

# SMD Aluminum Electrolytic Capacitors

## AEF Series



### FEATURES

- Endurance, 105°C, 6000 hours
- Designed for surface mounting on high density PC board
- RoHS Compliance
- AEC-Q200 Tested

### APPLICATIONS

- Industrial
- Consumer electronics
- Lighting
- DC/DC converters



LEAD-FREE  
LEAD-FREE COMPATIBLE  
COMPONENT



RoHS  
COMPLIANT

### HOW TO ORDER

**Product Type** Aluminum

**Series Type**

**Case Size** See table below

**Capacitance Code**  $\mu$ F code: 1st two digits represent significant figures, 3rd digit represents multiplier (number of zeros to follow)

**Tolerance** M =  $\pm 20\%$

**Special** No Code = std

**Packaging** R = Pure Tin  
13" Reel (D  $\geq$  12.50mm)  
15" Reel (D  $\leq$  10.00mm)

**Rated DC Voltage**

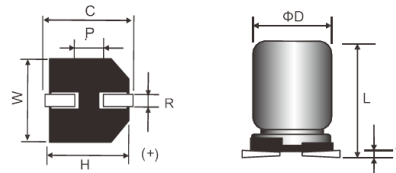
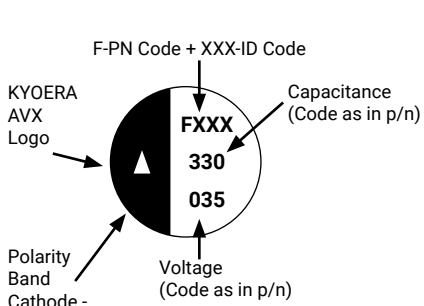
006 = 6.3Vdc	080 = 80Vdc
010 = 10Vdc	100 = 100Vdc
016 = 16Vdc	160 = 160Vdc
025 = 25Vdc	200 = 200Vdc
035 = 35Vdc	250 = 250Vdc
050 = 50Vdc	400 = 400Vdc
063 = 63Vdc	

Ordering code example: **A EF 0608 330 M 035 R -**

### CASE DIMENSIONS millimeters (inches)

Code	D $\pm 0.50$ (0.020)	L $\pm 0.50$ (0.020)	W $\pm 0.20$ (0.008)	H $\pm 0.20$ (0.008)	C $\pm 0.20$ (0.008)	R	P $\pm 0.30$ (0.012)	V max	Typical Weight (g)
0608	6.30 (0.248)	8.00 (0.315)	6.60 (0.260)	6.60 (0.260)	7.30 (0.287)	0.50 - 0.80 (0.020 - 0.031)	2.00 (0.080)	0.30 (0.012)	0.41
0610	6.30 (0.248)	10.50 (0.413)	6.60 (0.260)	6.60 (0.260)	7.30 (0.287)	0.50 - 0.80 (0.020 - 0.031)	2.00 (0.080)	0.30 (0.012)	0.90
0810	8.00 (0.315)	10.50 (0.413)	8.30 (0.327)	8.30 (0.327)	9.00 (0.354)	0.70 - 1.10 (0.028 - 0.043)	3.20 (0.126)	0.30 (0.012)	0.90
0812	8.00 (0.315)	12.50 (0.492)	8.30 (0.327)	8.30 (0.327)	9.00 (0.354)	0.70 - 1.10 (0.028 - 0.043)	3.20 (0.126)	0.30 (0.012)	0.90
0813	8.00 (0.315)	13.50 (0.531)	8.30 (0.327)	8.30 (0.327)	9.00 (0.354)	0.70 - 1.10 (0.028 - 0.043)	3.20 (0.126)	0.30 (0.012)	0.90
1010	10.00 (0.394)	10.50 (0.413)	10.30 (0.406)	10.30 (0.406)	11.00 (0.433)	0.70 - 1.10 (0.028 - 0.043)	4.50 (0.177)	0.30 (0.012)	1.40
1012	10.00 (0.394)	12.50 (0.492)	10.30 (0.406)	10.30 (0.406)	11.00 (0.433)	0.70 - 1.10 (0.028 - 0.043)	4.50 (0.177)	0.30 (0.012)	1.58
1013	10.00 (0.394)	13.50 (0.531)	10.30 (0.406)	10.30 (0.406)	11.00 (0.433)	0.70 - 1.10 (0.028 - 0.043)	4.50 (0.177)	0.30 (0.012)	1.63
1016	10.00 (0.394)	16.50 (0.650)	10.30 (0.406)	10.30 (0.406)	11.00 (0.433)	0.70 - 1.10 (0.028 - 0.043)	4.50 (0.177)	0.30 (0.012)	2.00
1213	12.50 (0.492)	13.50 (0.531)	13.00 (0.512)	13.00 (0.512)	13.70 (0.539)	1.10 - 1.40 (0.043 - 0.055)	4.50 (0.177)	0.40 (0.016)	2.90
1216	12.50 (0.492)	16.00 (0.630)	13.00 (0.512)	13.00 (0.512)	13.70 (0.539)	1.10 - 1.40 (0.043 - 0.055)	4.50 (0.177)	0.40 (0.016)	3.20

### MARKING



# SMD Aluminum Electrolytic Capacitors

## AEF Series

### TECHNICAL SPECIFICATIONS

<b>Category Temperature Range:</b>	-55°C to +105°C (6.3 - 100V), -40°C to +105°C (160 - 400V)		
<b>Capacitance Range:</b>	At 25°C, 120Hz	2.2µF to 470µF	
<b>Capacitance Tolerance:</b>	At 25°C, 120Hz	±20%	
<b>Dissipation Factor (%):</b>	Measurement Frequency: 120Hz at 25°C	Please see the Ratings and Part Number Reference Table below	
<b>Leakage Current:</b>	Rated voltage at 25°C*	6.3 - 100V	160 - 400V
		$I \leq 0.03CV$ or 4µA, whichever is greater (2min)	$I \leq 0.04CV + 100\mu A$ (1min)

\* Note: In the case of an anomalous reading, re-measure the leakage current after following voltage treatment:  
Voltage treatment: DC rated voltage to be applied to the capacitors for 120 minutes at 105°C.

### CAPACITANCE AND RATED VOLTAGE RANGE (FIGURES DENOTES CASE SIZE)

Capacitance		Rated Voltage DC (V <sub>R</sub> )												
µF	Code	6.3V	10V	16V	25V	35V	50V	63V	80V	100V	160V	200V	250V	400V
2.2	2R2													0610
3.3	3R3													0810
4.7	4R7												0810	0812
5.6	5R6													0812
6.8	6R8													1013
10	100					0608			0608	0608	1010	0810	0812	1013
15	150										0812	0813		1016
22	220					0608	0608	0608	0810	0810			1016	
33	330					0608		0810	0810	1010	1013			
47	470				0608	0608	0810	0810	1010	1010	1016			
100	101	0608			0608	0810	1010	1010	1012	1213				
150	151		0608											
220	221	0608	0810	0810	0810	1010	1213	1213	1216					
330	331	0810	1010	0812	1010		1216							
470	471	0810	1010	1010										

Released ratings

### RATINGS & PART NUMBER REFERENCE

Part No.	Case Size	Capacitance (µF)	Rated Voltage (V)	DCL Max. (µA)	DF Max. (%)	ESR Max. @100kHz (Ω)	100kHz RMS Current (mA)
<b>6.3 Volt</b>							
AEF0608101M006R	0608	100	6.3	18	32	0.75	145
AEF0608221M006R	0608	220	6.3	39.6	32	0.75	180
AEF0810331M006R	0810	330	6.3	59.4	32	0.36	280
AEF0810471M006R	0810	470	6.3	84.6	32	0.36	360
<b>10 Volt</b>							
AEF0608151M010R	0608	150	10	45	28	0.75	105
AEF0810221M010R	0810	220	10	66	28	0.36	280
AEF1010331M010R	1010	330	10	99	28	0.23	400
AEF1010471M010R	1010	470	10	141	28	0.23	545
<b>16 Volt</b>							
AEF0810221M016R	0810	220	16	105.6	26	0.36	475
AEF0812331M016R	0812	330	16	158.4	26	0.36	510
AEF1010471M016R	1010	470	16	225.6	26	0.23	720
<b>25 Volt</b>							
AEF0608470M025R	0608	47	25	35.3	16	0.75	165
AEF0608101M025R	0608	100	25	75	16	0.75	175
AEF0810221M025R	0810	220	25	165	16	0.36	535
AEF1010331M025R	1010	330	25	247.5	16	0.23	750
<b>35 Volt</b>							
AEF0608100M035R	0608	10	35	10.5	14	0.75	145
AEF0608220M035R	0608	22	35	23.1	14	0.75	160
AEF0608330M035R	0608	33	35	34.7	14	0.75	175
AEF0608470M035R	0608	47	35	49.4	14	0.75	190
AEF0810101M035R	0810	100	35	105	14	0.36	560

All technical data relates to an ambient temperature of +25°C. Capacitance and DF are measured at 120Hz, 0.5RMS with DC bias of 2.2 volts. DCL is measured at rated voltage after 5 minutes.

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## AEF Series

### RATINGS & PART NUMBER REFERENCE

Part No.	Case Size	Capacitance (µF)	Rated Voltage (V)	DCL Max. (µA)	DF Max. (%)	ESR Max. @100kHz (Ω)	100kHz RMS Current (mA)
AEF1010221M035R	1010	220	35	231	14	0.23	800
<b>50 Volt</b>							
AEF0608220M050R	0608	22	50	33	14	1.5	145
AEF0810470M050R	0810	47	50	70.5	14	0.57	520
AEF1010101M050R	1010	100	50	150	14	0.4	680
AEF1213221M050R	1213	220	50	330	14	0.18	875
AEF1216331M050R	1216	330	50	495	14	0.17	1020
<b>63 Volt</b>							
AEF0608220M063R	0608	22	63	41.6	12	4.6	140
AEF0810330M063R	0810	33	63	62.4	12	1.36	320
AEF0810470M063R	0810	47	63	88.8	12	1.36	380
AEF1010101M063R	1010	100	63	189	12	0.73	530
AEF1213221M063R	1213	220	63	415.8	12	0.3	840
<b>80 Volt</b>							
AEF0608100M080R	0608	10	80	24	12	5.2	130
AEF0810220M080R	0810	22	80	52.8	12	2.2	360
AEF0810330M080R	0810	33	80	79.2	12	2.2	410
AEF1010470M080R	1010	47	80	112.8	12	1.4	490
AEF1012101M080R	1012	100	80	240	12	1.4	530
AEF1216221M080R	1216	220	80	528	12	0.49	1020
<b>100 Volt</b>							
AEF0608100M100R	0608	10	100	30	10	5.5	140
AEF0810220M100R	0810	22	100	66	10	2.7	320
AEF1010330M100R	1010	33	100	99	10	1.8	360
AEF1010470M100R	1010	47	100	141	10	1.8	540
AEF1213101M100R	1213	100	100	300	10	0.68	550
<b>160 Volt</b>							
AEF1010100M160R	1010	10	160	164	20	16	176
AEF0812150M160R	0812	15	160	196	20	14	204
AEF1013330M160R	1013	33	160	311.2	20	9	340
AEF1016470M160R	1016	47	160	400.8	20	8	420
<b>200 Volt</b>							
AEF0810100M200R	0810	10	200	180	20	16	170
AEF0813150M200R	0813	15	200	220	20	14	210
<b>250 Volt</b>							
AEF08104R7M250R	0810	4.7	250	147	20	30	90
AEF0812100M250R	0812	10	250	200	20	16	150
AEF1016220M250R	1016	22	250	320	20	12	312
<b>400 Volt</b>							
AEF06102R2M400R	0610	2.2	400	135.2	24	35	48
AEF08103R3M400R	0810	3.3	400	152.8	24	32	72
AEF08124R7M400R	0812	4.7	400	175.2	24	26	100
AEF08125R6M400R	0812	5.6	400	189.6	24	24	108
AEF10136R8M400R	1013	6.8	400	208.8	24	22	140
AEF1013100M400R	1013	10	400	260	24	18	194
AEF1016150M400R	1016	15	400	340	24	16	235

All technical data relates to an ambient temperature of +25°C. Capacitance and DF are measured at 120Hz, 0.5RMS with DC bias of 2.2 volts. DCL is measured at rated voltage after 5 minutes.

### FREQUENCY COEFFICIENT OF PERMISSIBLE RIPPLE CURRENT

Rated Voltage (Vdc)	120 - 1K(Hz)	1K - 10K(Hz)	10K - 100K(Hz)	100K(Hz)
6.3 - 400	0.50	0.80	0.90	1.00

Internal heating produced by ripple current will reduce the lifetime of capacitors, at a rate of halving the lifetime with every 5°C rise. When long life performance is required in actual use the rms ripple current should be minimized.

# SMD Aluminum Electrolytic Capacitors

## AEF Series

### QUALIFICATION TABLE

Test	AEF series (Temperature Range -55°C to +105°C (6.3-100V), -40°C to +105°C (160-400V))								
	Condition	Characteristics							
Low Temperature Characteristics (Max. Impedance Ratio)	At 120Hz	Rated Voltage (V)	6.3	10	16	25	35 - 100	160 - 250	400
		Z(-25°C)/Z(+20°C)	4	3	2	2	2	6	6
		Z(-40°C)/Z(+20°C)	10	8	6	4	3	10	18
Endurance	The specifications shall be met when the capacitors are restored to 20°C after rated voltage is applied for 6,000 hours at 105°C.	Rated Voltage (V)	6.3 - 100				160 - 400		
		ΔC/C	≤±30% of the initial limit				≤±20% of the initial limit		
		DF	≤300% of the initial specified limit				≤200% of the initial specified limit		
		DCL	≤the initial specified limit				≤the initial specified limit		
Shelf Life	The following specifications shall be satisfied when the capacitors are restored to 20°C after leaving them under no load at 105°C for 1,000 hours.	Rated Voltage (V)	6.3 - 100				160 - 400		
		ΔC/C	≤±30% of the initial limit				≤±20% of the initial limit		
		DF	≤300% of the initial specified limit				≤200% of the initial specified limit		
		DCL	≤200% of the initial specified limit				≤200% of the initial specified limit		

### REFLOW

Diameter (mm)	Φ6.3	Φ8	Φ10	Φ12.5
Peak Temperature	260°C, 5 sec. max.			
Preheat Temperature	100°C to 200°C, 180 sec. max.			100°C to 180°C, 150 sec. max.
Duration at 200°C or higher	90 sec. max.	90 sec. max.	60 sec. max.	60 sec. max.
Duration at 230°C or higher	40 sec. max.	30 sec. max.	30 sec. max.	30 sec. max.
Reflow Number	Twice* or less			

\*if twice then need to be at least 2hrs between reflows

### STORAGE

- It is recommended to keep capacitors between the ambient temperatures of 5°C to 35°C (if between 35°C to 85°C, it should be less than three months) and the relative humidity of 75% or below.
- Confirm that the environment does not have any of the following conditions:
  - Damp conditions such as water, saltwater spray, or oil spray or fumes. High humidity or humidity condensation situations.
  - In an atmosphere filled with toxic gasses (such as hydrogen sulfide, sulfurous acid, nitrous acid, chlorine, ammonia, etc.).
  - Being exposed to direct sunlight, ozone, ultraviolet ray, or radiation.
  - Being exposed to acidic or alkaline solutions.
  - Under severe conditions where vibration and / or mechanical shock exceed the applicable ranges of the specification.
- Storage time:
  - Before unseal: within 2 years after delivery

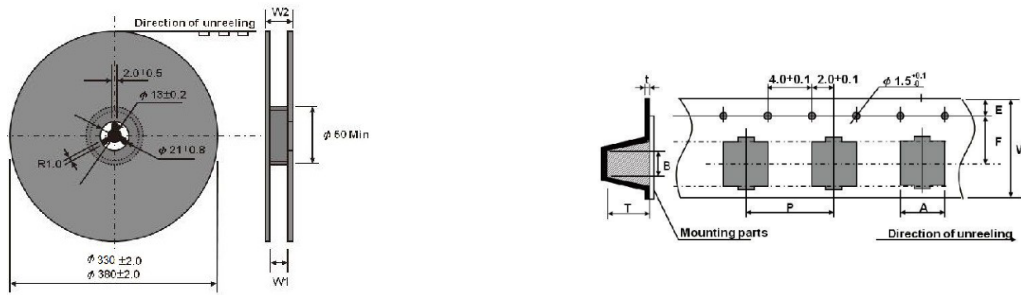
### PACKAGE TAPE DIMENSIONS units (mm)

Size Code	A0±0.20	B0±0.20	W±0.30	F±0.10	E±0.10	P±0.10	t±0.10	T±0.20
0608	7.0	7.0	16.0	7.5	1.75	12.0	0.4	8.0
0610	7.0	7.0	16.0	7.5	1.75	12.0	0.4	11.0
0810	8.7	8.7	24.0	11.5	1.75	16.0	0.4	11.0
0812	8.7	8.7	24.0	11.5	1.75	16.0	0.4	13.0
0813	8.7	8.7	24.0	11.5	1.75	16.0	0.4	14.0
1010	10.7	10.7	24.0	11.5	1.75	16.0	0.4	11.0
1012	10.7	10.7	24.0	11.5	1.75	16.0	0.4	13.0 - 13.5
1013	10.7	10.7	24.0	11.5	1.75	16.0	0.4	15.0
1016	10.7	10.7	24.0	11.5	1.75	16.0	0.4	17.5
1213	13.4	13.4	32.0	14.2	1.75	24.0	0.4	14.5
1216	13.4	13.4	32.0	14.2	1.75	24.0	0.4	16.5

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## AEF Series

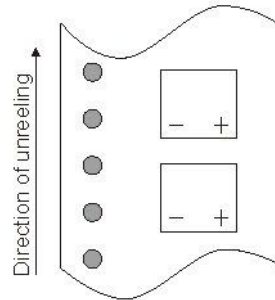
### REEL



### DIMENSIONS units (mm)

Size Code	W1±1.00	W2±1.00	Qty./Reel	Reel size (inch)
0608	18.0	22.0	1000	15
0610	18.0	22.0	1000	15
0810	18.0	22.0	550	15
0812	26.0	31.0	550	15
0813	26.0	31.0	550	15
1010	26.0	31.0	550	15
1012	26.0	31.0	500	15
1013	26.0	31.0	450	15
1016	26.0	31.0	350	15
1213	34.0	39.0	200	13
1216	34.0	39.0	150	13

### POLARITY



### RECOMMENDED LAND PATTERN DIMENSION OF PCB

Size Code	A (mm)	B (mm)	C (mm)
0608	1.9	3.5	1.6
0610	1.9	3.5	1.6
0810	3.1	4.2	2.2
0812	3.1	4.2	2.2
0813	3.1	4.2	2.2
1010	4.5	4.4	2.2
1012	4.5	4.4	2.2
1013	4.5	4.4	2.2
1016	4.5	4.4	2.2
1213	4.0	5.7	2.5
1216	4.0	5.7	2.5

