

**BOX CAPACITORS  
 HARSH ENVIRONMENT  
 AC FILTERING**

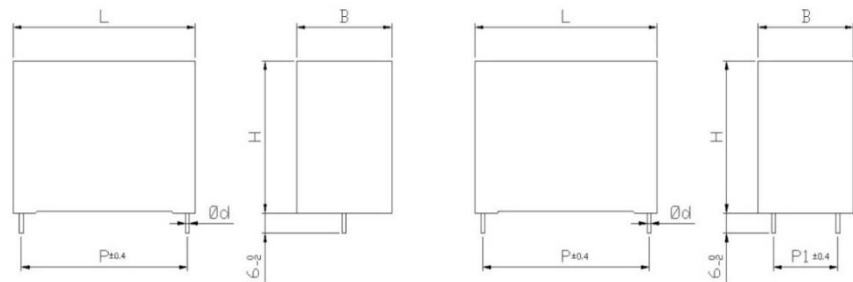
**C4AF SERIES**  
 RoHS COMPLIANT

CAPACITORS  
 FOR PCB APPLICATIONS

**OVERVIEW:** C4AF capacitors are polypropylene metallized film, rectangular plastic box type filled with resin (white colour), 2 or 4 tinned copper wires and designed to withstand harsh environment condition of work. Automotive grade devices meet the demanding Automotive Electronics Council's AEC-Q200 qualification requirements.

**BENEFIT:**

- Self-healing
- Low losses
- High ripple current
- High contact reliability
- Optimized AC Voltage performance
- Suitable for high frequency applications
- Harsh Environment withstanding
- Automotive (AEC-Q200) grades



BOX Style: 2 Wires      All dimensions are in mm      BOX Style: 4 Wires

P [mm]	nr pins	Ød [mm]
27.5	2	0.8
37.5	4	1.2
52.5	4	1.2

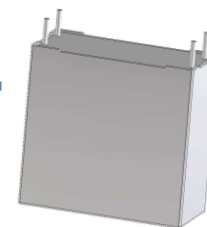
**TYPICAL APPLICATION:** Clamping, AC filtering, UPS System, Renewable energy - grid interface, Harmonic Filter, Welding equipment, Motor Drives, Automotive

**GENERAL TECHNICAL DATA**

Dielectric	Polypropylene metallized film, non-inductive, self-healing
Application	AC Filtering (310 Vac ; 400 Vac) AC Output Filtering (250 Vac)
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, EN61071, VDE0560, AEC-Q200
Protection	Solvent resistant plastic case UL94 V-0 compliant Thermosetting resin sealing UL94 V-0 compliant
Installation	Any position
Leads	Tinned copper wires - standard lead wire length 6 (+0/-2) mm
Packaging	Packed in cardboard trays with protection for the terminals
RoHS Compliance	Compliant with the restricted substance requirements of Directive 2011/65/EU

**ELECTRICAL CHARACTERISTICS**

Rated Capacitance Range	1 to 62 µF
Rated Voltage (V <sub>NDC</sub> ) Range	250 – 310 - 400 VAC
Capacitance Tolerance	±5% (J) or ±10% (K) measured at T = +25°C
Dissipation Factor PP Typical (tgδ <sub>0</sub> )	≤ 0.0002 at 10 kHz with T = 25°C (±5°C)
Surge Voltage	1.5 * V <sub>NDC</sub> for max. 10 times in lifetime at 25°C
Overvoltage (IEC 61071)	1.15 * V <sub>NDC</sub> for max. 30 minutes, once per day 1.3 * V <sub>NDC</sub> for max. 1 minute, once per day
Peak Non-Repetitive Current	1.5 * I <sub>PKR</sub> , for max. 1,000 times in lifetime
Insulation Resistance	IR x C ≥ 30.000 seconds at 100 VDC 1 minute (+25°C)
Capacitance Deviation in the operating temperature range -55 to 105°C	±2.5% max. on capacitance value measured at T = +25°C



**LIFE EXPECTANCY**

Life Expectancy	≥ 60.000 hours at $U_{NAC}$ and $T_{HS}=+85^{\circ}C$
Capacitance Drop at End of Life	-5% (typical)
Failure Rate IEC 61709	10 FIT ( $\leq 10 \times 10^{-9}/h$ ) at $0.5 \times U_{NAC}$ , $40^{\circ}C$

**TEST METHOD**

Peak Non-Repetitive Maximum Current	$I_{PKR} \times 1.5$
Test Voltage Terminal to Terminal $V_{TT}$	$2 V_n$ for 10 seconds
Test Voltage Terminal to Case $V_{TC}$	3k V – 50 Hz for 60 seconds
Endurance Test	500h + 500h @ $1.3 \times$ Rated Voltage @ $85^{\circ}C$ 500h + 500h @ $1.3 \times$ Operative Voltage @ $105^{\circ}C$
Damp Heat	IEC 60068-2-78 250 and 310 Vac version 240 Vac $85^{\circ}C/85\%$ r.h. 500 h: $\Delta C/C < 10\%$ & $\Delta T_g < 3 \times 10^{-3}$ at 1 kHz
THB Test 85/85 with Voltage	400 Vac version 335 Vac $85^{\circ}C/85\%$ r.h. 500 h: $\Delta C/C < 10\%$ & $\Delta T_g < 3 \times 10^{-3}$ at 1 kHz
Change of Temperature	IEC 60068-2-14

**OPERATIVE VOLTAGE DERATING**

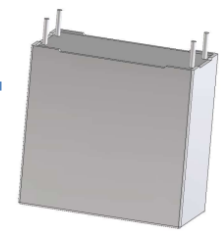
Operating Voltage	Voltage (VAC)		
	250	310	400
Rated Voltage @ $85^{\circ}C$ ( $T_{HS}$ )	250	310	400
Operating Voltage @ $105^{\circ}C$ ( $T_{HS}$ )	175	217	280

**PART NUMBER CODING**

C4	A	F	1	B	W	5330	A	3	N	J
Series	Type	Application	Rated Voltage (VAC)	Case	Terminals Code	Capacitance Code (pF)	C-spec	Lead Diameter (mm)	Size Code: BxHxL (mm)	Tolerance
C4 = MKP Power Capacitors	A = Box, wire terminals	F = AC Filtering	1 = 250 9 = 310 3 = 400	B = Box plastic case E = Box plastic case Extended (>35x50x57,5)	U = 2 pins 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 = Standard Grade	1 = 0.8 3 = 1.2	W = 11x20x31.5 X = 13x25x31.5 Y = 14x28x31.5 1 = 19x29x31.5 2 = 22x37x31.5 F = 20x40x42 J = 28x37x42 L = 30x45x42 M = 30x45x57.5 N = 35x50x57.5	J = 5% K = 10%
									Digit 6=E A = 45x56x57.5 B = 45x65x57.5	

**Reminder**

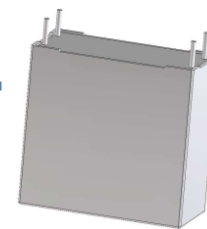
It is not possible to manufacture every part number which could be created from the coding description. Please refer to the table of standard part numbers below and ask KEMET for other possibilities.



**ORDERING CODE**

Part number	C ( $\mu$ F)	U <sub>RAC</sub> (Vac)	dV/dt (V/ $\mu$ s)	I <sub>pkr</sub> (A <sub>pk</sub> )	Max ESL (nH)	Typ. ESR 70°C@10kHz (m $\Omega$ )	I <sub>rms</sub> 70°C@10kHz (Arms)	R <sub>th</sub> (°C/W)	Dimensions (mm)				
									B	H	L	P	P1
<b>U<sub>RAC</sub> @ 85°C = 250 Vac; U<sub>OPAC</sub> @ 105°C = 175 Vac;</b>													
C4AF1BU4100A1WK	1	250	38	38	24	14.1	4.0	44	11	20	31.5	27.5	\
C4AF1BU4150A1WK	1.5	250	38	56	24	9.7	4.8	44	11	20	31.5	27.5	\
C4AF1BU4220A1XK	2.2	250	38	83	25	7.2	6.2	36	13	25	31.5	27.5	\
C4AF1BU4330A11K	3.3	250	38	125	26	5.3	8.0	29	19	29	31.5	27.5	\
C4AF1BU4470A11K	4.7	250	38	179	26	4.2	9.1	29	19	29	31.5	27.5	\
C4AF1BU4680A12K	6.8	250	38	259	28	3.6	11.0	23	22	37	31.5	27.5	\
C4AF1BU4750A12K	7.5	250	38	285	28	3.4	11.3	23	22	37	31.5	27.5	\
C4AF1BW5100A3FK	10	250	27	272	30	2.7	13.7	20	20	40	42	37.5	10.2
C4AF1BW5150A3LK	15	250	27	400	33	1.9	18.9	15	30	45	42	37.5	20.3
C4AF1BW5220A3OK	22	250	27	587	35	1.4	23.8	13	35	50	42	37.5	20.3
C4AF1BW5245A3OK	24.5	250	27	654	35	1.2	24.8	13	35	50	42	37.5	20.3
C4AF1BW5330A3NK	33	250	18	587	38	1.7	24	10	35	50	57.5	52.5	20.3
<b>C4AF1EW5470A3AK</b>	<b>47</b>	250	<b>18</b>	<b>837</b>	<b>41</b>	<b>1.3</b>	<b>30.9</b>	<b>8</b>	<b>45</b>	<b>56</b>	<b>57.5</b>	<b>52.5</b>	<b>20.3</b>
<b>C4AF1EW5550A3AK</b>	<b>55</b>	250	<b>18</b>	<b>960</b>	<b>41</b>	<b>1.2</b>	<b>32.8</b>	<b>8</b>	<b>45</b>	<b>56</b>	<b>57.5</b>	<b>52.5</b>	<b>20.3</b>
<b>C4AF1EW6220A3BK</b>	<b>62</b>	250	<b>18</b>	<b>1116</b>	<b>45</b>	<b>1.1</b>	<b>36.2</b>	<b>7</b>	<b>45</b>	<b>65</b>	<b>57.5</b>	<b>52.5</b>	<b>20.3</b>
<b>U<sub>RAC</sub> @ 85°C = 310 Vac; U<sub>OPAC</sub> @ 105°C = 215 Vac;</b>													
C4AF9BU4100A1WK	1	310	45	45	24	13.4	4.1	44	11	20	31.5	27.5	\
C4AF9BU4150A1XK	1.5	310	45	68	25	9.5	5.4	36	13	25	31.5	27.5	\
C4AF9BU4220A1YK	2.2	310	45	99	26	7.0	6.6	33	14	28	31.5	27.5	\
C4AF9BU4330A11K	3.3	310	45	149	26	5.1	8.2	29	19	29	31.5	27.5	\
C4AF9BU4470A12K	4.7	310	45	212	28	4.3	10.1	23	22	37	31.5	27.5	\
C4AF9BW4680A3FK	6.8	310	32	218	30	3.3	12.3	20	20	40	42	37.5	10.2
C4AF9BW5100A3JK	10	310	32	320	29	2.3	15.5	18	28	37	42	37.5	10.2
C4AF9BW5150A3OK	15	310	32	480	35	1.6	21.6	13	35	50	42	37.5	20.3
C4AF9BW5170A3OK	17	310	32	560	35	1.5	22.8	13	35	50	42	37.5	20.3
C4AF9BW5220A3NK	22	310	21	462	38	2.1	21.6	10	35	50	57.5	52.5	20.3
<b>C4AF9EW5330A3AK</b>	<b>33</b>	<b>310</b>	<b>21</b>	<b>693</b>	<b>41</b>	<b>1.5</b>	<b>28.6</b>	<b>8</b>	<b>45</b>	<b>56</b>	<b>57.5</b>	<b>52.5</b>	<b>20.3</b>
<b>C4AF9EW5375A3AK</b>	<b>37.5</b>	<b>310</b>	<b>21</b>	<b>788</b>	<b>41</b>	<b>1.4</b>	<b>30.2</b>	<b>8</b>	<b>45</b>	<b>56</b>	<b>57.5</b>	<b>52.5</b>	<b>20.3</b>
<b>C4AF9EW5420A3BK</b>	<b>42</b>	<b>310</b>	<b>21</b>	<b>882</b>	<b>45</b>	<b>1.3</b>	<b>33.3</b>	<b>7</b>	<b>45</b>	<b>65</b>	<b>57.5</b>	<b>52.5</b>	<b>20.3</b>
<b>U<sub>RAC</sub> @ 85°C = 400 Vac; U<sub>OPAC</sub> @ 105°C = 280 Vac;</b>													
C4AF3BU4100A1YK	1	400	141	141	26	7.9	6.2	33	14	28	31.5	27.5	\
C4AF3BU4150A11K	1.5	400	141	212	26	5.8	7.7	29	19	29	31.5	27.5	\
C4AF3BU4220A12K	2.2	400	141	310	28	4.7	9.7	23	22	37	31.5	27.5	\
C4AF3BU4250A12K	2.5	400	141	353	28	4.3	10.1	23	22	37	31.5	27.5	\
C4AF3BW4330A3FK	3.3	400	90	297	30	3.2	12.4	20	20	40	42	37.5	10.2
C4AF3BW4470A3JK	4.7	400	90	423	29	2.3	15.4	18	28	37	42	37.5	10.2
C4AF3BW4680A3LK	6.8	400	90	612	33	1.7	19.8	15	30	45	42	37.5	20.3
C4AF3BW4900A3OK	9.0	400	90	810	35	1.4	23.8	13	35	50	42	37.5	20.3
C4AF3BW5100A3MK	10	400	61	610	35	1.9	20.8	12	30	45	57.5	52.5	20.3
<b>C4AF3EW5150A3AK</b>	15	<b>400</b>	<b>61</b>	<b>915</b>	<b>41</b>	<b>1.4</b>	<b>29.8</b>	<b>8</b>	<b>45</b>	<b>56</b>	<b>57.5</b>	<b>52.5</b>	<b>20.3</b>
<b>C4AF3EW5200A3AK</b>	20	<b>400</b>	<b>61</b>	<b>1220</b>	<b>41</b>	<b>1.1</b>	<b>33.4</b>	<b>8</b>	<b>45</b>	<b>56</b>	<b>57.5</b>	<b>52.5</b>	<b>20.3</b>
<b>C4AF3EW5225A3BK</b>	22.5	<b>400</b>	<b>61</b>	<b>1342</b>	<b>45</b>	<b>1.1</b>	<b>36.8</b>	<b>7</b>	<b>45</b>	<b>65</b>	<b>57.5</b>	<b>52.5</b>	<b>20.3</b>

<sup>1)</sup> Bold only for samples

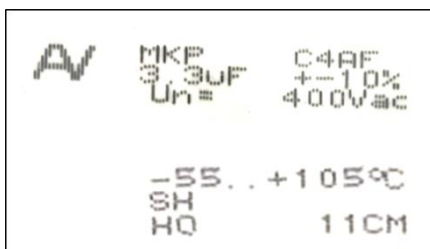


**DIMENSIONS TABLE (mm)**

Size Code		P		P1		B		H		L		L wires	
Dgt 6	Dgt 14	Nominal	Tolerance	Nominal	Tolerance	Nominal	Tolerance	Nominal	Tolerance	Nominal	Tolerance	Nominal	Tolerance
B	W	27.5	±0.4	-	-	11.0	+0.3	20.0	+0.2	31.5	+0.5	6.0	0.0/-2.0
B	X	27.5	±0.4	-	-	13.0	+0.3	25.0	+0.2	31.5	+0.5	6.0	0.0/-2.0
B	Y	27.5	±0.4	-	-	14.0	+0.3	28.0	+0.2	31.5	+0.5	6.0	0.0/-2.0
B	1	27.5	±0.4	-	-	19.0	+0.3	29.0	+0.2	31.5	+0.5	6.0	0.0/-2.0
B	2	27.5	±0.4	-	-	22.0	+0.3	37.0	+0.2	31.5	+0.5	6.0	0.0/-2.0
B	F	37.5	±0.4	10.2	±0.4	20.0	+0.4	40.0	+0.2	42.0	+0.6	6.0	0.0/-2.0
B	J	37.5	±0.4	10.2	±0.4	28.0	+0.4	37.0	+0.2	42.0	+0.6	6.0	0.0/-2.0
B	L	37.5	±0.4	20.3	±0.4	30.0	+0.4	45.0	+0.2	42.0	+0.6	6.0	0.0/-2.0
B	O	37.5	±0.4	20.3	±0.4	35.0	+0.4	50.0	+0.2	42.0	+0.6	6.0	0.0/-2.0
B	M	52.5	±0.4	20.3	±0.4	30.0	+0.5	45.0	+0.3	57.5	+0.8	6.0	0.0/-2.0
B	N	52.5	±0.4	20.3	±0.4	35.0	+0.5	50.0	+0.3	57.5	+0.8	6.0	0.0/-2.0
E	A	52.5	±0.4	20.3	±0.4	45.0	+0.5	56.0	+0.3	57.5	+0.8	6.0	0.0/-2.0
E	B	52.5	±0.4	20.3	±0.4	45.0	+0.5	65.0	+0.3	57.5	+0.8	6.0	0.0/-2.0

**MARKING**

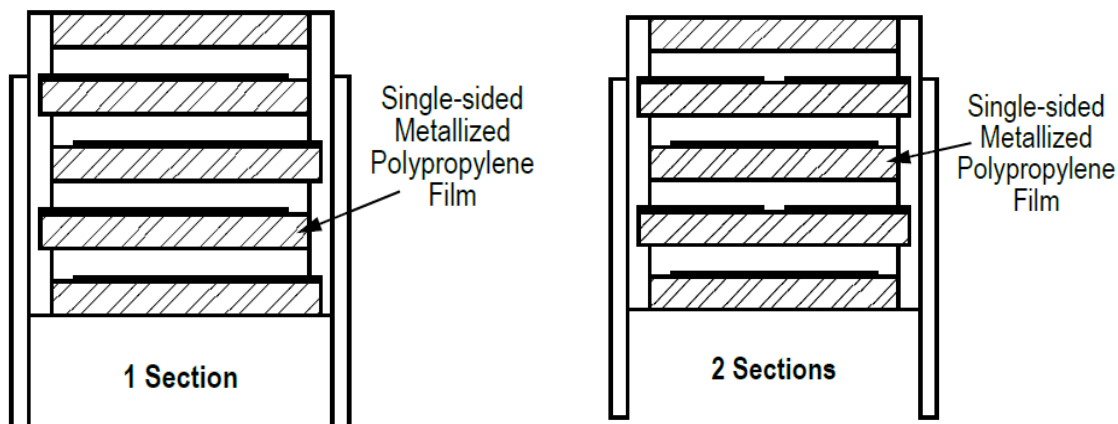
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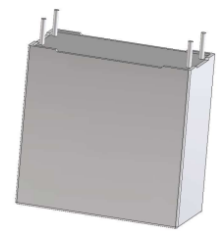


MKP C4AF → Dielectric type Series  
 3.3 uF +-10% → Capacitance Tolerance  
 Un = 400Vac → Rated Voltage  
 -55 +105°C → Climatic Category Temperatures - Min / Max  
 SH → Self-Healing dielectric  
 HO 11CM → Production date\*\*: Year/Month - Day - Prod Line (Internal Code)

\*\* Year/Month correspondence table available on General Catalogue - in the example H=2016 / O=October / 11=11<sup>th</sup> / CM=internal

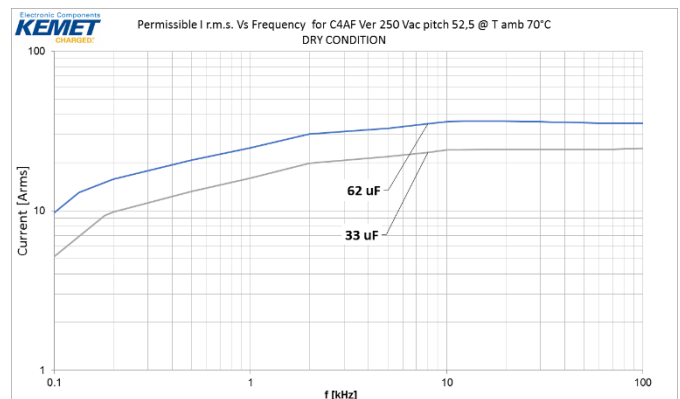
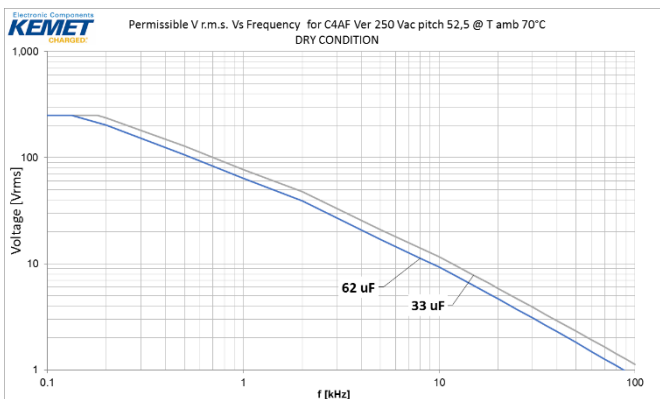
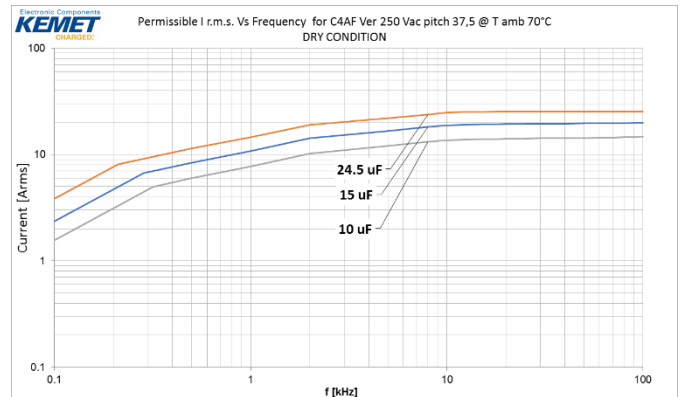
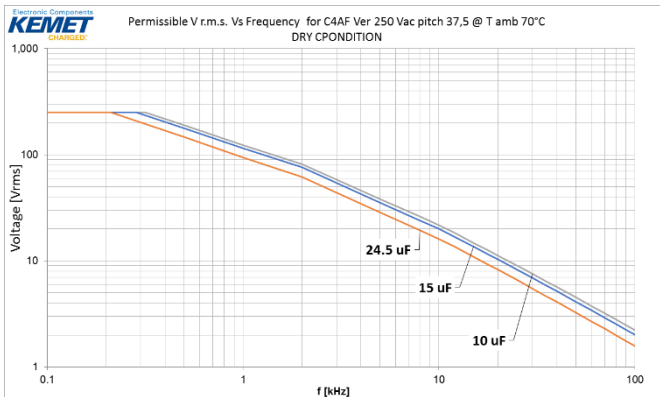
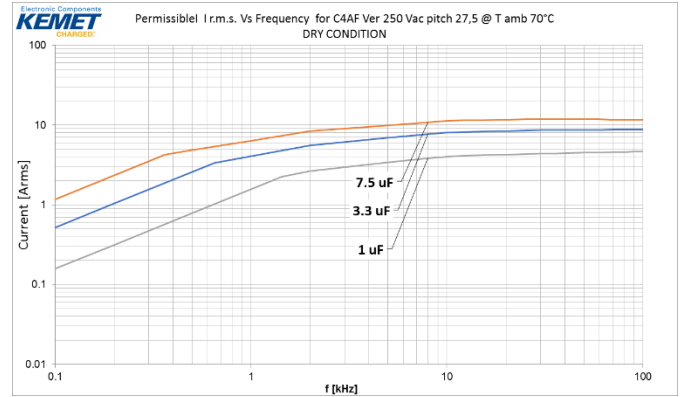
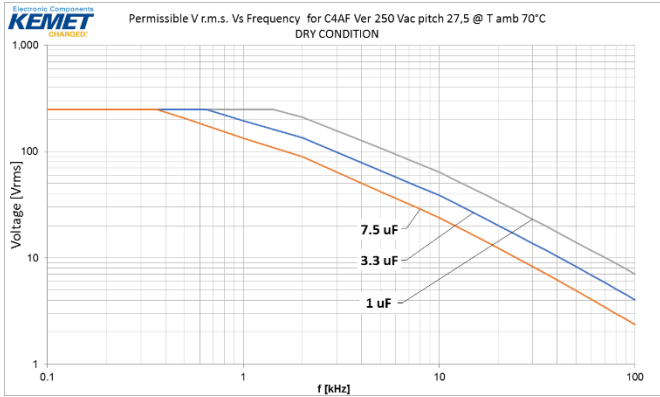
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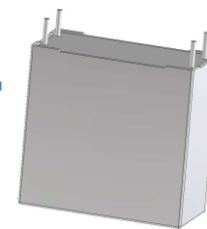




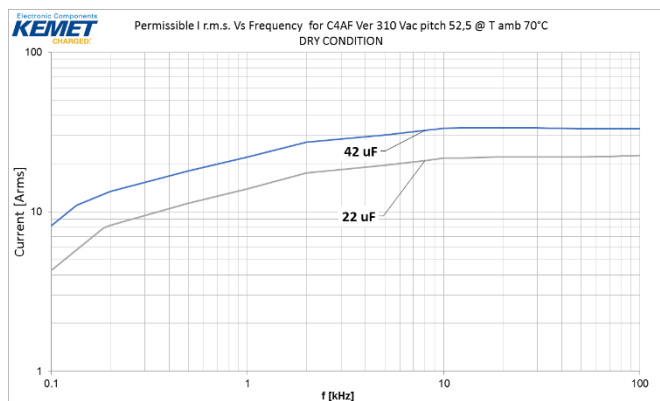
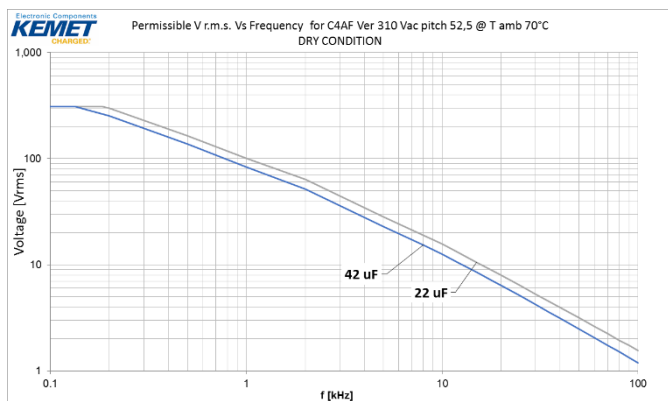
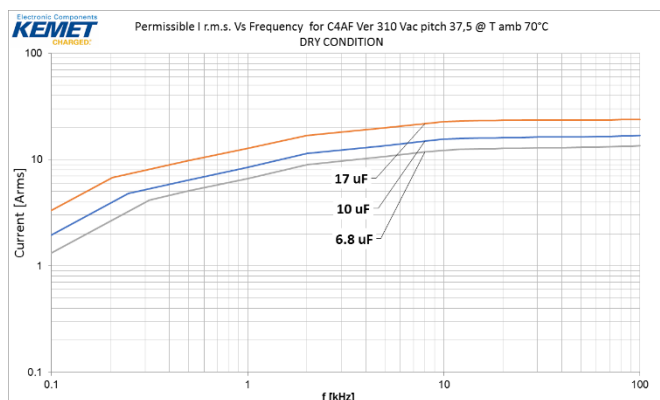
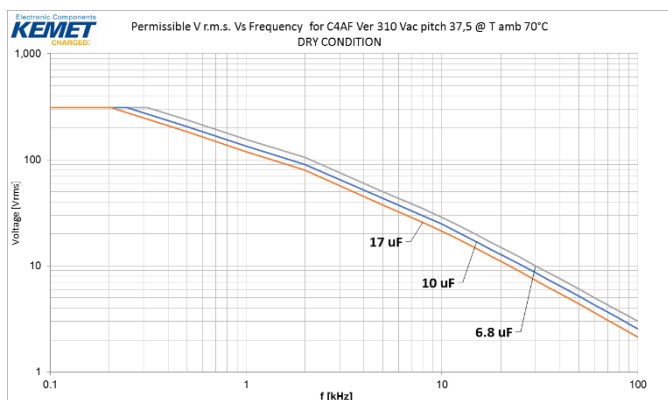
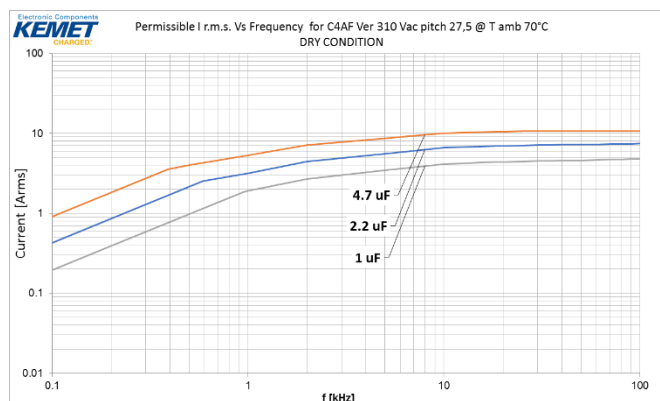
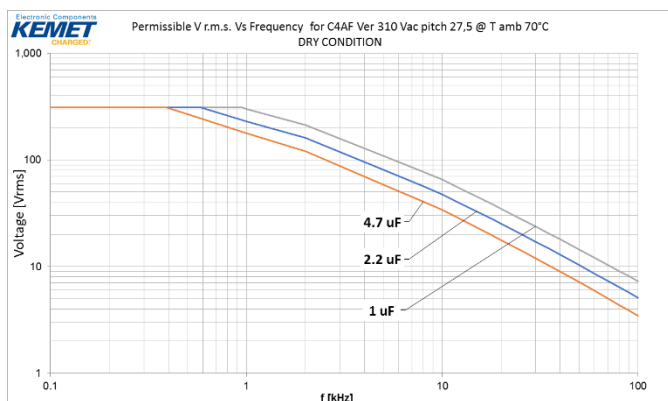
**VOLTAGE AND CURRENT GRAPH**

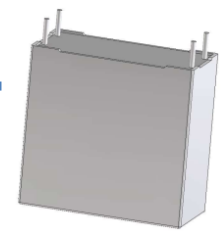
**250 VAC**



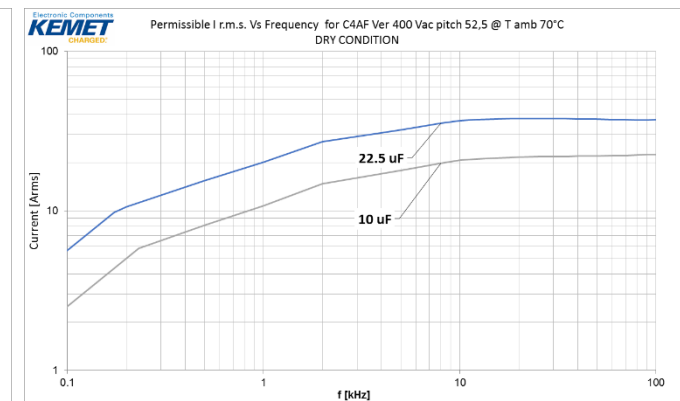
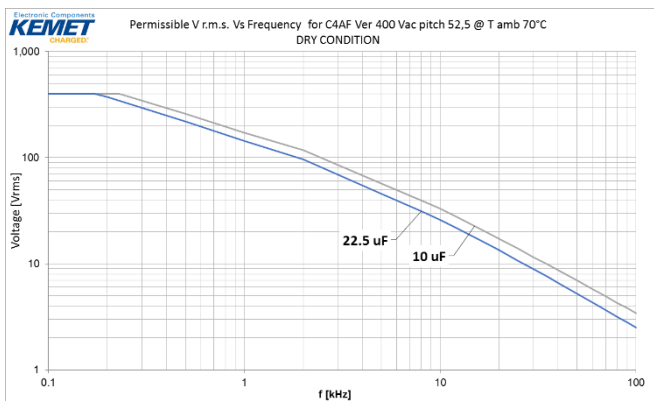
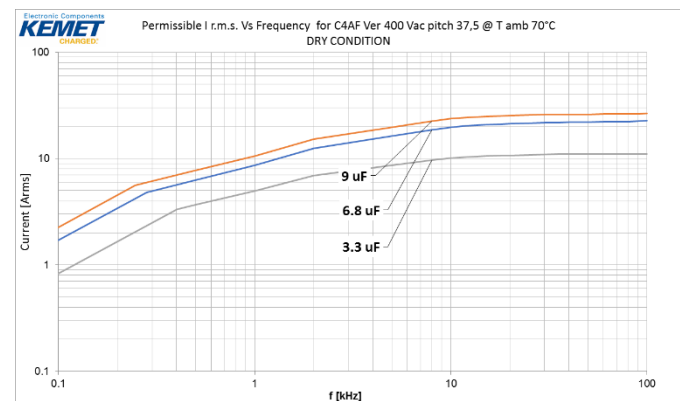
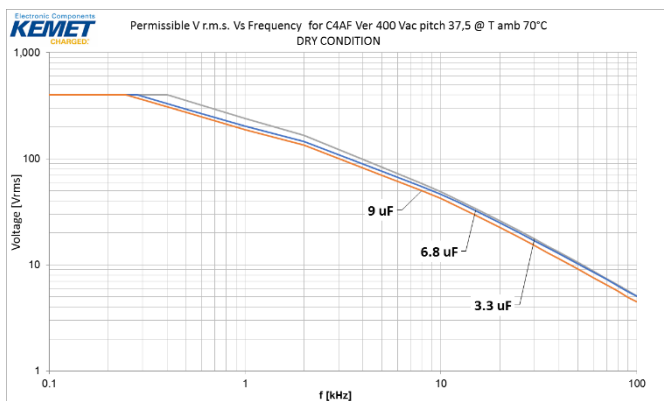
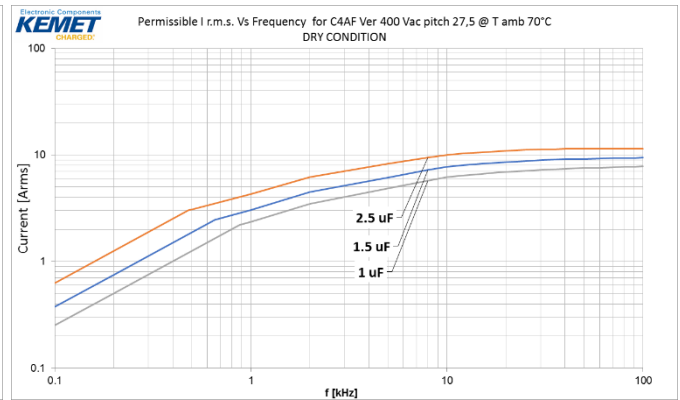
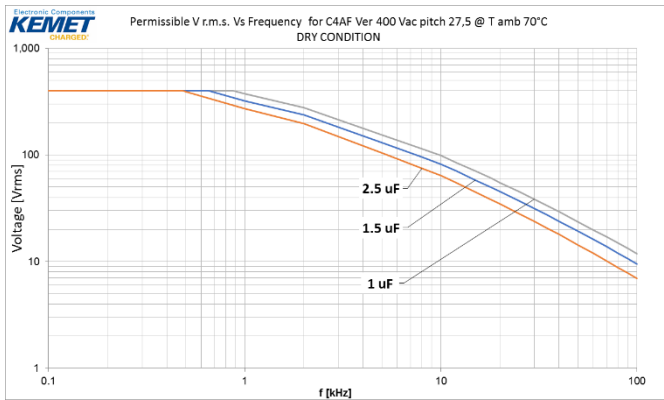


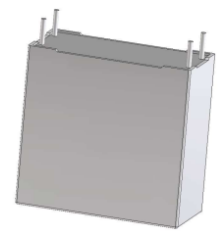
## 310 VAC



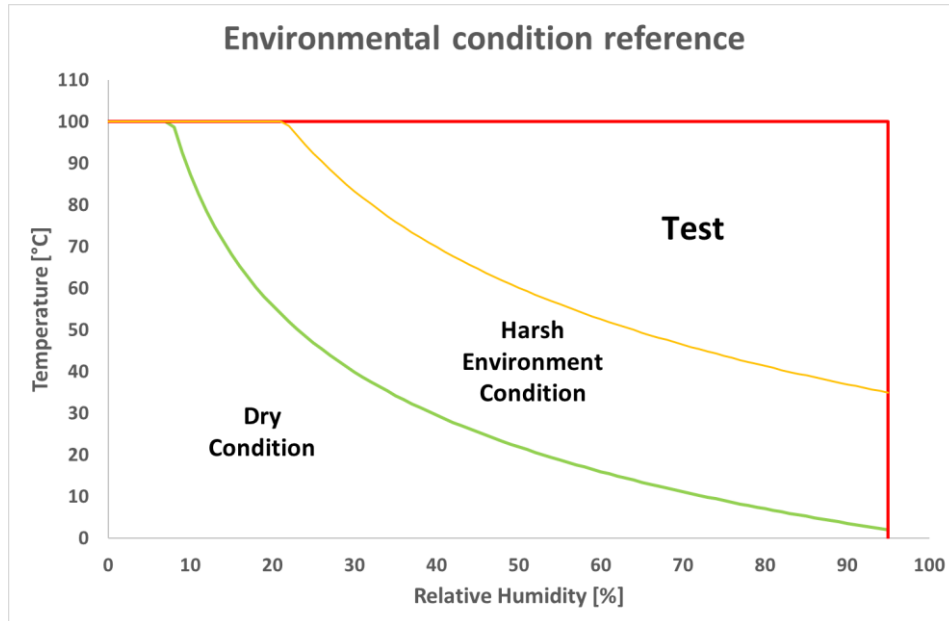


## 400 VAC





**Environmental Condition Reference**



The formula used to calculate the max power dissipated by the capacitor is the following:

$$P_{diss} = \sum_i^N \frac{(I_{rms})_i^2}{2 * \pi * f_i * C} * tg\delta_{max}(f_i)$$

Where:

- $P_{diss}$  [W]= Dissipated power by Customer application
- $(I_{rms})_i$  [Arms] = r.m.s current of the  $i^{th}$  harmonic in Ampere from customer application
- $f_i$  [Hz] = Frequency of the  $i^{th}$  harmonic in Hertz
- $tg\delta_{max}(f)_i$  = Max. dissipation factor corresponding to the frequency of the  $i^{th}$  harmonic
- $N$  = Number of significant harmonics
- $C$  [F] = Capacity in Farad

$$P_{MAX} = \frac{(I_{rms,PRM})^2}{2 * \pi * f_i * C} * tg\delta_{max}(f)_i$$

$$\frac{P_{diss}}{P_{MAX}} \leq 1$$

$$\sum_i^N \left( \frac{I_{rms,i}}{I_{rmsPRM,i}} \right)^2 \leq 1$$

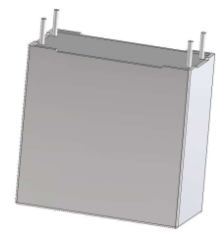
$$\Delta T = \Delta T_{Lim} * \sum_i^N \left( \frac{I_{rms,i}}{I_{rmsPRM,i}} \right)^2$$

- $(I_{rmsPRM})_i$  [Arms]= Permissible r.m.s current of the  $i^{th}$  harmonic in Ampere linked to the graphic of the working condition
- $P_{MAX}$  [W]= Max power dissipated by the capacitor:

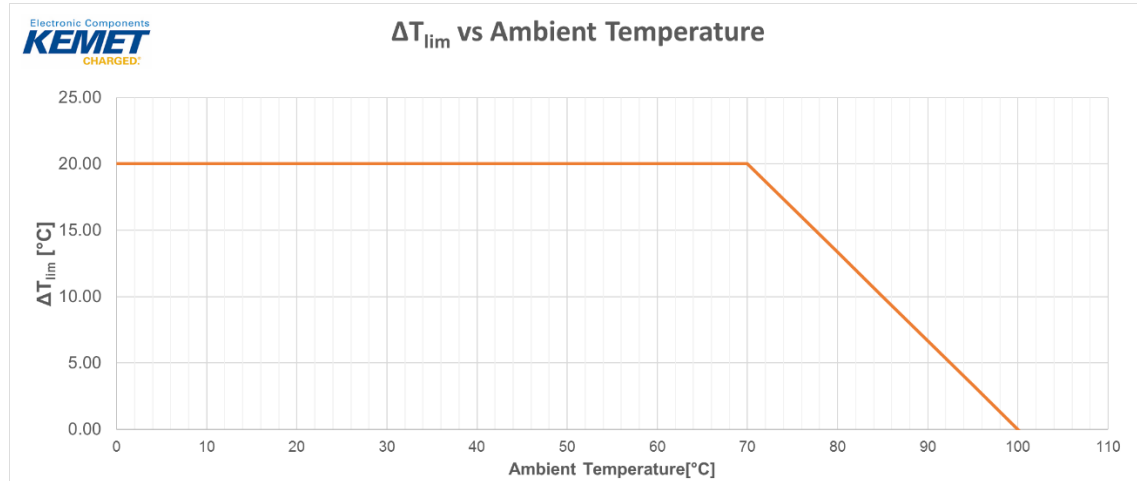
$$P_{MAX} = \frac{\Delta T_{Lim}}{R_{th}}$$

- $\Delta T$  [°C] = Temperature change from ambient temperature
- $\Delta T_{Lim}$  [°C] = Maximum temperature change allowed for the capacitor
- $R_{th}$   $\left[ \frac{°C}{W} \right]$  = Thermal resistance linked to the box dimension





KEMET defines maximum ripple current, based on Hot-Spot/Ambient self-heating temperature. For C4AF series, maximum allowed self-heating is 20°C which ambient temperature up to 70°C.  $\Delta T$  is reduced linearly with increasing ambient temperature, down to 0°C at 100°C (no self-heating allowed at maximum operating temperature):



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- (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.

#### DATA SHEET DISCLAIMER

The present data sheet edition replaces and supersedes any former one.

**KEMET's product warranty is set forth at [www.kemet.com](http://www.kemet.com) under Terms and Conditions of Sale.**

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