

Overview

KEMET's EDK Series of aluminum electrolytic surface mount capacitors are designed for high density printed circuit boards.

Applications

Typical applications include coupling, decoupling, bypass, and filtering.

Benefits

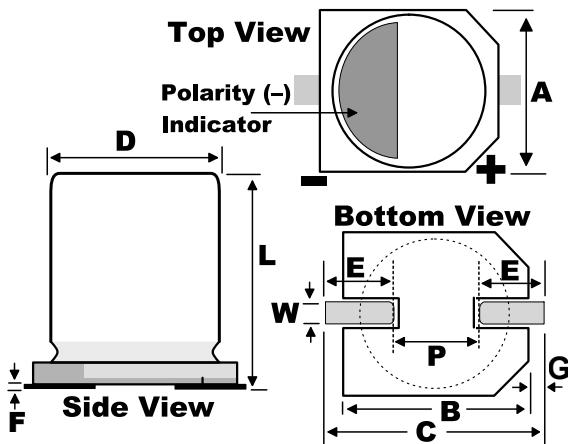
- Surface mount lead terminals
- Low profile vertical chip
- General purpose +85°C/2,000 hours



Part Number System

EDK	226	M	004	A	9B	AA
Series	Capacitance Code (pF)	Tolerance	Rated Voltage (VDC)	Electrical Parameters	Size Code	Packaging
Surface Mount Aluminum Electrolytic	Digits 4 – 5 represent the first two digits of the capacitance value. The final digit indicates the number of zeros to be added.	M = $\pm 20\%$	004 = 4 6R3 = 6.3 010 = 10 016 = 16 025 = 25 035 = 35	050 = 50 063 = 63 100 = 100 250 = 250 400 = 400 450 = 450	A = Standard	See Dimension Table AA = Tape & Reel

Dimensions – Millimeters



Size Code	D		L		A/B		C		E	
	Nominal	Tolerance	Nominal	Tolerance	Nominal	Tolerance	Nominal	Tolerance	Nominal	Tolerance
9B	4	± 0.5	5.4	$+0.25/-0.1$	4.3	± 0.2	5.5	Maximum	1.8	± 0.2
9D	5	± 0.5	5.4	$+0.25/-0.1$	5.3	± 0.2	6.5	Maximum	2.2	± 0.2
9G	6.3	± 0.5	5.4	$+0.25/-0.1$	6.6	± 0.2	7.8	Maximum	2.6	± 0.2
9H	6.3	± 0.5	7.7	± 0.3	6.6	± 0.2	7.8	Maximum	2.6	± 0.2
9L	8	± 0.5	6.2	± 0.3	8.3	± 0.2	9.5	Maximum	3.4	± 0.2
9M	8	± 0.5	10.2	± 0.3	8.3	± 0.2	10	Maximum	3.4	± 0.2
9P	10	± 0.5	10.2	± 0.3	10.3	± 0.2	13	Maximum	3.5	± 0.2
9R	12.5	± 0.5	13.5	± 0.5	12.8	± 0.2	15.2	Maximum	4.9	± 0.2
9S	12.5	± 0.5	16	± 0.5	12.8	± 0.2	15.2	Maximum	4.9	± 0.2
9T	16	± 0.5	16.5	± 1.0	16.3	± 0.2	18.7	Maximum	5.8	± 0.2

Size Code	F		G		P		W	
	Nominal	Tolerance	Nominal	Tolerance	Nominal	Tolerance	Nominal	Tolerance
9B	0.3	Maximum	0.35	$+0.15/-0.2$	1.0	± 0.2	0.65	± 0.1
9D	0.3	Maximum	0.35	$+0.15/-0.2$	1.5	± 0.2	0.65	± 0.1
9G	0.3	Maximum	0.35	$+0.15/-0.2$	1.8	± 0.2	0.65	± 0.1
9H	0.3	Maximum	0.35	$+0.15/-0.2$	1.8	± 0.2	0.65	± 0.1
9L	0.3	Maximum	0.35	$+0.15/-0.2$	2.2	± 0.2	0.65	± 0.1
9M	0.3	Maximum	0.70	± 0.2	3.1	± 0.2	0.9	± 0.2
9P	0.3	Maximum	0.70	± 0.2	4.6	± 0.2	0.9	± 0.2
9R	0.3	Maximum	1.0	± 0.2	4.6	± 0.2	1.25	± 0.2
9S	0.3	Maximum	1.0	± 0.2	4.6	± 0.2	1.25	± 0.2
9T	0.3	Maximum	1.0	± 0.2	6.0	± 0.2	2.0	± 0.2

Performance Characteristics

Item	Performance Characteristics	
Capacitance Range	1 – 1,000 μ F	4.7 – 68 μ F
Rated Voltage	4 – 100 VDC	160 – 450 VDC
Operating Temperature	-40°C to +85°C	
Capacitance Tolerance	$\pm 20\%$ at 120 Hz / 20°C	
Life Test	2,000 hours (see conditions in Test Method & Performance)	
Leakage Current	$I \leq 0.01 CV$ or 3 μ A, whichever is greater	$I = 0.04 CV + 100 \mu$ A
	C = rated capacitance (μ F), V = rated voltage (VDC). Voltage applied for 2 minutes at 20°C.	

Impedance Z Characteristics at 120 Hz

Rated Voltage (VDC)	4	6.3	10	16	25	35	50	63	100	160	200	250	400	450
Z (-25°C) / Z (20°C)	7	4	3	2	2	2	2	2	2	3	3	3	6	6
Z (-40°C) / Z (20°C)	15	8	6	4	4	3	3	3	3	6	6	6	10	10

Compensation Factor of Ripple Current (RC) vs. Frequency

Rated Voltage (VDC)	60 Hz	120 Hz	1 kHz	10 kHz
4 – 100	0.80	1.00	1.15	1.25
160 – 450	0.70	1.00	1.40	1.60

Compensation Factor of Ripple Current (RC) vs. Temperature

Rated Voltage (VDC)	50°C	75°C	85°C
4 – 100	1.36	1.25	1.00
160 – 450	1.60	1.25	1.00

Test Method & Performance

Conditions	Load Life Test	Shelf Life Test
Temperature	85°C	85°C
Test Duration	2,000 hours	1,000 hours
Ripple Current	Maximum ripple current specified at 120 Hz 85°C	No ripple current applied
Voltage	The sum of DC voltage and the peak AC voltage must not exceed the rated voltage of the capacitor.	No voltage applied
Performance	The following specifications will be satisfied when the capacitor is restored to 20°C:	
Capacitance Change	Within $\pm 20\%$ of the initial value	
Dissipation Factor	Does not exceed 200% of the specified value	
Leakage Current	Does not exceed specified value	

Environmental Compliance

As an environmentally conscious company, KEMET is working continuously with improvements concerning the environmental effects of both our capacitors and their production. In Europe (RoHS Directive) and in some other geographical areas like China, legislation has been put in place to prevent the use of some hazardous materials, such as lead (Pb), in electronic equipment. All products in this catalog are produced to help our customers' obligations to guarantee their products and fulfill these legislative requirements. The only material of concern in our products has been lead (Pb), which has been removed from all designs to fulfill the requirement of containing less than 0.1% of lead in any homogeneous material. KEMET will closely follow any changes in legislation world wide and makes any necessary changes in its products, whenever needed.

Some customer segments such as medical, military and automotive electronics may still require the use of lead in electrode coatings. To clarify the situation and distinguish products from each other, a special symbol is used on the packaging labels for RoHS compatible capacitors.

Because of customer requirements, there may appear additional markings such as LF = Lead Free or LFW = Lead Free Wires on the label.



RoHS Compliant

Table 1 – Ratings & Part Number Reference

VDC	VDC Surge Voltage	Rated Capacitance 120 Hz 20°C (µF)	Case Size D x L (mm)	DF 120 Hz 20°C (tan δ %)	RC 120 Hz 85°C (mA)	LC 20°C 2 Minutes (µA)	Part Number
4	5	22	4 x 5.4	35	19	3	EDK226M004A9BAA
4	5	33	4 x 5.4	35	26	3	EDK336M004A9BAA
4	5	47	4 x 5.4	35	34	3	EDK476M004A9BAA
4	5	100	5 x 5.4	35	61	4	EDK107M004A9DAA
4	5	220	6.3 x 5.4	35	82	9	EDK227M004A9GAA
6.3	8	22	4 x 5.4	26	20	3	EDK226M6R3A9BAA
6.3	8	33	5 x 5.4	26	22	3	EDK336M6R3A9DAA
6.3	8	47	5 x 5.4	26	46	3	EDK476M6R3A9DAA
6.3	8	100	6.3 x 5.4	26	71	6	EDK107M6R3A9GAA
6.3	8	220	8 x 6.2	35	250	14	EDK227M6R3A9LAA
6.3	8	330	8 x 6.2	35	300	21	EDK337M6R3A9LAA
6.3	8	470	8 x 10.2	35	380	30	EDK477M6R3A9MMA
6.3	8	680	10 x 10.2	35	458	43	EDK687M6R3A9PAA
6.3	8	1000	10 x 10.2	35	700	63	EDK108M6R3A9PAA
10	13	15	4 x 5.4	30	23	3	EDK156M010A9BAA
10	13	22	4 x 5.4	30	28	3	EDK226M010A9BAA
10	13	33	4 x 5.4	30	29	3	EDK336M010A9BAA
10	13	33	5 x 5.4	20	43	3	EDK336M010A9DAA
10	13	47	5 x 5.4	30	43	5	EDK476M010A9DAA
10	13	100	6.3 x 5.4	26	70	10	EDK107M010A9GAA
10	13	220	6.3 x 7.7	26	220	22	EDK227M010A9HAA
10	13	220	8 x 6.2	26	250	22	EDK227M010A9LAA
10	13	330	8 x 10.2	26	330	33	EDK337M010A9MMA
10	13	470	10 x 10.2	26	400	47	EDK477M010A9PAA
16	20	4.7	4 x 5.4	16	20	3	EDK475M016A9BAA
16	20	10	4 x 5.4	16	28	3	EDK106M016A9BAA
16	20	22	4 x 5.4	26	27	4	EDK226M016A9BAA
16	20	22	5 x 5.4	16	39	4	EDK226M016A9DAA
16	20	33	5 x 5.4	26	45	5	EDK336M016A9DAA
16	20	33	6.3 x 5.4	16	66	5	EDK336M016A9GAA
16	20	47	6.3 x 5.4	16	70	8	EDK476M016A9GAA
16	20	100	6.3 x 5.4	20	70	16	EDK107M016A9GAA
16	20	150	6.3 x 7.7	26	109	24	EDK157M016A9HAA
16	20	220	6.3 x 7.7	20	215	35	EDK227M016A9HAA
16	20	220	8 x 10.2	20	280	35	EDK227M016A9MMA
16	20	330	10 x 10.2	20	380	53	EDK337M016A9PAA
16	20	470	8 x 10.2	20	365	75	EDK477M016A9MMA
16	20	470	10 x 10.2	20	420	75	EDK477M016A9PAA
25	32	1	4 x 5.4	16	9	3	EDK105M025A9BAA
25	32	2.2	4 x 5.4	16	14	3	EDK225M025A9BAA
25	32	4.7	4 x 5.4	14	22	3	EDK475M025A9BAA
25	32	10	5 x 5.4	14	28	3	EDK106M025A9DAA
25	32	22	5 x 5.4	14	45	5	EDK226M025A9DAA
25	32	22	6.3 x 5.4	14	55	6	EDK226M025A9GAA
25	32	33	6.3 x 5.4	14	65	8	EDK336M025A9GAA
25	32	47	6.3 x 5.4	20	70	12	EDK476M025A9GAA
25	32	47	8 x 6.2	16	96	12	EDK476M025A9LAA
25	32	68	6.3 x 7.7	20	95	17	EDK686M025A9HAA
25	32	100	6.3 x 7.7	16	135	25	EDK107M025A9HAA
25	32	100	8 x 6.2	16	145	25	EDK107M025A9LAA
25	32	100	8 x 10.2	16	180	25	EDK107M025A9MMA
25	32	220	8 x 10.2	16	300	55	EDK227M025A9MMA
25	32	220	10 x 10.2	16	310	55	EDK227M025A9PAA
25	32	330	10 x 10.2	16	350	82	EDK337M025A9PAA
25	32	470	10 x 10.2	16	450	117	EDK477M025A9PAA
35	44	2.2	4 x 5.4	12	8	3	EDK225M035A9BAA
35	44	3.3	4 x 5.4	12	10	3	EDK335M035A9BAA
35	44	4.7	4 x 5.4	12	22	3	EDK475M035A9BAA
35	44	10	5 x 5.4	12	30	4	EDK106M035A9DAA
35	44	22	5 x 5.4	14	47	8	EDK226M035A9DAA
35	44	22	6.3 x 5.4	12	60	8	EDK226M035A9GAA
VDC	VDC Surge	Rated Capacitance	Case Size	DF	RC	LC	Part Number

Table 1 – Ratings & Part Number Reference cont'd

VDC	VDC Surge Voltage	Rated Capacitance 120 Hz 20°C (µF)	Case Size D x L (mm)	DF 120 Hz 20°C (tan δ %)	RC 120 Hz 85°C (mA)	LC 20°C 2 Minutes (µA)	Part Number
35	44	33	8 x 6.2	14	130	12	EDK336M035A9LAA
35	44	47	6.3 x 5.4	14	135	16	EDK476M035A9GAA
35	44	47	8 x 6.2	14	165	16	EDK476M035A9LAA
35	44	100	6.3 x 7.7	14	145	35	EDK107M035A9HAA
35	44	100	10 x 10.2	14	210	35	EDK107M035A9PAA
35	44	220	10 x 10.2	14	310	77	EDK227M035A9PAA
35	44	330	10 x 10.2	14	380	115	EDK337M035A9PAA
50	63	0.1	4 x 5.4	12	1	3	EDK104M050A9BAA
50	63	0.22	4 x 5.4	12	2	3	EDK224M050A9BAA
50	63	0.33	4 x 5.4	12	3	3	EDK334M050A9BAA
50	63	0.47	4 x 5.4	12	5	3	EDK474M050A9BAA
50	63	1	4 x 5.4	12	10	3	EDK105M050A9BAA
50	63	2.2	4 x 5.4	12	16	3	EDK225M050A9BAA
50	63	3.3	4 x 5.4	12	16	3	EDK335M050A9BAA
50	63	4.7	4 x 5.4	12	20	3	EDK475M050A9BAA
50	63	4.7	5 x 5.4	12	23	3	EDK475M050A9DAA
50	63	10	6.3 x 5.4	12	35	5	EDK106M050A9GAA
50	63	22	8 x 6.2	12	110	11	EDK226M050A9LAA
50	63	33	8 x 10.2	12	120	16.5	EDK336M050A9MAA
50	63	47	6.3 x 7.7	12	98	23.5	EDK476M050A9HAA
50	63	47	10 x 10.2	12	130	23.5	EDK476M050A9PAA
50	63	100	8 x 10.2	12	165	50	EDK107M050A9MAA
50	63	100	10 x 10.2	12	190	50	EDK107M050A9PAA
50	63	220	10 x 10.2	12	300	110	EDK227M050A9PAA
63	79	4.7	6.3 x 5.4	18	20	3	EDK475M063A9GAA
63	79	10	6.3 x 5.4	18	20	6	EDK106M063A9GAA
63	79	22	8 x 10.2	18	30	14	EDK226M063A9MAA
63	79	33	8 x 10.2	18	30	21	EDK336M063A9MAA
63	79	47	8 x 10.2	18	30	30	EDK476M063A9MAA
63	79	100	10 x 10.2	18	60	63	EDK107M063A9PAA
100	125	3.3	8 x 10.2	18	30	3	EDK335M100A9MAA
100	125	4.7	8 x 10.2	18	50	5	EDK475M100A9MAA
100	125	10	6.3 x 7.7	18	40	10	EDK106M100A9HAA
100	125	10	8 x 10.2	18	55	10	EDK106M100A9MAA
100	125	22	10 x 10.2	18	60	22	EDK226M100A9PAA
100	125	33	10 x 10.2	18	65	33	EDK336M100A9PAA
160	200	33	12.5 x 13.5	20	240	310	EDK336M160A9RAA
160	200	47	12.5 x 16	20	370	400	EDK476M160A9SAA
160	200	68	16 x 16.5	20	500	540	EDK686M160A9TAA
200	250	22	12.5 x 13.5	20	240	280	EDK226M200A9RAA
200	250	33	12.5 x 16	20	310	370	EDK336M200A9SAA
200	250	47	16 x 16.5	20	340	480	EDK476M200A9TAA
200	250	68	16 x 16.5	20	340	650	EDK686M200A9TAA
250	300	10	12.5 x 13.5	20	150	200	EDK106M250A9RAA
250	300	22	12.5 x 13.5	20	150	320	EDK226M250A9RAA
250	300	33	12.5 x 16	20	240	430	EDK336M250A9SAA
250	300	47	16 x 16.5	20	340	570	EDK476M250A9TAA
400	450	4.7	12.5 x 13.5	25	120	180	EDK475M400A9RAA
400	450	10	12.5 x 13.5	25	120	260	EDK106M400A9RAA
400	450	22	16 x 16.5	25	140	460	EDK226M400A9TAA
400	450	33	16 x 16.5	25	140	630	EDK336M400A9TAA
450	500	4.7	12.5 x 13.5	25	120	180	EDK475M450A9RAA
450	500	10	12.5 x 16	25	130	280	EDK106M450A9SAA
450	500	22	16 x 16.5	25	140	500	EDK226M450A9TAA
VDC	VDC Surge	Rated Capacitance	Case Size	DF	RC	LC	Part Number

Mounting Positions (Safety Vent)

In operation, electrolytic capacitors will always conduct a leakage current which causes electrolysis. The oxygen produced by electrolysis will regenerate the dielectric layer but, at the same time, the hydrogen released may cause the internal pressure of the capacitor to increase. The overpressure vent (safety vent) ensures that the gas can escape when the pressure reaches a certain value. All mounting positions must allow the safety vent to work properly.

Installing

- A general principle is that lower-use temperatures result in a longer, useful life of the capacitor. For this reason, it should be ensured that electrolytic capacitors are placed away from heat-emitting components. Adequate space should be allowed between components for cooling air to circulate, particularly when high ripple current loads are applied. In any case, the maximum category temperature must not be exceeded.
- Do not deform the case of capacitors or use capacitors with a deformed case.
- Verify the correct polarization of the capacitor on the board.

It is recommended that capacitors always be mounted with the safety device uppermost or in the upper part of the capacitor.

- If the capacitors are stored for a long time, the leakage current must be verified. If the leakage current is superior to the value listed in this catalog, the capacitors must be reformed. In this case, they can be reformed by application of the rated voltage through a series resistor approximately $1\text{ k}\Omega$ for capacitors with $V_R \leq 160\text{ V}$ (5 W resistor) and $10\text{ k}\Omega$ for the other rated voltages.
- In the case of capacitors connected in series, a suitable voltage sharing must be used.

In the case of balancing resistors, the approximate resistance value can be calculated as: $R = 60/C$

KEMET recommends, nevertheless, to ensure that the voltage across each capacitor does not exceed its rated voltage.

Application and Operation Guidelines

Electrical Ratings: Capacitance (ESC)

Capacitance is measured by applying an alternate voltage of $\leq 0.5\text{ V}$ at a frequency of 120 or 100 Hz and 20°C .

Temperature Dependence of the Capacitance

Capacitance of an electrolytic capacitor depends upon temperature: with decreasing temperature the viscosity of the electrolyte increases, thereby reducing its conductivity.

Capacitance will decrease if temperature decreases. Furthermore, temperature drifts cause armature dilatation and, therefore, capacitance changes (up to 20% depending on the series considered, from 0 to 80°C). This phenomenon is more evident for electrolytic capacitors than for other types.

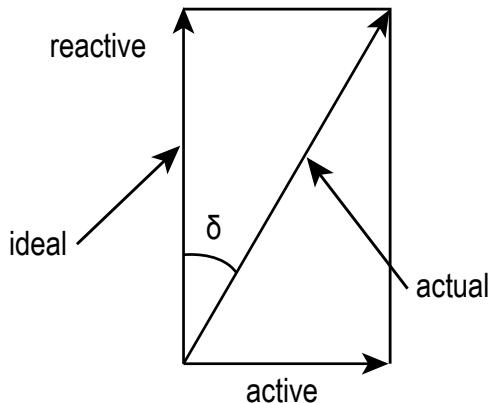
Frequency Dependence of the Capacitance

Effective capacitance value is derived from the impedance curve, as long as impedance is still in the range where the capacitance component is dominant.

$$C = \frac{1}{2\pi fZ} \quad C = \text{Capacitance (F)} \\ f = \text{Frequency (Hz)} \\ Z = \text{Impedance (\Omega)}$$

Dissipation Factor $\tan \delta$ (DF)

Dissipation Factor $\tan \delta$ is the ratio between the active and reactive power for a sinusoidal waveform voltage. It can be thought of as a measurement of the gap between an actual and ideal capacitor.



$\tan \delta$ is measured with the same set-up used for the series capacitance ESC.

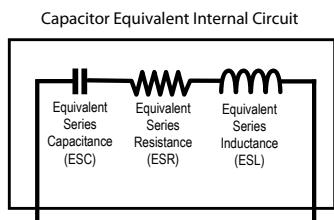
$\tan \delta = \omega \times \text{ESC} \times \text{ESR}$ where:

ESC = Equivalent Series Capacitance

ESR = Equivalent Series Resistance

Equivalent Series Inductance (ESL)

Self inductance or Equivalent Series Inductance results from the terminal configuration and internal design of the capacitor.



Equivalent Series Resistance (ESR)

Equivalent Series Resistance is the resistive component of the equivalent series circuit. ESR value depends on frequency and temperature and is related to the $\tan \delta$ by the following equation:

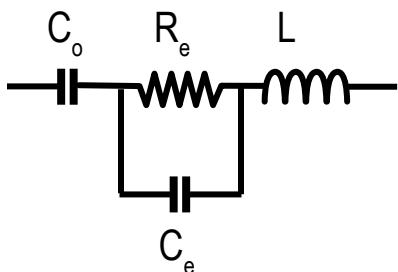
$$ESR = \frac{\tan \delta}{2\pi f \cdot ESC}$$

ESR = Equivalent Series Resistance (Ω)
 $\tan \delta$ = Dissipation Factor
 ESC = Equivalent Series Capacitance (F)
 f = Frequency (Hz)

Tolerance limits of the rated capacitance must be taken into account when calculating this value.

Impedance (Z)

Impedance of an electrolytic capacitor results from a circuit formed by the following individual equivalent series components:



C_o = Aluminum oxide capacitance (surface and thickness of the dielectric)

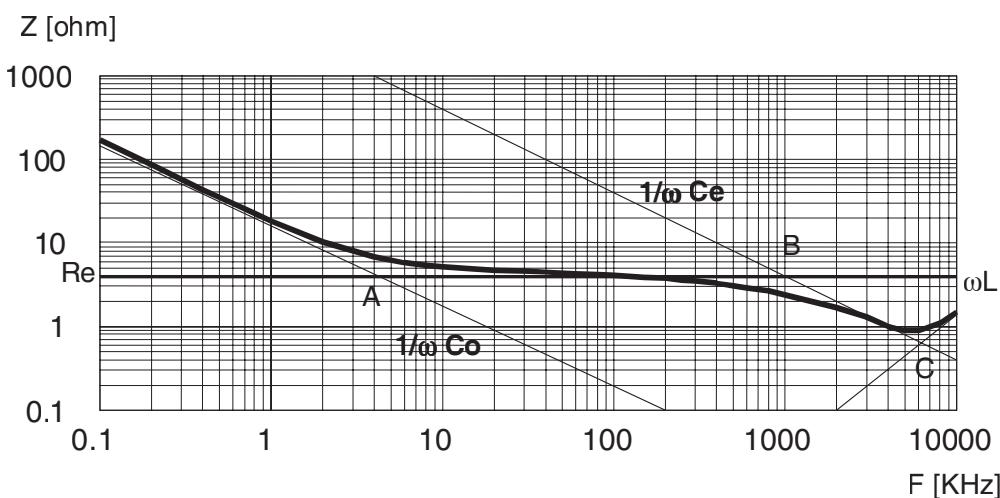
R_e = Resistance of electrolyte and paper mixture (other resistances not depending on the frequency are not considered: tabs, plates, etc.)

C_e = Electrolyte soaked paper capacitance

L = Inductive reactance of the capacitor winding and terminals

Impedance of an electrolytic capacitor is not a constant quantity that retains its value under all conditions; it changes depending on frequency and temperature.

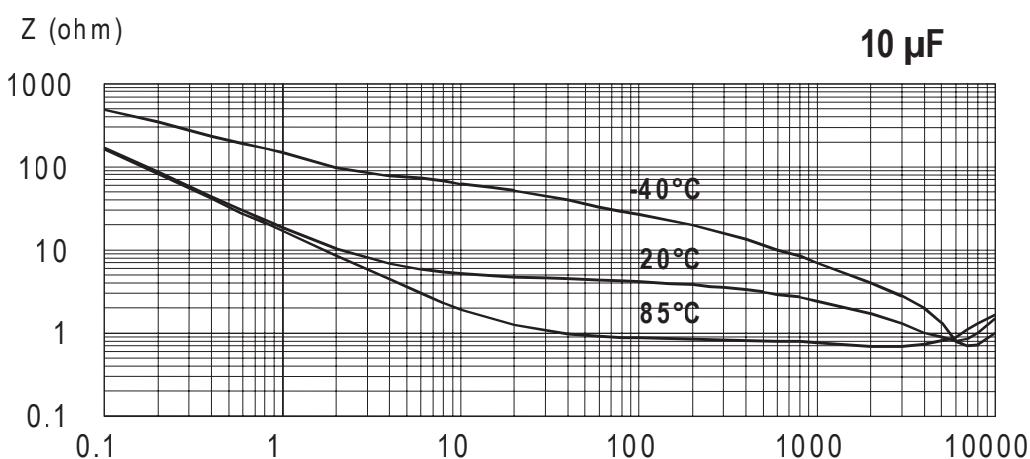
Impedance as a function of frequency (sinusoidal waveform) for a certain temperature can be represented as follows:



- Capacitive reactance predominates at low frequencies
- With increasing frequency, capacitive reactance $X_C = 1/\omega C_o$ decreases until it reaches the order of magnitude of electrolyte resistance R_e (A)
- At even higher frequencies, resistance of the electrolyte predominates: $Z = R_e (A - B)$
- When the capacitor's resonance frequency is reached (ω_0), capacitive and inductive reactance mutually cancel each other $1/\omega C_e = \omega L$, $\omega_0 = C\sqrt{1/LC_e}$
- Above this frequency, inductive reactance of the winding and its terminals ($X_L = Z = \omega L$) becomes effective and leads to an increase in impedance

Generally speaking, it can be estimated that $C_e \approx 0.01 C_o$.

Impedance as a function of frequency (sinusoidal waveform) for different temperature values can be represented as follows (typical values):



R_e is the most temperature-dependent component of an electrolytic capacitor equivalent circuit. Electrolyte resistivity will decrease if temperature rises.

In order to obtain a low impedance value throughout the temperature range, R_e must be as little as possible. However, R_e values that are too low indicate a very aggressive electrolyte, resulting in a shorter life of the electrolytic capacitor at high temperatures. A compromise must be reached.

Leakage Current (LC)

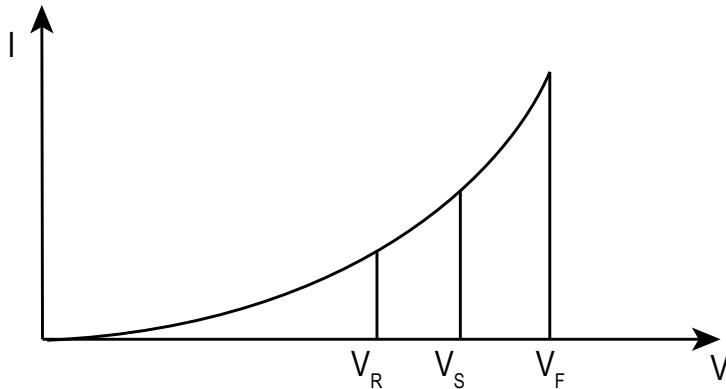
Due to the aluminum oxide layer that serves as a dielectric, a small current will continue to flow even after a DC voltage has been applied for long periods. This current is called leakage current.

A high leakage current flows after applying voltage to the capacitor then decreases in a few minutes, e.g., after prolonged storage without any applied voltage. In the course of continuous operation, the leakage current will decrease and reach an almost constant value.

After a voltage-free storage the oxide layer may deteriorate, especially at high temperature. Since there are no leakage currents to transport oxygen ions to the anode, the oxide layer is not regenerated. The result is that a higher than normal leakage current will flow when voltage is applied after prolonged storage.

As the oxide layer is regenerated in use, the leakage current will gradually decrease to its normal level.

The relationship between the leakage current and voltage applied at constant temperature can be shown schematically as follows:



Where:

V_F = **Forming voltage**

If this level is exceeded, a large quantity of heat and gas will be generated and the capacitor could be damaged.

V_R = **Rated voltage**

This level represents the top of the linear part of the curve.

V_S = **Surge voltage**

This lies between V_R and V_F . The capacitor can be subjected to V_S for short periods only.

Electrolytic capacitors are subjected to a reforming process before acceptance testing. The purpose of this preconditioning is to ensure that the same initial conditions are maintained when comparing different products.

Ripple Current (RC)

The maximum ripple current value depends on:

- Ambient temperature
- Surface area of the capacitor (heat dissipation area)
- $\tan \delta$ or ESR
- Frequency

The capacitor's life depends on the thermal stress.

Frequency Dependence of the Ripple Current

ESR and, thus, the $\tan \delta$ depend on the frequency of the applied voltage. This indicates that the allowed ripple current is also a function of the frequency.

Temperature Dependence of the Ripple Current

The data sheet specifies maximum ripple current at the upper category temperature for each capacitor.

Expected Life Calculation

Expected life depends on operating temperature according to the following formula: $L = L_0 \times 2^{(T_0-T)/10}$

Where:

L: Expected life

L_0 : Load life at maximum permissible operating temperature

T: Actual operating temperature

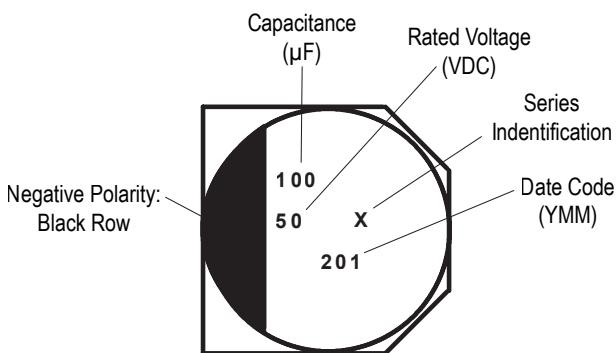
T_0 : Maximum permissible operating temperature

This formula is applicable between 40°C and T_0 .

Packaging Quantities

Size Code	Diameter (mm)	Length (mm)	Reel Quantity	Box Quantity (4 Reels per box)
9B	4	5.4	2000	20000
9D	5	5.4	1000	10000
9G	6.3	5.4	1000	10000
9H	6.3	7.7	1000	10000
9L	8	6.2	1000	10000
9M	8	10.2	500	4000
9P	10	10.2	500	4000
9R	12.5	13.5	200	800
9S	12.5	16	150	600
9T	16	16.5	125	500

Standard Marking for Surface Mount Types



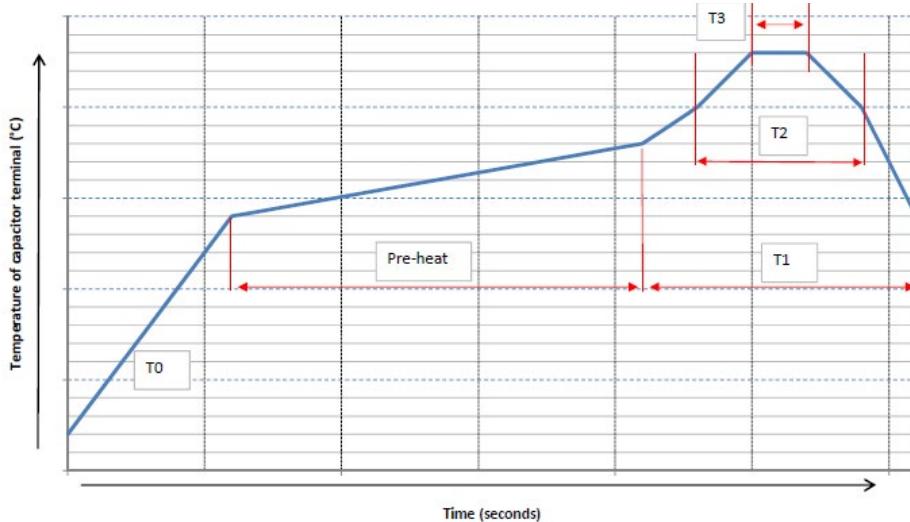
Note: 6.3 V rated voltage shall be marked as 6 V, but 6.3 V shall be assured.

- Series
- Rated voltage (VDC)
- Capacitance (μ F)
- Negative polarity: black line

Soldering Process

The soldering conditions should be within the specified conditions below:

Do not dip the capacitors body into the melted solder. Flux should only be applied to the capacitors terminals



Vapour heat transfer systems are not recommended.

The system should be thermal, such as infra-red radiation or hot blast

Observe the soldering conditions as shown below.

Do not exceed these limits and avoid repeated reflowing

Reflow Soldering

	Temperature (°C)	Maximum Time (Seconds)
T0	20 to 140	60
Pre-heat	140 to 180	150
T1	180 to 140	100
T2	> 200	60
T3	230	20

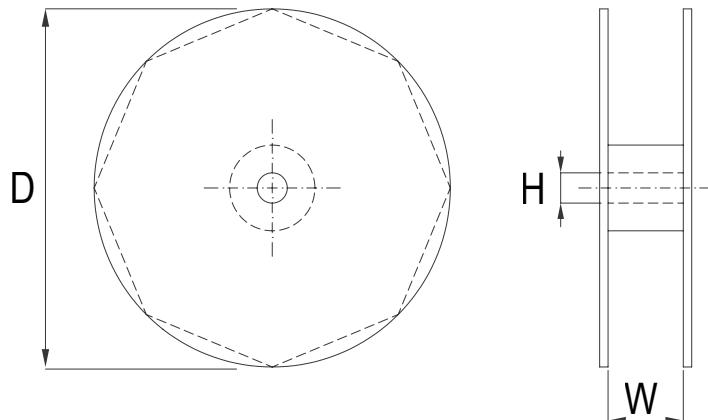
Lead Free Reflow Soldering

	Temperature (°C)	Maximum Time (Seconds)
T0	20 to 160	60
Pre-heat	160 to 190	120
T1	190 to 180	90
T2	> 220	60

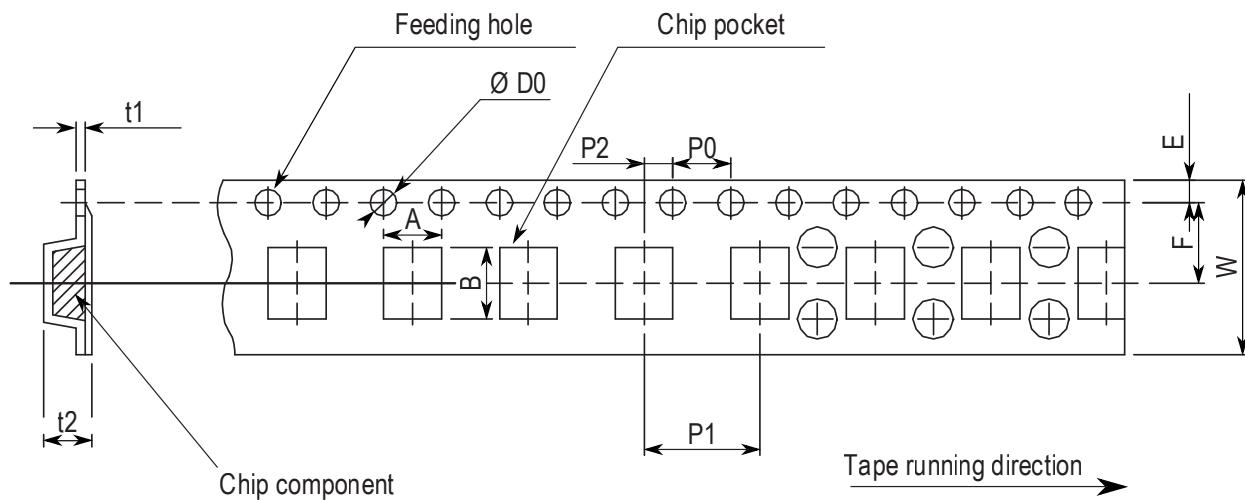
T3	Size	Temperature (°C)	Maximum Time (Seconds)
		250	10
	Φ4 ~ Φ5 (4 – 50 V)	260	5
	Φ6.3 ~ Φ10 (4 – 50 V)	250	5
	Φ4 ~ Φ10 (63 – 100 V)	250	5

Lead Taping & Packaging

Case Size (mm)	Reel		
	D	H	W
	±0.2	±0.8	±1.0
4 x 5.4	380	21	14
5 x 5.4		21	14
6.3 x 5.4		21	18
6.3 x 7.7		21	18
8 x 6.2		21	18
8 x 10.2		21	26
10 x 10.2		21	26
12.5 x 13.5		23	34
12.5 x 16		23	34
16 x 16.5		23	46



Taping for Automatic Insertion Machines



Dimensions (mm)	W	A	B	P0	P1	P2	F	D0	E	t1	t2
Tolerance	Nominal	Nominal	Nominal	±0.1	±0.1	±0.1	Nominal	±0.1	Nominal	Nominal	Nominal
4 x 5.4	12	4.7	4.7	4	8	2	5.5	1.5	1.75	0.4	5.8
5 x 5.4	12	5.7	5.7	4	12	2	5.5	1.5	1.75	0.4	5.8
6.3 x 5.4	16	7	7	4	12	2	7.5	1.5	1.75	0.4	5.8
6.3 x 7.7	16	7	7	4	12	2	7.5	1.5	1.75	0.4	5.8
8 x 6.2	16	8.7	8.7	4	12	2	7.5	1.5	1.75	0.4	6.8
8 x 10.2	24	8.7	8.7	4	16	2	11.5	1.5	1.75	0.4	11
10 x 10.2	24	10.7	10.7	4	16	2	11.5	1.5	1.75	0.4	11
12.5 x 13.5	32	13.4	13.4	4	24	2	14.2	1.5	1.75	0.5	14
12.5 x 16	32	13.4	13.4	4	24	2	14.2	1.5	1.75	0.5	17.5
16 x 16.5	44	17.5	17.5	4	28	2	20.2	1.5	1.75	0.5	17.5

Construction

The manufacturing process begins with the anode foil being electrochemically etched to increase the surface area and then "formed" to produce the aluminum oxide layer. Both the anode and cathode foils are then interleaved with absorbent paper and wound into a cylinder. During the winding process, aluminum tabs are attached to each foil to provide the electrical contact.

The deck, complete with terminals, is attached to the tabs and then folded down to rest on top of the winding. The complete winding is impregnated with electrolyte before being housed in a suitable container, usually an aluminum can, and sealed. Throughout the process, all materials inside the housing must be maintained at the highest purity and be compatible with the electrolyte.

Each capacitor is aged and tested before being sleeved and packed. The purpose of aging is to repair any damage in the oxide layer and thus reduce the leakage current to a very low level. Aging is normally carried out at the rated temperature of the capacitor and is accomplished by applying voltage to the device while carefully controlling the supply current. The process may take several hours to complete.

Damage to the oxide layer can occur due to variety of reasons:

- Slitting of the anode foil after forming
- Attaching the tabs to the anode foil
- Minor mechanical damage caused during winding

A sample from each batch is taken by the quality department after completion of the production process.

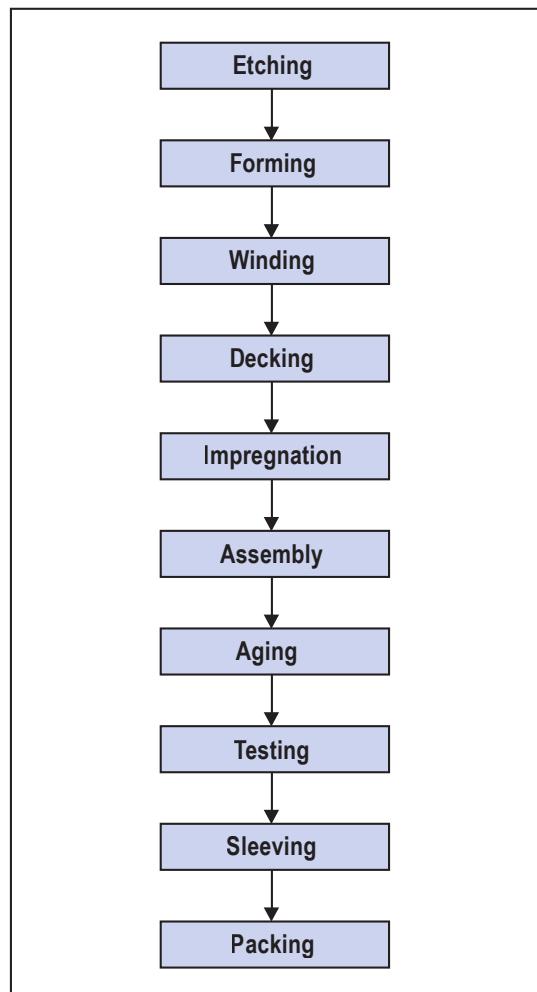
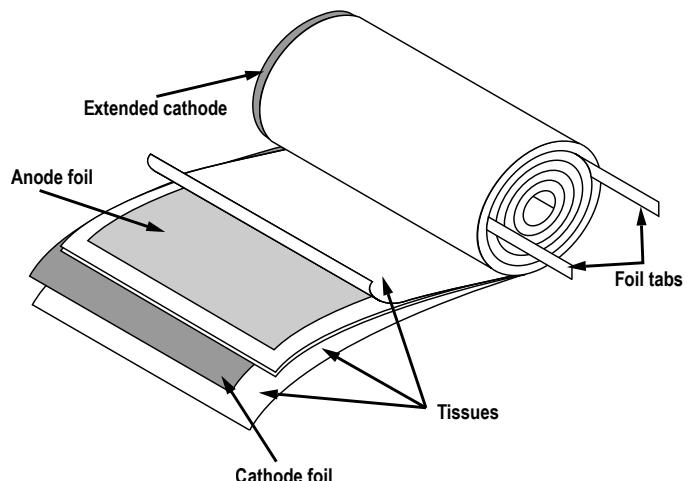
The following tests are applied and may be varied at the request of the customer. In this case the batch, or special procedure, will determine the course of action.

Electrical:

- Leakage current
- Capacitance
- ESR
- Impedance
- Tan Delta

Mechanical/Visual:

- Overall dimensions
- Torque test of mounting stud
- Print detail
- Box labels
- Packaging, including packed quantity



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