering, and great care must be taken so that the parts do not overheat.

## Mounting

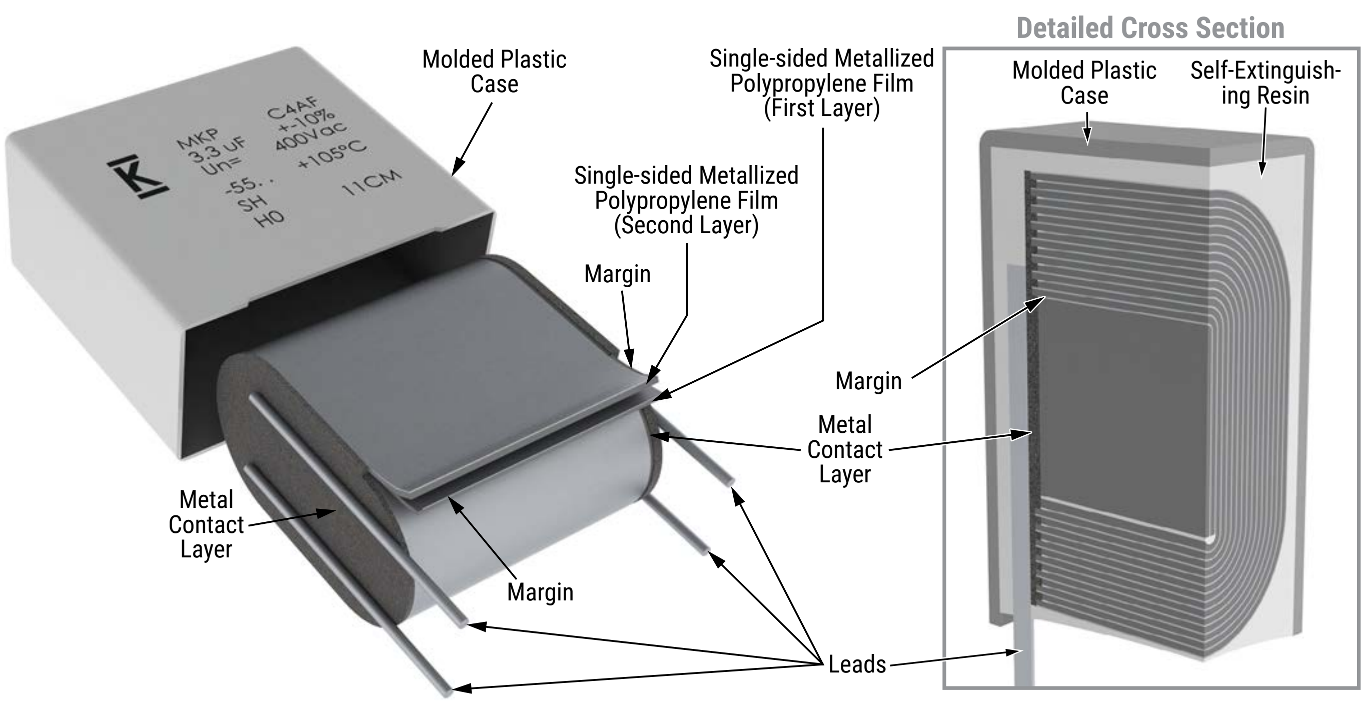
### Resistance to Vibration and Mechanical Shock

AEC-Q200 Mechanical Stress Tests:

| | | |
|---|---|---|
| **Mechanical Shock** | **MIL-SDT-202 Method 213** | Test condition C<br>Peak value 100 g, duration 6 ms, half-sine-wave<br>(see MIL-HDBK for details) |
| **Vibration** | **MIL-SDT-202 Method 204** | 5 g for 20 minutes, 12 cycles each of 3 orientations<br>Use 8"X5" PCB, .031" thick. 7 secure points on one 8" side and 2 secure points at corners of opposite sides. Parts mounted within 2" from any secure point.<br>Test from 10 – 2,000 Hz. |

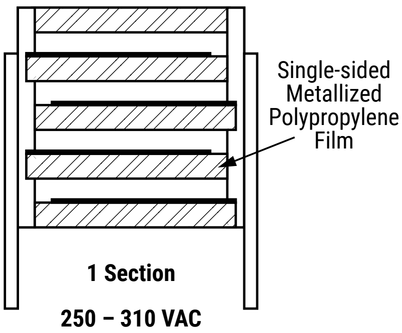
The capacitors are designed for PCB mounting.
The stand-off pipes must be in good contact with the printed circuit board.
The capacitor body has to be properly fixed (e.g. clamped or glued).

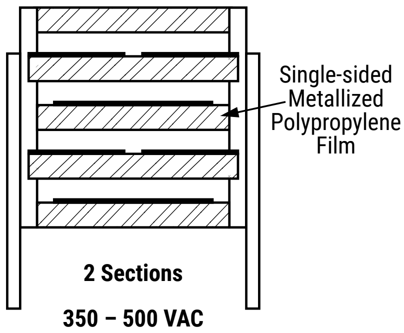
## Construction



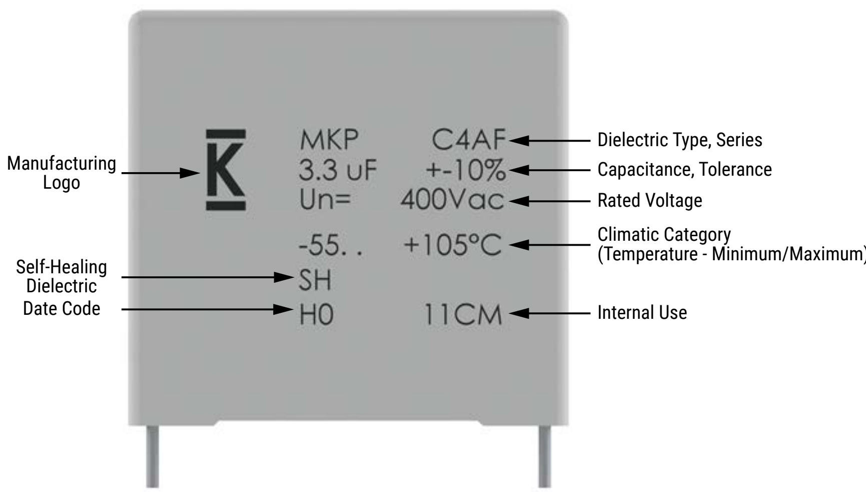
## Construction cont.

### Winding Scheme




## Marking




| Manufacturing Date Code (IEC–60062) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Y = Year, Z = Month | | | | | | | | | |
| Year | Code | Year | Code | Year | Code | Month | Code | Month | Code |
| 2010 | A | 2017 | J | 2024 | S | January | 1 | July | 7 |
| 2011 | B | 2018 | K | 2025 | T | February | 2 | August | 8 |
| 2012 | C | 2019 | L | 2026 | U | March | 3 | September | 9 |
| 2013 | D | 2020 | M | 2027 | V | April | 4 | October | O |
| 2014 | E | 2021 | N | 2028 | W | May | 5 | November | N |
| 2015 | F | 2022 | P | 2029 | X | June | 6 | December | D |
| 2016 | H | 2023 | R | 2030 | A | | | | |

## KEMET Electronics Corporation Sales Offices

For a complete list of our global sales offices, please visit www.kemet.com/sales.

## Disclaimer

All product specifications, statements, information and data (collectively, the "Information") in this datasheet are subject to change. The customer is responsible for checking and verifying the extent to which the Information contained in this publication is applicable to an order at the time the order is placed. All Information given herein is believed to be accurate and reliable, but it is presented without guarantee, warranty, or responsibility of any kind, expressed or implied.

Statements of suitability for certain applications are based on KEMET Electronics Corporation's ("KEMET") knowledge of typical operating conditions for such applications, but are not intended to constitute – and KEMET specifically disclaims – any warranty concerning suitability for a specific customer application or use. The Information is intended for use only by customers who have the requisite experience and capability to determine the correct products for their application. Any technical advice inferred from this Information or otherwise provided by KEMET with reference to the use of KEMET's products is given gratis, and KEMET assumes no obligation or liability for the advice given or results obtained.

Although KEMET designs and manufactures its products to the most stringent quality and safety standards, given the current state of the art, isolated component failures may still occur. Accordingly, customer applications which require a high degree of reliability or safety should employ suitable designs or other safeguards (such as installation of protective circuitry or redundancies) in order to ensure that the failure of an electrical component does not result in a risk of personal injury or property damage.

Although all product–related warnings, cautions and notes must be observed, the customer should not assume that all safety measures are indicted or that other measures may not be required.