Printed Circuit Board Mount Power Film Capacitors

C4AF, Radial, 2 or 4 Leads, 250 – 600 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 filled with resin, and uses 2 or 4 tinned wires. These capacitors are intended to withstand harsh environmental conditions.

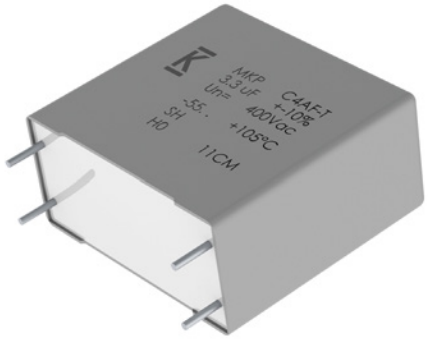
Automotive grade devices meet the demanding Automotive Electronics Council's AEC–Q200 qualification requirements.

Applications

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

Benefits

- C4AF-T High Ripple Current & THB
- C4AF-F Miniaturized & Advanced THB
- Self-healing
- Low loss
- High contact reliability
- Optimized AC voltage performance
- Suitable for high frequency applications
- Able to withstand harsh environmental conditions
- Automotive grades (AEC–Q200)



Simulator Tool and Lifetime Expectancy model available online:

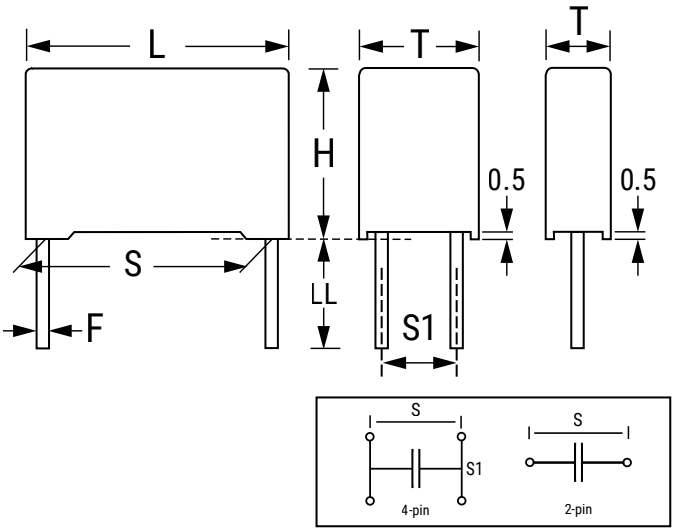
K-SIM ***K-LEM***

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 9 = 310 7 = 350 3 = 400 A = 500 B = 600	B, E = Box plastic case	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 = THB 500 hours 85°C/85% R.H. (Not for new design) T = THB 1,000 hours 85°C/85% R.H. F = THB 1,500 hours 85°C/85% R.H. V_{rac}	1 = 0.8 3 = 1.2	See Dimensions Table for valid case sizes	K = 10%

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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	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, 600 VAC) 250 VAC rating recommended 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 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 75 µF
Rated Voltage (VNAC) Range	250 to 600 VAC (50/60 Hz)
Capacitance Tolerance	±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
	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	Please refer to our Lifetime Expectancy Model
Failure Rate at 40°C and 0.5 x V_R acc. to IEC 61709	≤ 5 FIT

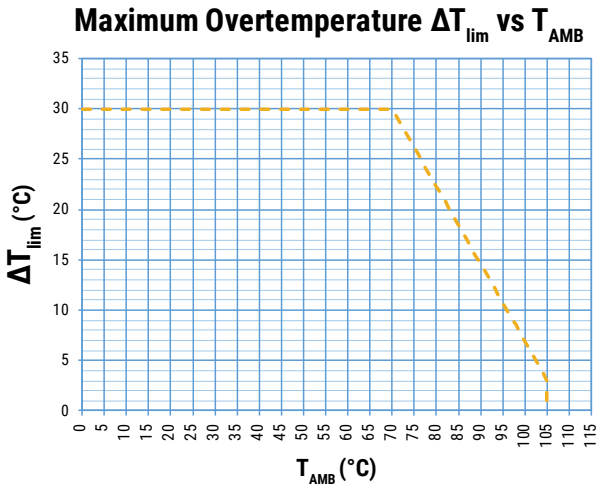
Test Method

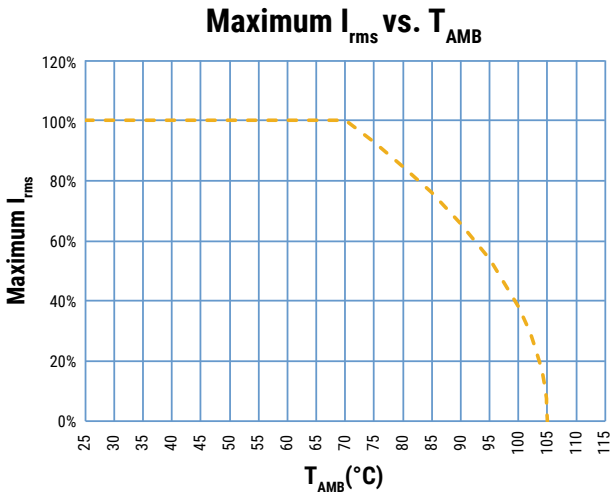
Peak Non-Repetitive Maximum Current	I_{PKR} x 1.5
Test Voltage Terminal to Terminal V_{TT}	1.5 * V_{NDC} for 10 seconds
Test Voltage Terminal to Case V_{TC}	2 k VAC – 50/60 Hz for 60 seconds
Endurance Test	500 hours + 500 hours at 1.25 x rated voltage at 85°C
	500 hours + 500 hours at 1.25 x operative voltage at 105°C
Damp Heat	IEC 60068-2-78
THB Test 85/85 with Voltage Release "A": 500 hours Release "T": 1,000 hours	Test Voltages:
	250 and 310 V_{NAC} version: 240 VAC 350 and 400 V_{NAC} version: 310 VAC 500 V_{NAC} version: 410 VAC 600 V_{NAC} version: 500 VAC
	Performance:
	|ΔC/C| <10% |ΔTg| < $3*10^{-3}$ at 1 kHz Release "A" |ΔTg| < $5*10^{-3}$ at 1 kHz Release "T" IR ≥ 50% initial limit
THB Test 85/85 with Rated Voltage Release "F": 1,500 hours	1,000 hours: |ΔC/C| ≤ 10% ΔDF ≤ $5*10^{-3}$ at 1 kHz IR ≥ 50% initial limit 1,500 hours: |ΔC/C| ≤ 10% ΔDF ≤ $30*10^{-3}$ at 1 kHz IR ≥ 100 MΩ
Change of Temperature	IEC 60068–2–14

Operative Voltage Derating

	Voltage (VAC)					
Operating Voltage	250	310	350	400	500	600
Rated Voltage at 85°C (T_{HS})	250	310	350	400	500	600
Operating Voltage at 105°C (T_{HS})	175	217	245	280	350	420

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:





T_{AMB} is the maximum ambient temperature surrounding the capacitor or hottest contact point (e.g. tracks), whichever is higher, in the worst operation conditions in °C.

Lifetime Expectancy

For lifetime expectancy calculations, please refer to our Lifetime Expectancy Model.

Power Losses & Hot Spot Temperature Calculation in Dry Conditions

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 in Dry Conditions cont.

Limits for the formulas

The limits listed below should not be exceeded:

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

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

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

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]
ESR_{10kHz} = 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 1A – C4AF-T Ratings & Part Number Reference

Cap Value (µF)	V_{NAC}	V_{NDC}	Dimensions (mm)					dV/dt	I_{pkr}	ESL	ESR 70°C at 10 kHz	I_{rms} Max (*) at 70°C	R_{th} (HS/Amb)	Packaging Quantity	PART NUMBER
			T	H	L	S	S1	V/µs	A_{pk}	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	A_{pk}	nH	mΩ	A_{rms}	(°C/W)	Packaging Quantity	PART NUMBER
			Dimensions (mm)					dV/dt	I_{pkr}	ESL	ESR	I_{rms} Max (*) at 70°C	R_{th} (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.

Table 1A – C4AF-T Ratings & Part Number Reference cont.

Cap Value (µF)	V_{NAC}	V_{NDC}	Dimensions (mm)					dV/dt	I_{pkr}	ESL	ESR 70°C at 10 kHz	I_{rms} Max (*) at 70°C	R_{th} (HS/Amb)	Packaging Quantity	PART NUMBER
			T	H	L	S	S1	V/µs	A_{pk}	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	A_{pk}	nH	mΩ	A_{rms}	(°C/W)	Packaging Quantity	PART NUMBER
			Dimensions (mm)					dV/dt	I_{pkr}	ESL	ESR	I_{rms} Max (*) at 70°C	R_{th} (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

Table 1A – C4AF-T Ratings & Part Number Reference cont.

Cap Value (µF)	V_{NAC}	V_{NDC}	Dimensions (mm)					dV/dt	I_{pkr}	ESL	ESR 70°C at 10 kHz	I_{rms} Max (*) at 70°C	R_{th} (HS/Amb)	Packaging Quantity	PART NUMBER
			T	H	L	S	S1	V/µs	A_{pk}	nH	mΩ	A_{rms}	(°C/W)		
V_{NAC} at 85°C = 500 VAC; V_{OPAC} at 105°C = 350 VAC															
1	500	1,000	19	29	31.5	27.5	\	176	176	25	8.3	7.1	29	72	C4AFABU4100T11K
1.5	500	1,000	22	37	31.5	27.5	\	176	264	28	7.2	8.9	23	64	C4AFABU4150T12K
2.2	500	1,000	20	40	42	37.5	10.2	113	249	12	5.7	11.0	20	58	C4AFABW4220T3FK
3	500	1,000	28	37	42	37.5	10.2	113	339	10	4.3	13.3	18	36	C4AFABW4300T3JK
4.4	500	1,000	30	45	42	37.5	20.3	113	498	13	3.2	16.9	15	36	C4AFABW4440T3LK
5.5	500	1,000	35	50	42	37.5	20.3	113	623	14	2.7	20.5	13	30	C4AFABW4550T3OK
6.6	500	1,000	30	45	57.5	52.5	20.3	75	498	13	4.2	18.1	12	27	C4AFABW4660T3MK
8	500	1,000	35	50	57.5	52.5	20.3	76	604	17	3.7	21.3	10	23	C4AFABW4800T3NK
12	500	1,000	45	56	57.5	52.5	20.3	76	907	17	2.7	27.1	8	18	C4AFAEW5120T3AK
15	500	1,000	45	65	57.5	52.5	20.3	76	1133	19	2.4	30.4	7	18	C4AFAEW5150T3BK
V_{NAC} at 85°C = 600 VAC; V_{OPAC} at 105°C = 420 VAC															
1	600	1,200	22	37	31.5	27.5	/	204	204	28	8.0	7.8	23	64	C4AFBBU4100T12K
1.8	600	1,200	20	40	42	37.5	10.2	126	226	12	5.9	10.3	20	58	C4AFBBW4180T3FK
2.2	600	1,200	28	37	42	37.5	10.2	126	277	10	4.9	11.9	18	36	C4AFBBW4220T3JK
3.3	600	1,200	30	45	42	37.5	20.3	126	416	13	3.5	15.3	15	36	C4AFBBW4330T3LK
4.7	600	1,200	35	50	42	37.5	20.3	126	592	14	2.7	19.5	13	30	C4AFBBW4470T3OK
5	600	1,200	30	45	57.5	52.5	20.3	82	409	13	4.8	16.5	12	27	C4AFBBW4500T3MK
7	600	1,200	35	50	57.5	52.5	20.3	82	573	15	3.6	20.4	10	23	C4AFBBW4700T3NK
10	600	1,200	45	56	57.5	52.5	20.3	82	820	17	2.8	25.5	8	18	C4AFBEW5100T3AK
12	600	1,200	45	65	57.5	52.5	20.3	82	984	19	2.6	28.3	7	18	C4AFBEW5120T3BK
Cap Value (µF)	V_{NAC}	V_{NDC}	T	H	L	S	S1	V/µs	A_{pk}	nH	mΩ	A_{rms}	(°C/W)	Packaging Quantity	PART NUMBER
			Dimensions (mm)					dV/dt	I_{pkr}	ESL	ESR	I_{rms} Max (*) at 70°C	R_{th} (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

Table 1B – C4AF-F Ratings & Part Number Reference

Cap Value (µF)	V_{NAC}	V_{NDC}	Dimensions (mm)					dV/dt	I_{pkr}	ESL	ESR 70°C at 10 kHz	I_{rms} Max (*) at 70°C	R_{th} (HS/Amb)	Packaging Quantity	PART NUMBER
			T	H	L	S	S1	V/µs	A_{pk}	nH	mΩ	A_{rms}	(°C/W)		
V_{NAC} at 85°C = 250 VAC; V_{OPAC} at 105°C = 175 VAC															
1.5	250	500	11	20	31.5	27.5	/	30	45	22	39.8	4.0	44	256	C4AF1BU4150F1WK
2.5	250	500	13	25	31.5	27.5	/	30	75	29	25.2	5.5	36	234	C4AF1BU4250F1XK
3.3	250	500	14	28	31.5	27.5	/	30	99	31	20.0	6.6	33	96	C4AF1BU4330F1YK
5.5	250	500	19	29	31.5	27.5	/	30	165	33	13.3	8.5	29	72	C4AF1BU4550F11K
8.5	250	500	22	37	31.5	27.5	/	30	255	36	10.3	10.4	23	64	C4AF1BU4850F12K
11	250	500	20	40	42	37.5	10.2	15	165	16	8.4	12.3	20	58	C4AF1BW5110F3FK
15	250	500	28	37	42	37.5	10.2	15	225	13	6.4	14.6	18	36	C4AF1BW5150F3JK
22	250	500	30	45	42	37.5	20.3	15	330	17	4.7	18.1	15	36	C4AF1BW5220F3LK
28	250	500	35	50	42	37.5	20.3	15	420	18	4.0	21.8	13	30	C4AF1BW5280F3OK
33	250	500	30	45	57.5	52.5	20.3	8	264	17	5.1	20.0	12	27	C4AF1BW5330F3MK
40	250	500	35	50	57.5	52.5	20.3	8	320	20	4.4	23.2	10	23	C4AF1BW5400F3NK
60	250	500	45	56	57.5	52.5	20.3	8	480	22	3.4	28.8	8	18	C4AF1EW5600F3AK
75	250	500	45	65	57.5	52.5	20.3	8	600	25	3.1	31.8	7	18	C4AF1EW5750F3BK
V_{NAC} at 85°C = 310 VAC; V_{OPAC} at 105°C = 215 VAC															
1	310	630	11	20	31.5	27.5	/	40	40	22	53.3	3.5	44	256	C4AF9BU4100F1WK
1.5	310	630	13	25	31.5	27.5	/	40	60	29	36.7	4.6	36	234	C4AF9BU4150F1XK
2	310	630	14	28	31.5	27.5	/	40	80	31	28.5	5.5	33	96	C4AF9BU4200F1YK
3.3	310	630	19	29	31.5	27.5	/	40	132	33	18.5	7.2	29	72	C4AF9BU4330F11K
5.5	310	630	22	37	31.5	27.5	/	40	220	36	13.0	9.3	23	64	C4AF9BU4550F12K
7.5	310	630	20	40	42	37.5	10.2	20	150	16	10.6	10.9	20	58	C4AF9BW4750F3FK
10	310	630	28	37	42	37.5	10.2	20	200	13	8.1	12.9	18	36	C4AF9BW5100F3JK
15	310	630	30	45	42	37.5	20.3	20	300	17	5.8	16.2	15	36	C4AF9BW5150F3LK
20	310	630	35	50	42	37.5	20.3	20	400	18	4.7	19.9	13	30	C4AF9BW5200F3OK
22	310	630	30	45	57.5	52.5	20.3	10	220	17	6.2	18.1	12	27	C4AF9BW5220F3MK
27	310	630	35	50	57.5	52.5	20.3	10	270	20	5.3	21.2	10	23	C4AF9BW5270F3NK
40	310	630	45	56	57.5	52.5	20.3	10	400	22	4.0	26.5	8	18	C4AF9EW5400F3AK
50	310	630	45	65	57.5	52.5	20.3	10	500	25	3.6	29.4	7	18	C4AF9EW5500F3BK
Cap Value (µF)	V_{NAC}	V_{NDC}	T	H	L	S	S1	V/µs	A_{pk}	nH	mΩ	A_{rms}	(°C/W)	Packaging Quantity	PART NUMBER
			Dimensions (mm)					dV/dt	I_{pkr}	ESL	ESR 70°C at 10 kHz	I_{rms} Max (*) at 70°C	R_{th} (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.

Table 1B – C4AF-F Ratings & Part Number Reference cont.

Cap Value (µF)	V_{NAC}	V_{NDC}	Dimensions (mm)					dV/dt	I_{pkr}	ESL	ESR 70°C at 10 kHz	I_{rms} Max (*) at 70°C	R_{th} (HS/Amb)	Packaging Quantity	PART NUMBER
			T	H	L	S	S1	V/µs	A_{pk}	nH	mΩ	A_{rms}	(°C/W)		
V_{NAC} at 85°C = 350 VAC; V_{OPAC} at 105°C = 245 VAC															
1.3	350	700	13	25	31.5	27.5	/	50	65	29	40.8	4.4	36	234	C4AF7BU4130F1XK
1.6	350	700	14	28	31.5	27.5	/	50	80	31	33.9	5.0	33	96	C4AF7BU4160F1YK
2.7	350	700	19	29	31.5	27.5	/	50	135	33	21.4	6.7	29	72	C4AF7BU4270F11K
4.7	350	700	22	37	31.5	27.5	/	50	235	36	14.2	8.8	23	64	C4AF7BU4470F12K
6	350	700	20	40	42	37.5	10.2	25	150	16	12.5	10.0	20	58	C4AF7BW4600F3FK
8	350	700	28	37	42	37.5	10.2	25	200	13	9.6	11.9	18	36	C4AF7BW4800F3JK
12.5	350	700	30	45	42	37.5	20.3	25	313	17	6.6	15.2	15	36	C4AF7BW5125F3LK
16	350	700	35	50	42	37.5	20.3	25	400	18	5.4	18.5	13	30	C4AF7BW5160F3OK
18.5	350	700	30	45	57.5	52.5	20.3	12	222	17	6.8	17.1	12	27	C4AF7BW5185F3MK
22	350	700	35	50	57.5	52.5	20.3	12	264	20	6.0	19.9	10	23	C4AF7BW5220F3NK
33	350	700	45	56	57.5	52.5	20.3	12	396	22	4.4	25.1	8	18	C4AF7EW5330F3AK
40	350	700	45	65	57.5	52.5	20.3	12	480	25	4.0	27.8	7	18	C4AF7EW5400F3BK
V_{NAC} at 85°C = 400 VAC; V_{OPAC} at 105°C = 280 VAC															
1	400	800	14	28	31.5	27.5	/	60	60	31	46.5	4.3	33	96	C4AF3BU4100F1YK
1.8	400	800	19	29	31.5	27.5	/	60	108	33	27.2	6.0	29	72	C4AF3BU4180F11K
3	400	800	22	37	31.5	27.5	/	60	180	36	18.2	7.9	23	64	C4AF3BU4300F12K
4.4	400	800	20	40	42	37.5	10.2	30	132	16	15.1	9.2	20	58	C4AF3BW4440F3FK
6	400	800	28	37	42	37.5	10.2	30	180	13	11.2	11.0	18	36	C4AF3BW4600F3JK
8.5	400	800	30	45	42	37.5	20.3	30	255	17	8.3	13.7	15	36	C4AF3BW4850F3LK
11	400	800	35	50	42	37.5	20.3	30	330	18	6.7	16.8	13	30	C4AF3BW5110F3OK
12.5	400	800	30	45	57.5	52.5	20.3	15	188	17	8.3	15.6	12	27	C4AF3BW5125F3MK
16	400	800	35	50	57.5	52.5	20.3	15	240	20	6.8	18.7	10	23	C4AF3BW5160F3NK
24	400	800	45	56	57.5	52.5	20.3	15	360	22	5.0	23.7	8	18	C4AF3EW5240F3AK
28	400	800	45	65	57.5	52.5	20.3	15	420	25	4.6	26.1	7	18	C4AF3EW5280F3BK
Cap Value (µF)	V_{NAC}	V_{NDC}	T	H	L	S	S1	V/µs	A_{pk}	nH	mΩ	A_{rms}	(°C/W)	Packaging Quantity	PART NUMBER
			Dimensions (mm)					dV/dt	I_{pkr}	ESL	ESR 70°C at 10 kHz	I_{rms} Max (*) at 70°C	R_{th} (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.

Table 1B – C4AF-F Ratings & Part Number Reference cont.

Cap Value (µF)	V_{NAC}	V_{NDC}	Dimensions (mm)					dV/dt	I_{pkr}	ESL	ESR 70°C at 10 kHz	I_{rms} Max (*) at 70°C	R_{th} (HS/Amb)	Packaging Quantity	PART NUMBER
			T	H	L	S	S1	V/µs	A_{pk}	nH	mΩ	A_{rms}	(°C/W)		
V_{NAC} at 85°C = 500 VAC; V_{OPAC} at 105°C = 350 VAC															
1.1	500	1000	19	29	31.5	27.5	/	70	77	33	38.4	5.0	29	72	C4AFABU4110F11K
1.8	500	1000	22	37	31.5	27.5	/	70	126	36	25.3	6.7	23	64	C4AFABU4180F12K
2.7	500	1000	20	40	42	37.5	10.2	35	95	16	20.4	7.9	20	58	C4AFABW4270F3FK
3.5	500	1000	28	37	42	37.5	10.2	35	123	13	15.9	9.3	18	36	C4AFABW4350F3JK
5	500	1000	30	45	42	37.5	20.3	35	175	17	11.5	11.7	15	36	C4AFABW4500F3LK
6.8	500	1000	35	50	42	37.5	20.3	35	238	18	8.8	14.7	13	30	C4AFABW4680F3OK
7.5	500	1000	30	45	57.5	52.5	20.3	18	135	17	10.7	13.8	12	27	C4AFABW4750F3MK
10	500	1000	35	50	57.5	52.5	20.3	18	180	20	8.4	16.9	10	23	C4AFABW5100F3NK
15	500	1000	45	56	57.5	52.5	20.3	18	270	22	6.0	21.6	8	18	C4AFAEW5150F3AK
18	500	1000	45	65	57.5	52.5	20.3	18	324	25	5.4	24.1	7	18	C4AFAEW5180F3BK
V_{NAC} at 85°C = 600 VAC; V_{OPAC} at 105°C = 420 VAC															
1	600	1200	22	37	31.5	27.5	/	80	80	36	39.6	5.4	23	64	C4AFBBU4100F12K
1.6	600	1200	20	40	42	37.5	10.2	40	64	16	30.2	6.5	20	58	C4AFBBW4160F3FK
2.2	600	1200	28	37	42	37.5	10.2	40	88	13	22.2	7.9	18	36	C4AFBBW4220F3JK
3	600	1200	30	45	42	37.5	20.3	40	120	17	16.6	9.9	15	36	C4AFBBW4300F3LK
4	600	1200	35	50	42	37.5	20.3	40	160	18	12.8	12.4	13	30	C4AFBBW4400F3OK
5	600	1200	30	45	57.5	52.5	20.3	20	100	17	13.2	12.5	12	27	C4AFBBW4500F3MK
6	600	1200	35	50	57.5	52.5	20.3	20	120	20	11.3	14.7	10	23	C4AFBBW4600F3NK
9	600	1200	45	56	57.5	52.5	20.3	20	180	22	8.0	19.0	8	18	C4AFBEW4900F3AK
11	600	1200	45	65	57.5	52.5	20.3	20	220	25	6.9	21.6	7	18	C4AFBEW5110F3BK
Cap Value (µF)	V_{NAC}	V_{NDC}	T	H	L	S	S1	V/µs	A_{pk}	nH	mΩ	A_{rms}	(°C/W)	Packaging Quantity	PART NUMBER
			Dimensions (mm)					dV/dt	I_{pkr}	ESL	ESR 70°C at 10 kHz	I_{rms} Max (*) at 70°C	R_{th} (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.

Soldering Process

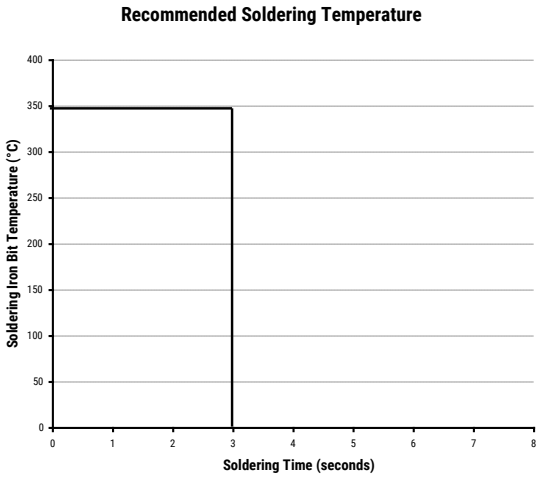
The implementation of the RoHS directive has resulted in the selection of SnAuCu (SAC) alloys, or SnCu alloys, as the primary solder material. This has increased the liquidus temperature from 183°C for a SnPb eutectic alloy to 217 – 221°C for new alloys. As a result, the heat stress to the components, 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.

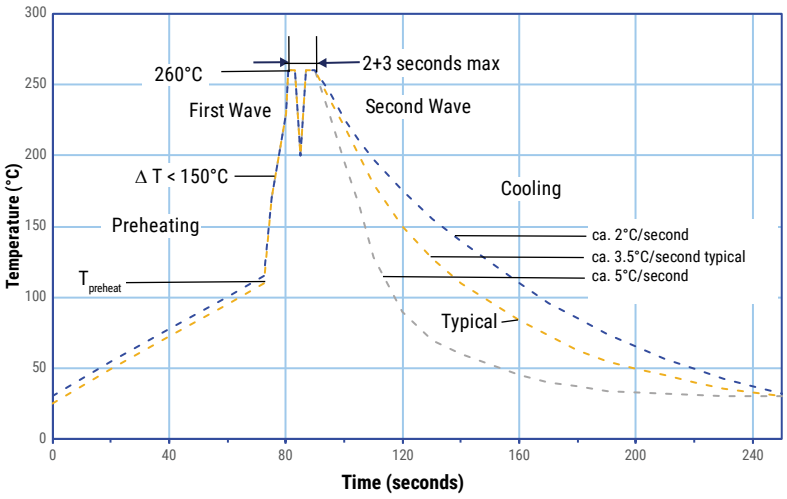
Manual Soldering Recommendations

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.

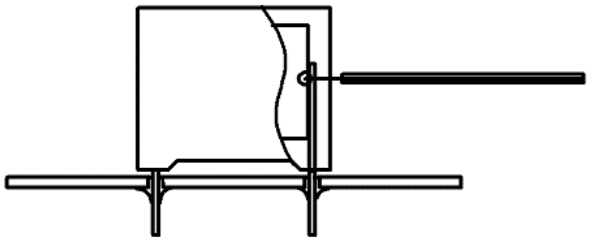
Wave Soldering Recommendations cont.

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

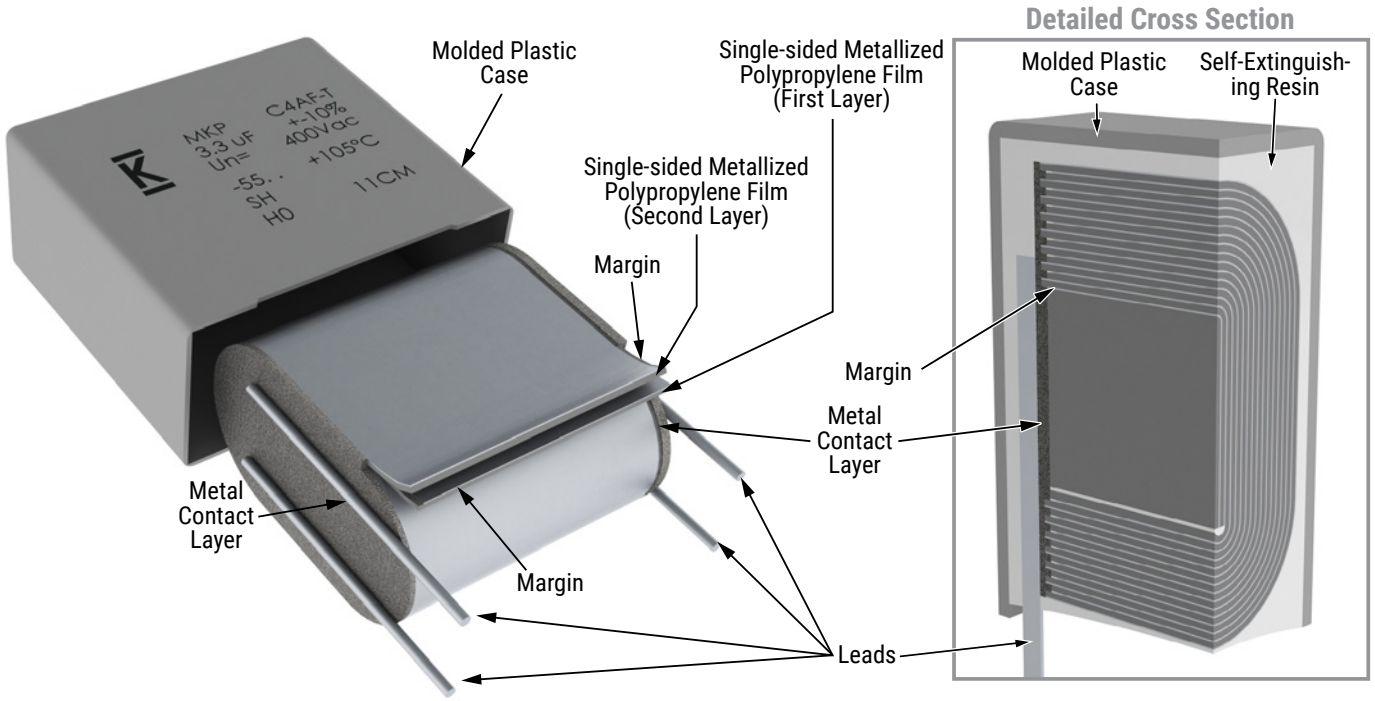
Resistance to Vibration and Mechanical Shock

AEC-Q200 Rev. E, Mechanical Stress Tests:

Mechanical Shock	**MIL-SDT-202 Method 213**	Figure 1 of Method 213 • THT: Condition C • SMD: Condition C • Tested per the Supplier's recommended mounting method
Vibration	**MIL-SDT-202 Method 204**	• 5 g for 20 minutes, 12 cycles each of 3 orientations • Tested per the Supplier's recommended mounting method • Verification of transfer load: during setup, verify that with the selected PCB design (size, thickness and secure points), or an alternative mount, that the transferred load onto the component corresponds to the requested load. This verification can be achieved using a laser vibrometer or other adequate measuring device • Test from 10 Hz – 2,000 Hz.

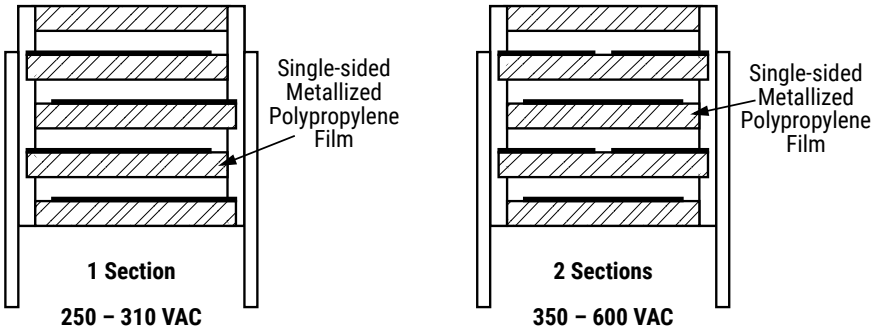
The capacitors are designed for PCB mounting.
The stand-off pipes must be in good contact with the printed circuit board.
The capacitor body has to be properly fixed (e.g. clamped or glued).

Construction

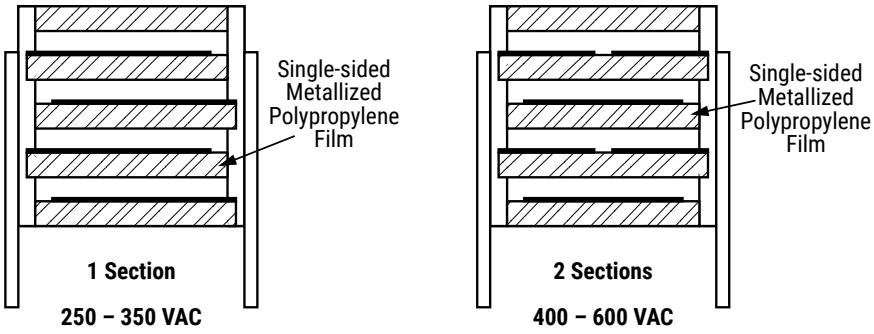


Construction cont.

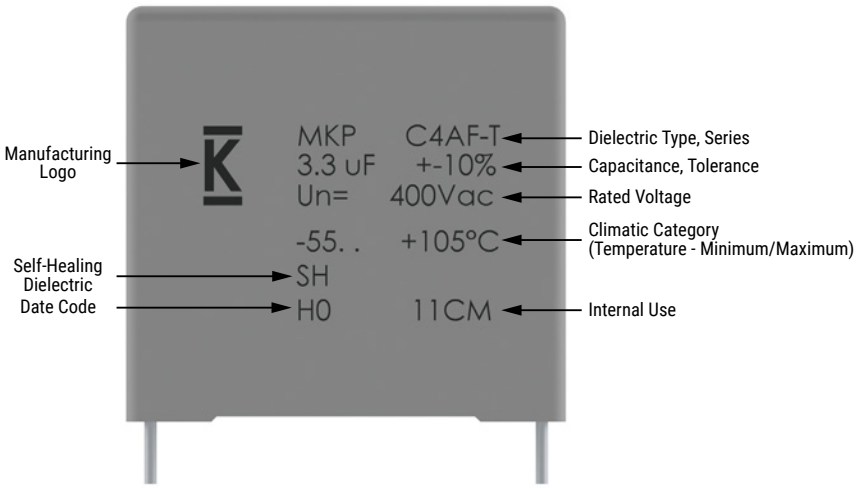
C4AF-A/-T Winding Scheme



C4AF-F Winding Scheme



Marking



Slight change in the layout can be possible but this does not affect the content of the information of the current marking.
This change will be achieved without impact to product form, fit or function, as the products are equivalent with respect to physical, mechanical, quality and reliability characteristics

Manufacturing Date Code (IEC–60062)									
Y = Year, Z = Month									
Year	Code	Year	Code	Year	Code	Month	Code	Month	Code
2020	M	2027	V	2034	E	January	1	July	7
2021	N	2028	W	2035	F	February	2	August	8
2022	P	2029	X	2036	H	March	3	September	9
2023	R	2030	A	2037	J	April	4	October	O
2024	S	2031	B	2038	K	May	5	November	N
2025	T	2032	C	2039	L	June	6	December	D
2026	U	2033	D	2040	M				

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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 indicated or that other measures may not be required.

Additional information about production site flexibility can be found <here>

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KEMET:

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