

## Overview

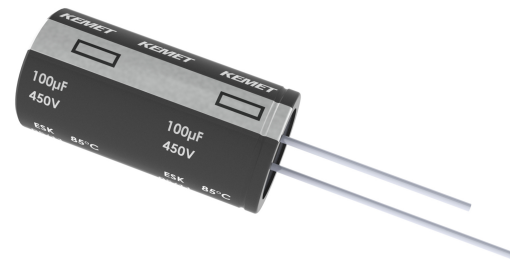
The KEMET ESK radial aluminum electrolytic capacitors are designed for high-density printed circuit boards requiring a miniature solution.

## Applications

Typical applications include general purpose coupling, decoupling, bypass, and filtering in consumer electronics.

## Benefits

- Operating temperature of up to 85°C
- 2,000 hour operating life
- Case with  $\varnothing D \geq 5$  mm
- Safety vent on the capacitor base



## Part Number System

ESK	226	M	6R3		A	C3	AA
Series	Capacitance Code (pF)	Tolerance	Rated Voltage (VDC)		Electrical Parameters	Size Code	Packaging
Radial Aluminum Electrolytic	First two digits represent significant figures for capacitance values. Last digit specifies the number of zeros to be added.	M = $\pm 20\%$	6R3 = 6.3 010 = 10 016 = 16 025 = 25 035 = 35 050 = 50 063 = 63	100 = 100 160 = 160 200 = 200 250 = 250 350 = 350 400 = 400 450 = 450 500 = 500	A = Standard	See Dimension Table	See Ordering Options Table

## Ordering Options Table

Diameter	Length	Packaging Type	Lead Type	Lead Length (mm)	Lead and Packaging Code
Standard Bulk Packaging Options					
4 – 22	All	Bulk (bag)	Straight	20/15 Minimum	AA
Tape & Reel					
4 – 5	All	Tape & Reel	Formed to 2.5 mm	$H_0 = 16 \pm 0.75$	LA
4 – 8	All	Tape & Reel	2.5 mm lead spacing	$H_0 = 18.5 \pm 0.75$	KA
4 – 8	All	Tape & Reel	Formed to 5 mm	$H_0 = 16 \pm 0.75$	JA
10	≤ 20	Tape & Reel	Straight	$H_0 = 18.5 \pm 0.75$	KA
Ammo Pack					
4 – 8	All	Ammo	Formed to 5 mm	$H_0 = 16 \pm 0.75$	DA
4 – 8	All	Ammo	Straight	$H_0 = 18.5 \pm 0.75$	EA
4 – 5	All	Ammo	Formed to 2.5 mm	$H_0 = 16 \pm 0.75$	FA
10 – 13	All	Ammo	5 mm lead spacing	$H_0 = 18.5 \pm 0.75$	EA
16	All	Ammo	7.5 mm lead spacing	$H_0 = 18.5 \pm 0.75$	EA
18	≤ 25	Ammo	7.5 mm lead spacing	$H_0 = 18.5 \pm 0.75$	EA
Contact KEMET for other lead and packaging options					

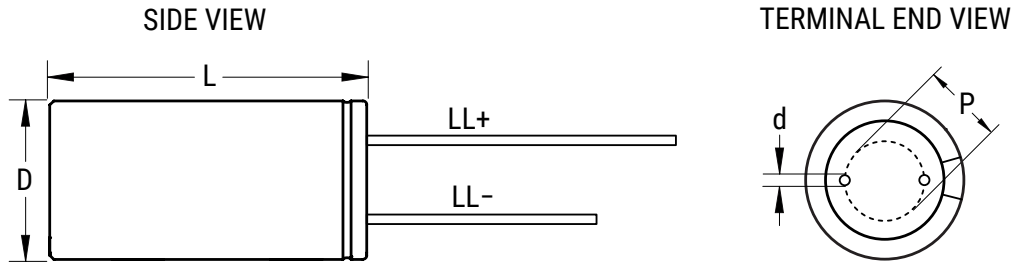
## Environmental Compliance

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 make 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.

Due to customer requirements, there may appear additional markings such as lead free (LF) or lead-free wires (LFW) on the label.

## Dimensions – Millimeters



Size Code	D		L		p		d		LL+/LL-	
	Nominal	Tolerance	Nominal	Tolerance	Nominal	Tolerance	Nominal	Tolerance	Nominal	Tolerance
C3	5.0	±0.5	11.0	+1.5/-0	2.0	±0.5	0.5	Nominal	20/15	Minimum
E3	6.3	±0.5	11.0	+1.5/-0	2.5	±0.5	0.5	Nominal	20/15	Minimum
G3	8.0	±0.5	11.0	+1.5/-0	3.5	±0.5	0.6	Nominal	20/15	Minimum
G7	8.0	±0.5	14.0	+2.0/-0	3.5	±0.5	0.6	Nominal	20/15	Minimum
G4	8.0	±0.5	15.0	+2.0/-0	3.5	±0.5	0.6	Nominal	20/15	Minimum
H9	10.0	±0.5	12.5	+1.5/-0	5.0	±0.5	0.6	Nominal	20/15	Minimum
H1	10.0	±0.5	12	+1.5/-0	5.0	±0.5	0.6	Nominal	20/15	Minimum
H2	10.0	±0.5	15.0	+2.0/-0	5.0	±0.5	0.6	Nominal	20/15	Minimum
H4	10.0	±0.5	20.0	+2.0/-0	5.0	±0.5	0.6	Nominal	20/15	Minimum
L2	13.0	±0.5	16.0	+2.0/-0	5.0	±0.5	0.6	Nominal	20/15	Minimum
L3	13.0	±0.5	20.0	+2.0/-0	5.0	±0.5	0.6	Nominal	20/15	Minimum
L4	13.0	±0.5	25.0	+2.0/-0	5.0	±0.5	0.6	Nominal	20/15	Minimum
M7	16.0	±0.5	25.0	+2.0/-0	7.5	±0.5	0.8	Nominal	20/15	Minimum
M1	16.0	±0.5	26.0	+2.0/-0	7.5	±0.5	0.8	Nominal	20/15	Minimum
M2	16.0	±0.5	32.0	+2.0/-0	7.5	±0.5	0.8	Nominal	20/15	Minimum
M3	16.0	±0.5	36.0	+2.0/-0	7.5	±0.5	0.8	Nominal	20/15	Minimum
M4	16.0	±0.5	40.0	+2.0/-0	7.5	±0.5	0.8	Nominal	20/15	Minimum
N5	18.0	±0.5	25.0	+2.0/-0	7.5	±0.5	0.8	Nominal	20/15	Minimum
N1	18.0	±0.5	32.0	+2.0/-0	7.5	±0.5	0.8	Nominal	20/15	Minimum
N2	18.0	±0.5	36.0	+2.0/-0	7.5	±0.5	0.8	Nominal	20/15	Minimum
N3	18.0	±0.5	40.0	+2.0/-0	7.5	±0.5	0.8	Nominal	20/15	Minimum
Q3	22.0	±0.5	35.0	+2.0/-0	10.0	±0.5	0.8	Nominal	20/15	Minimum
Q4	22.0	±0.5	40.0	+2.0/-0	10.0	±0.5	0.8	Nominal	20/15	Minimum

## Performance Characteristics

Item	Performance Characteristics	
Capacitance Range	1 – 22,000 $\mu$ F	1 – 470 $\mu$ F
Capacitance Tolerance	$\pm$ 20% at 120 Hz/20°C	
Rated Voltage	6.3 – 100 VDC	160 – 500 VDC
Life Test	2,000 hours (see conditions in Test Methods & Performance)	
Operating Temperature	-40°C to +85°C	-25°C to +85°C
Leakage Current	$I \leq 0.01 CV$ or 3 $\mu$ A, whichever is greater	$I = 0.03 CV + 10$ ( $\mu$ A)
	C = rated capacitance ( $\mu$ F), V = rated voltage (VDC). Voltage applied for 2 minutes at 20°C.	

## Impedance Z Characteristics at 120 Hz

Rated Voltage (VDC)	6	10	16	25	35 – 100	160 – 250	315 – 350	400 – 500
Z (-25°C)/Z (20°C)	8	6	5	3	3	7	10	15
Z (-40°C)/Z (20°C)	10	8	6	4	3	-	-	-

## Compensation Factor of Ripple Current (RC) vs. Frequency

Rated Voltage (VDC)	Capacitance Range ( $\mu$ F)	120 Hz	300 Hz	1 kHz	10 kHz
6.3 – 100	1 – 68	1.00	1.20	1.30	1.50
6.3 – 100	100 – 680	1.00	1.10	1.15	1.20
6.3 – 100	1,000 – 22,000	1.00	1.05	1.10	1.15
160 – 450	1 – 220	1.00	1.25	1.40	1.40
160 – 450	330 – 22,000	1.00	1.10	1.13	1.13
500	All	1.00	1.05	1.10	1.10

## 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 ±20% of the initial value	
Dissipation Factor	Does not exceed 200% of the specified value	
Leakage Current	Does not exceed specified value	

## Shelf Life

The capacitance, ESR and impedance of a capacitor will not change significantly after extended storage periods, however, the leakage current will very slowly increase.

KEMET's E aluminum electrolytic capacitors should not be stored in high temperatures or where there is a high level of humidity. The suitable storage condition for KEMET's E aluminum electrolytic capacitors is +5 to +35°C and less than 75% in relative humidity. KEMET's E aluminum electrolytic capacitors should not be stored in damp conditions such as water, saltwater spray or oil spray. KEMET's E aluminum electrolytic capacitors should not be stored in an environment full of hazardous gas (hydrogen sulphide, sulphurous acid gas, nitrous acid, chlorine gas, ammonium, etc.) KEMET's E aluminum electrolytic capacitors should not be stored under exposure to ozone, ultraviolet rays or radiation.

**If a capacitor has been stored for more than 18 months under these conditions and it shows increased leakage current, then a treatment by voltage application is recommended.**

## Re-Age (Reforming) Procedure

Apply the rated voltage to the capacitor at room temperature for a period of one hour, or until the leakage current has fallen to a steady value below the specified limit. During re-aging a maximum charging current of twice the specified leakage current or 5 mA, whichever is greater, is suggested.

**Table 1 – Ratings & Part Number Reference**

Rated Voltage	Surge Voltage	Rated Capacitance	Case Size	DF	RC	LC	Part Number
(VDC)	(VDC)	120 Hz 20°C (µF)	D x L (mm)	120 Hz 20°C (tanδ %)*	120 Hz 85°C (mA)	20°C 2 minutes (µA)	( ) Represents Part Number Options
6.3	8	1,000	10 x 12.5	24	580	63	ESK108M6R3AH9(1)
6.3	8	2,200	10 x 20	24	840	138.6	ESK228M6R3AH4(1)
6.3	8	3,300	10 x 20	24	1,000	207.9	ESK338M6R3AH4(1)
6.3	8	4,700	13 x 20	24	1,300	296.1	ESK478M6R3AL3(1)
6.3	8	6,800	13 x 25	24	1,550	428.4	ESK688M6R3AL4(1)
6.3	8	10,000	16 x 25	24	1,900	630	ESK109M6R3AM7(1)
6.3	8	15,000	16 x 36	24	2,500	945	ESK159M6R3AM3(1)
6.3	8	22,000	18 x 40	24	3,650	1,386	ESK229M6R3AN3(1)
6.3	8	22	5 x 11	24	35	3	ESK226M6R3AC3(1)
6.3	8	33	5 x 11	24	55	3	ESK336M6R3AC3(1)
6.3	8	47	5 x 11	24	75	3	ESK476M6R3AC3(1)
6.3	8	100	5 x 11	24	130	6.3	ESK107M6R3AC3(1)
6.3	8	220	5 x 11	24	200	13.9	ESK227M6R3AC3(1)
6.3	8	220	6.3 x 11	24	240	13.9	ESK227M6R3AE3(1)
6.3	8	330	6.3 x 11	24	260	20.8	ESK337M6R3AE3(1)
6.3	8	470	6.3 x 11	24	330	29.6	ESK477M6R3AE3(1)
6.3	8	680	8 x 11	24	410	42.8	ESK687M6R3AG3(1)
6.3	8	1,000	8 x 11	24	460	63	ESK108M6R3AG3(1)
10	13	1,000	10 x 12	19	580	100	ESK108M010AH1(1)
10	13	1,000	10 x 12.5	20	580	100	ESK108M010AH9(1)
10	13	2,200	10 x 20	20	880	220	ESK228M010AH4(1)
10	13	3,300	13 x 20	20	1,250	330	ESK338M010AL3(1)
10	13	4,700	13 x 25	20	1,500	470	ESK478M010AL4(1)
10	13	6,800	16 x 25	20	1,900	680	ESK688M010AM7(1)
10	13	10,000	16 x 36	20	2,225	1,000	ESK109M010AM3(1)
10	13	10,000	18 x 32	20	2,225	1,000	ESK109M010AN1(1)
10	13	15,000	18 x 36	20	2,950	1,500	ESK159M010AN2(1)
10	13	22,000	22 x 40	20	3,700	2,200	ESK229M010AQ4(1)
10	13	4.7	5 x 11	20	20	3	ESK475M010AC3(1)
10	13	10	5 x 11	20	35	3	ESK106M010AC3(1)
10	13	22	5 x 11	20	55	3	ESK226M010AC3(1)
10	13	33	5 x 11	20	80	3.3	ESK336M010AC3(1)
10	13	47	5 x 11	20	95	4.7	ESK476M010AC3(1)
10	13	100	5 x 11	20	180	10	ESK107M010AC3(1)
10	13	220	5 x 11	19	230	22	ESK227M010AC3(1)
10	13	220	6.3 x 11	20	250	22	ESK227M010AE3(1)
10	13	330	6.3 x 11	20	265	33	ESK337M010AE3(1)
10	13	470	6.3 x 11	20	320	47	ESK477M010AE3(1)
10	13	330	8 x 11	20	300	33	ESK337M010AG3DA
10	13	680	8 x 11	20	410	68	ESK687M010AG3(1)
10	13	680	8 x 15	19	430	68	ESK687M010AG4(1)
16	20	680	10 x 12.5	16	510	108.8	ESK687M016AH9(1)
16	20	1,000	10 x 15	16	630	160	ESK108M016AH2(1)
16	20	2,200	13 x 20	16	1,100	352	ESK228M016AL3(1)
16	20	3,300	13 x 25	16	1,400	528	ESK338M016AL4(1)
16	20	4,700	16 x 25	16	1,800	752	ESK478M016AM7(1)
16	20	4,700	16 x 26	16	1,800	752	ESK478M016AM1(1)
16	20	6,800	16 x 32	16	1,980	1,088	ESK688M016AM2(1)
16	20	6,800	16 x 36	16	2,200	1,088	ESK688M016AM3(1)
16	20	10,000	18 x 36	16	2,700	1,600	ESK109M016AN2(1)
16	20	15,000	22 x 40	16	3,150	2,400	ESK159M016AQ4(1)
16	20	20,000	22 x 40	16	3,200	3,200	ESK209M016AQ4(1)
16	20	22,000	22 x 40	16	3,800	3,520	ESK229M016AQ4(1)
16	20	4.7	5 x 11	16	25	3	ESK475M016AC3(1)
16	20	10	5 x 11	16	40	3	ESK106M016AC3(1)
16	20	22	5 x 11	16	75	3.5	ESK226M016AC3(1)
16	20	33	5 x 11	16	110	5.3	ESK336M016AC3(1)
Rated Voltage	Surge Voltage	Rated Capacitance	Case Size	DF	RC	LC	Part Number

(1) Insert packaging code. See Ordering Options Table for available options.

\* When capacitance exceeds 1,000 µF, the DF value (%) is increased by 2% for every additional 1,000 µF.

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

Rated Voltage	Surge Voltage	Rated Capacitance	Case Size	DF	RC	LC	Part Number
(VDC)	(VDC)	120 Hz 20°C (µF)	D x L (mm)	120 Hz 20°C (tanδ %)*	120 Hz 85°C (mA)	20°C 2 minutes (µA)	( ) Represents Part Number Options
16	20	47	5 x 11	16	130	7.5	ESK476M016AC3(1)
16	20	68	5 x 11	16	150	10.9	ESK686M016AC3(1)
16	20	100	5 x 11	16	165	16	ESK107M016AC3(1)
16	20	150	6.3 x 11	16	205	24	ESK157M016AE3(1)
16	20	220	6.3 x 11	16	260	35.2	ESK227M016AE3(1)
16	20	330	6.3 x 11	16	290	52.8	ESK337M016AE3(1)
16	20	330	8 x 11	16	360	52.8	ESK337M016AG3(1)
16	20	470	8 x 11	16	400	75.2	ESK477M016AG3(1)
25	32	330	10 x 12	14	420	82.5	ESK337M025AH1(1)
25	32	470	10 x 12.5	14	460	117.5	ESK477M025AH9(1)
25	32	680	10 x 15	14	550	170	ESK687M025AH2(1)
25	32	1,000	10 x 20	14	760	250	ESK108M025AH4(1)
25	32	1,000	13 x 16	14	760	250	ESK108M025AL2(1)
25	32	2,200	13 x 25	14	1,300	550	ESK228M025AL4(1)
25	32	3,300	16 x 25	14	1,660	825	ESK338M025AM7(1)
25	32	3,300	16 x 26	14	1,660	825	ESK338M025AM1(1)
25	32	4,700	16 x 32	14	1,950	1,175	ESK478M025AM2(1)
25	32	6,800	18 x 36	14	2,550	1,700	ESK688M025AN2(1)
25	32	10,000	22 x 40	14	2,800	2,500	ESK109M025AQ4(1)
25	32	15,000	22 x 40	14	3,200	3,750	ESK159M025AQ4(1)
25	32	4.7	5 x 11	14	30	3	ESK475M025AC3(1)
25	32	10	5 x 11	14	50	3	ESK106M025AC3(1)
25	32	22	5 x 11	14	90	5.5	ESK226M025AC3(1)
25	32	33	5 x 11	14	115	8.3	ESK336M025AC3(1)
25	32	47	5 x 11	14	135	11.8	ESK476M025AC3(1)
25	32	68	5 x 11	14	145	17	ESK686M025AC3(1)
25	32	100	5 x 11	16	145	25	ESK107M025AC3(1)
25	32	100	6.3 x 11	14	160	25	ESK107M025AE3(1)
25	32	220	8 x 11	14	290	55	ESK227M025AG3(1)
25	32	330	8 x 11	14	315	82.5	ESK337M025AG3(1)
25	32	470	8 x 14	14	420	117.5	ESK477M025AG7(1)
25	32	470	8 x 15	14	420	117.5	ESK477M025AG4(1)
35	44	330	10 x 12.5	12	420	115.5	ESK337M035AH9(1)
35	44	330	10 x 15	12	490	115.5	ESK337M035AH2(1)
35	44	470	10 x 15	12	430	164.5	ESK477M035AH2(1)
35	44	680	10 x 20	12	550	238	ESK687M035AH4(1)
35	44	1,000	13 x 20	12	950	350	ESK108M035AL3(1)
35	44	2,200	16 x 25	12	1,600	770	ESK228M035AM7(1)
35	44	2,200	16 x 26	12	1,600	770	ESK228M035AM1(1)
35	44	3,300	16 x 36	12	1,970	1,155	ESK338M035AM3(1)
35	44	4,700	16 x 36	12	1,970	1,645	ESK478M035AM3(1)
35	44	3,300	18 x 32	12	2,050	1,155	ESK338M035AN1(1)
35	44	4,700	18 x 36	12	2,400	1,645	ESK478M035AN2(1)
35	44	6,800	22 x 40	12	2,600	2,380	ESK688M035AQ4(1)
35	44	4.7	5 x 11	12	35	3	ESK475M035AC3(1)
35	44	10	5 x 11	12	60	3.5	ESK106M035AC3(1)
35	44	22	5 x 11	12	95	7.7	ESK226M035AC3(1)
35	44	33	5 x 11	12	120	11.6	ESK336M035AC3(1)
35	44	47	5 x 11	12	120	16.5	ESK476M035AC3(1)
35	44	100	6.3 x 11	12	185	35	ESK107M035AE3(1)
35	44	120	8 x 11	12	230	42	ESK127M035AG3(1)
35	44	220	8 x 11	12	290	77	ESK227M035AG3(1)
50	63	220	10 x 12.5	10	380	110	ESK227M050AH9(1)
50	63	330	10 x 15	10	490	165	ESK337M050AH2(1)
50	63	470	10 x 20	10	610	235	ESK477M050AH4(1)
50	63	1,000	13 x 25	10	1,100	500	ESK108M050AL4(1)
50	63	2,200	16 x 32	10	1,970	1,100	ESK228M050AM2(1)
Rated Voltage	Surge Voltage	Rated Capacitance	Case Size	DF	RC	LC	Part Number

(1) Insert packaging code. See Ordering Options Table for available options.

\* When capacitance exceeds 1,000 µF, the DF value (%) is increased by 2% for every additional 1,000 µF.

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

Rated Voltage	Surge Voltage	Rated Capacitance	Case Size	DF	RC	LC	Part Number
(VDC)	(VDC)	120 Hz 20°C (µF)	D x L (mm)	120 Hz 20°C (tanδ %)*	120 Hz 85°C (mA)	20°C 2 minutes (µA)	( ) Represents Part Number Options
50	63	2,200	16 x 36	10	1,850	1,100	ESK228M050AM3(1)
50	63	2,200	18 x 32	10	1,850	1,100	ESK228M050AN1(1)
50	63	3,300	18 x 36	10	2,170	1,650	ESK338M050AN2(1)
50	63	4,700	22 x 35	10	2,500	2,350	ESK478M050AQ3(1)
50	63	4,700	22 x 40	10	2,500	2,350	ESK478M050AQ4(1)
50	63	0.47	5 x 11	10	5	3	ESK474M050AC3(1)
50	63	1.0	5 x 11	10	10	3	ESK105M050AC3(1)
50	63	2.2	5 x 11	10	23	3	ESK225M050AC3(1)
50	63	3.3	5 x 11	10	35	3	ESK335M050AC3(1)
50	63	4.7	5 x 11	10	40	3	ESK475M050AC3(1)
50	63	6.8	5 x 11	10	50	3	ESK685M050AC3(1)
50	63	10	5 x 11	10	65	5	ESK106M050AC3(1)
50	63	22	5 x 11	10	100	11	ESK226M050AC3(1)
50	63	33	5 x 11	10	105	16.5	ESK336M050AC3(1)
50	63	33	6.3 x 11	10	125	16.5	ESK336M050AE3(1)
50	63	47	6.3 x 11	10	140	23.5	ESK476M050AE3(1)
50	63	47	8 x 11	10	150	23.5	ESK476M050AG3(1)
50	63	100	8 x 11	10	230	50	ESK107M050AG3(1)
50	63	120	8 x 11	10	240	60	ESK127M050AG3(1)
63	79	100	10 x 12	9	300	63	ESK107M063AH1(1)
63	79	100	10 x 12.5	10	300	63	ESK107M063AH9(1)
63	79	220	10 x 15	10	410	138.6	ESK227M063AH2(1)
63	79	220	10 x 20	10	490	138.6	ESK227M063AH4(1)
63	79	330	10 x 20	10	540	207.9	ESK337M063AH4(1)
63	79	470	13 x 20	10	755	296.1	ESK477M063AL3(1)
63	79	470	13 x 25	9	880	296.1	ESK477M063AL4(1)
63	79	680	13 x 25	10	965	428.4	ESK687M063AL4(1)
63	79	1,000	16 x 25	10	1,310	630	ESK108M063AM7(1)
63	79	2,200	18 x 36	10	2,200	1,386	ESK228M063AN2(1)
63	79	2,200	18 x 40	9	2,200	1,386	ESK228M063AN3(1)
63	79	3,300	22 x 40	10	2,500	2,079	ESK338M063AQ4(1)
63	79	1.0	5 x 11	10	10	3	ESK105M063AC3(1)
63	79	2.2	5 x 11	10	29	3	ESK225M063AC3(1)
63	79	3.3	5 x 11	10	40	3	ESK335M063AC3(1)
63	79	4.7	5 x 11	10	45	3	ESK475M063AC3(1)
63	79	10	5 x 11	10	70	6.3	ESK106M063AC3(1)
63	79	22	5 x 11	10	95	13.9	ESK226M063AC3(1)
63	79	22	6.3 x 11	10	115	13.9	ESK226M063AE3(1)
63	79	33	6.3 x 11	10	130	20.8	ESK336M063AE3(1)
63	79	47	6.3 x 11	10	190	29.6	ESK476M063AE3(1)
63	79	100	8 x 11	10	235	63	ESK107M063AG3(1)
100	125	33	10 x 12	8	170	33	ESK336M100AH1(1)
100	125	47	10 x 12	8	190	47	ESK476M100AH1(1)
100	125	47	10 x 12.5	10	190	47	ESK476M100AH9(1)
100	125	68	10 x 15	10	280	68	ESK686M100AH2(1)
100	125	100	10 x 20	10	400	100	ESK107M100AH4(1)
100	125	150	13 x 20	10	500	150	ESK157M100AL3(1)
100	125	220	13 x 25	10	710	220	ESK227M100AL4(1)
100	125	330	13 x 25	10	720	330	ESK337M100AL4(1)
100	125	470	16 x 25	10	1,100	470	ESK477M100AM7(1)
100	125	1,000	16 x 32	8	1,350	1,000	ESK108M100AM2(1)
100	125	680	16 x 36	10	1,260	680	ESK687M100AM3(1)
100	125	1,000	18 x 40	10	1,350	1,000	ESK108M100AN3(1)
100	125	2,200	22 x 40	8	2,300	2,200	ESK228M100AQ4(1)
100	125	1.0	5 x 11	10	21	3	ESK105M100AC3(1)
100	125	2.2	5 x 11	10	30	3	ESK225M100AC3(1)
100	125	3.3	5 x 11	10	45	3.3	ESK335M100AC3(1)
Rated Voltage	Surge Voltage	Rated Capacitance	Case Size	DF	RC	LC	Part Number

(1) Insert packaging code. See Ordering Options Table for available options.

\* When capacitance exceeds 1,000 µF, the DF value (%) is increased by 2% for every additional 1,000 µF.



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

Rated Voltage	Surge Voltage	Rated Capacitance	Case Size	DF	RC	LC	Part Number
(VDC)	(VDC)	120 Hz 20°C (µF)	D x L (mm)	120 Hz 20°C (tanδ %)*	120 Hz 85°C (mA)	20°C 2 minutes (µA)	( ) Represents Part Number Options
100	125	4.7	5 x 11	10	50	4.7	ESK475M100AC3(1)
100	125	6.8	5 x 11	10	55	6.8	ESK685M100AC3(1)
100	125	10	5 x 11	10	65	10	ESK106M100AC3(1)
100	125	10	6.3 x 11	10	75	10	ESK106M100AE3(1)
100	125	22	6.3 x 11	10	105	22	ESK226M100AE3(1)
100	125	22	8 x 11	10	130	22	ESK226M100AG3(1)
100	125	33	8 x 11	10	140	33	ESK336M100AG3(1)
160	200	10	10 x 12	15	65	58	ESK106M160AH1(1)
160	200	22	10 x 15	20	110	115.6	ESK226M160AH2(1)
160	200	33	10 x 15	20	135	168.4	ESK336M160AH2(1)
160	200	33	10 x 20	20	150	168.4	ESK336M160AH4(1)
160	200	47	10 x 20	20	160	235.6	ESK476M160AH4(1)
160	200	47	13 x 20	15	180	235.6	ESK476M160AL3(1)
160	200	68	13 x 20	20	200	336.4	ESK686M160AL3(1)
160	200	100	13 x 25	20	250	490	ESK107M160AL4(1)
160	200	100	16 x 25	15	300	490	ESK107M160AM7(1)
160	200	150	16 x 25	20	330	730	ESK157M160AM7(1)
160	200	220	16 x 32	20	450	1,066	ESK227M160AM2(1)
160	200	330	18 x 36	20	540	1,594	ESK337M160AN2(1)
160	200	470	18 x 40	20	750	2,266	ESK477M160AN3(1)
160	200	470	22 x 40	15	900	2,266	ESK477M160AQ4(1)
160	200	1.0	5 x 11	20	17	14.8	ESK105M160AC3(1)
160	200	1.0	6.3 x 11	20	17	14.8	ESK105M160AE3(1)
160	200	2.2	6.3 x 11	20	26	20.6	ESK225M160AE3(1)
160	200	3.3	6.3 x 11	20	30	25.8	ESK335M160AE3(1)
160	200	4.7	6.3 x 11	20	32	32.6	ESK475M160AE3(1)
160	200	3.3	8 x 11	15	35	25.8	ESK335M160AG3(1)
160	200	10	8 x 11	20	50	58	ESK106M160AG3(1)
200	250	10	10 x 12	15	57	70	ESK106M200AH1(1)
200	250	22	10 x 15	20	120	142	ESK226M200AH2(1)
200	250	33	10 x 20	20	160	208	ESK336M200AH4(1)
200	250	47	10 x 20	20	170	292	ESK476M200AH4(1)
200	250	47	13 x 20	20	200	292	ESK476M200AL3(1)
200	250	100	16 x 25	20	330	610	ESK107M200AM7(1)
200	250	100	16 x 26	20	330	610	ESK107M200AM1(1)
200	250	220	16 x 32	20	505	1,330	ESK227M200AM2(1)
200	250	330	16 x 40	20	710	1,990	ESK337M200AM4(1)
200	250	220	18 x 25	20	485	1,330	ESK227M200AN5(1)
200	250	330	18 x 32	20	685	1,990	ESK337M200AN1(1)
200	250	220	18 x 36	15	600	1,330	ESK227M200AN2(1)
200	250	470	18 x 40	20	750	2,830	ESK477M200AN3(1)
200	250	330	22 x 40	20	840	1,990	ESK337M200AQ4(1)
200	250	1.0	5 x 11	20	19	16	ESK105M200AC3(1)
200	250	2.2	6.3 x 11	20	22	23.2	ESK225M200AE3(1)
200	250	3.3	6.3 x 11	20	30	29.8	ESK335M200AE3(1)
200	250	4.7	6.3 x 11	20	35	38.2	ESK475M200AE3(1)
200	250	3.3	8 x 11	15	37	29.8	ESK335M200AG3(1)
200	250	4.7	8 x 11	15	36	38.2	ESK475M200AG3(1)
200	250	6.8	8 x 11	20	40	50.8	ESK685M200AG3(1)
200	250	10	8 x 11	20	45	70	ESK106M200AG3(1)
250	300	10	10 x 12	15	70	85	ESK106M250AH1(1)
250	300	10	10 x 12.5	20	65	85	ESK106M250AH9(1)
250	300	4.7	10 x 15	20	45	45	ESK475M250AH2(1)
250	300	22	10 x 20	20	130	175	ESK226M250AH4(1)
250	300	33	13 x 20	20	140	257.5	ESK336M250AL3(1)
250	300	33	13 x 25	15	160	257.5	ESK336M250AL4(1)
250	300	47	13 x 25	20	210	362.5	ESK476M250AL4(1)
Rated Voltage	Surge Voltage	Rated Capacitance	Case Size	DF	RC	LC	Part Number

(1) Insert packaging code. See Ordering Options Table for available options.

\* When capacitance exceeds 1,000 µF, the DF value (%) is increased by 2% for every additional 1,000 µF.

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

Rated Voltage	Surge Voltage	Rated Capacitance	Case Size	DF	RC	LC	Part Number
(VDC)	(VDC)	120 Hz 20°C (µF)	D x L (mm)	120 Hz 20°C (tanδ %)*	120 Hz 85°C (mA)	20°C 2 minutes (µA)	( ) Represents Part Number Options
250	300	100	16 x 25	20	250	760	ESK107M250AM7(1)
250	300	150	16 x 32	20	330	1,135	ESK157M250AM2(1)
250	300	100	18 x 40	20	320	760	ESK107M250AN3(1)
250	300	220	18 x 40	20	540	1,660	ESK227M250AN3(1)
250	300	220	22 x 40	20	630	1,660	ESK227M250AQ4(1)
250	300	0.47	5 x 11	15	14	13.5	ESK474M250AC3(1)
250	300	1.0	5 x 11	20	17	17.5	ESK105M250AC3(1)
250	300	1.0	6.3 x 11	20	19	17.5	ESK105M250AE3(1)
250	300	2.2	6.3 x 11	20	24	26.5	ESK225M250AE3(1)
250	300	2.2	8 x 11	20	30	26.5	ESK225M250AG3(1)
250	300	3.3	8 x 11	20	30	34.8	ESK335M250AG3(1)
250	300	4.7	8 x 11	20	36	45.3	ESK475M250AG3(1)
250	300	6.8	8 x 11	20	40	61	ESK685M250AG3(1)
350	400	3.3	10 x 12	20	39	44.7	ESK335M350AH1(1)
350	400	4.7	10 x 12	20	39	59.4	ESK475M350AH1(1)
350	400	6.8	10 x 12	24	39	81.4	ESK685M350AH1(1)
350	400	4.7	10 x 12.5	24	39	59.4	ESK475M350AH9(1)
350	400	10	10 x 15	24	70	115	ESK106M350AH2(1)
350	400	22	13 x 20	24	130	241	ESK226M350AL3(1)
350	400	33	13 x 25	24	170	356.5	ESK336M350AL4(1)
350	400	47	16 x 25	24	220	503.5	ESK476M350AM7(1)
350	400	100	16 x 36	24	620	1,060	ESK107M350AM3(1)
350	400	100	18 x 32	24	300	1,060	ESK107M350AN1(1)
350	400	100	18 x 36	20	360	1,060	ESK107M350AN2(1)
350	400	220	22 x 40	24	470	2,320	ESK227M350AQ4(1)
350	400	1.0	6.3 x 11	24	19	20.5	ESK105M350AE3(1)
350	400	2.2	8 x 11	24	33	33.1	ESK225M350AG3(1)
350	400	3.3	8 x 11	24	33	44.7	ESK335M350AG3(1)
400	450	3.3	10 x 12	20	40	49.6	ESK335M400AH1(1)
400	450	4.7	10 x 12.5	24	42	66.4	ESK475M400AH9(1)
400	450	6.8	10 x 12.5	24	45	91.6	ESK685M400AH9(1)
400	450	4.7	10 x 15	20	45	66.4	ESK475M400AH2(1)
400	450	10	10 x 15	24	50	130	ESK106M400AH2(1)
400	450	10	10 x 20	20	56	130	ESK106M400AH4(1)
400	450	22	13 x 20	24	100	274	ESK226M400AL3(1)
400	450	22	13 x 25	20	110	274	ESK226M400AL4(1)
400	450	33	13 x 25	24	140	406	ESK336M400AL4(1)
400	450	33	16 x 25	20	170	406	ESK336M400AM7(1)
400	450	47	16 x 25	24	180	574	ESK476M400AM7(1)
400	450	47	16 x 26	24	180	574	ESK476M400AM1(1)
400	450	68	16 x 32	24	250	826	ESK686M400AM2(1)
400	450	68	18 x 25	24	220	826	ESK686M400AN5(1)
400	450	100	18 x 32	24	320	1,210	ESK107M400AN1(1)
400	450	100	18 x 36	20	360	1,210	ESK107M400AN2(1)
400	450	150	18 x 40	24	420	1,810	ESK157M400AN3(1)
400	450	1.0	6.3 x 11	24	16	22	ESK105M400AE3(1)
400	450	2.2	6.3 x 11	24	20	36.4	ESK225M400AE3(1)
400	450	1.0	8 x 11	24	19	22	ESK105M400AG3(1)
400	450	2.2	8 x 11	24	26	36.4	ESK225M400AG3(1)
400	450	3.3	8 x 11	24	35	49.6	ESK335M400AG3(1)
400	450	4.7	8 x 11	24	38	66.4	ESK475M400AG3(1)
400	450	6.8	8 x 15	24	42	91.6	ESK685M400AG4(1)
450	500	2.2	10 x 12	20	33	39.7	ESK225M450AH1(1)
450	500	2.2	10 x 12.5	24	33	39.7	ESK225M450AH9(1)
450	500	3.3	10 x 12.5	24	40	54.6	ESK335M450AH9(1)
450	500	4.7	10 x 12.5	24	45	73.5	ESK475M450AH9(1)
450	500	3.3	10 x 15	20	42	54.6	ESK335M450AH2(1)
Rated Voltage	Surge Voltage	Rated Capacitance	Case Size	DF	RC	LC	Part Number

(1) Insert packaging code. See Ordering Options Table for available options.

\* When capacitance exceeds 1,000 µF, the DF value (%) is increased by 2% for every additional 1,000 µF.

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

Rated Voltage	Surge Voltage	Rated Capacitance	Case Size	DF	RC	LC	Part Number
(VDC)	(VDC)	120 Hz 20°C (µF)	D x L (mm)	120 Hz 20°C (tanδ %)*	120 Hz 85°C (mA)	20°C 2 minutes (µA)	( ) Represents Part Number Options
450	500	4.7	10 x 15	20	50	73.5	ESK475M450AH2(1)
450	500	6.8	10 x 15	24	50	101.8	ESK685M450AH2(1)
450	500	10	10 x 20	24	58	145	ESK106M450AH4(1)
450	500	10	13 x 20	24	60	145	ESK106M450AL3(1)
450	500	22	13 x 25	24	98	307	ESK226M450AL4(1)
450	500	22	16 x 25	20	130	307	ESK226M450AM7(1)
450	500	33	16 x 25	24	145	455.5	ESK336M450AM7(1)
450	500	22	16 x 32	24	120	307	ESK226M450AM2(1)
450	500	47	16 x 32	24	165	644.5	ESK476M450AM2(1)
450	500	33	16 x 36	20	180	455.5	ESK336M450AM3(1)
450	500	47	18 x 25	24	160	644.5	ESK476M450AN5(1)
450	500	68	18 x 25	24	265	928	ESK686M450AN5(1)
450	500	47	18 x 36	20	200	644.5	ESK476M450AN2(1)
450	500	100	18 x 40	24	330	1,360	ESK107M450AN3(1)
450	500	150	22 x 35	24	420	2,035	ESK157M450AQ3(1)
450	500	100	22 x 40	20	370	1,360	ESK107M450AQ4(1)
450	500	1.0	8 x 11	24	19	23.5	ESK105M450AG3(1)
500	550	2.2	10 x 12.5	24	33	43	ESK225M500AH9(1)
500	550	3.3	10 x 15	24	43	59.5	ESK335M500AH2(1)
500	550	6.8	10 x 20	24	70	112	ESK685M500AH4(1)
500	550	10	13 x 20	24	93	160	ESK106M500AL3(1)
500	550	22	16 x 25	24	105	340	ESK226M500AM7(1)
500	550	33	16 x 25	24	200	505	ESK336M500AM7(1)
500	550	47	18 x 32	24	185	715	ESK476M500AN1(1)
500	550	68	18 x 36	24	370	1,030	ESK686M500AN2(1)
Rated Voltage	Surge Voltage	Rated Capacitance	Case Size	DF	RC	LC	Part Number

(1) Insert packaging code. See Ordering Options Table for available options.

\* When capacitance exceeds 1,000 µF, the DF value (%) is increased by 2% for every additional 1,000 µF.

## 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, or 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

- As a general principle, 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 the capacitors or use capacitors with a deformed case.
- Verify that the connections of the capacitors are able to insert on the board without excessive mechanical force.
- If the capacitors require mounting through additional means, the recommended mounting accessories shall be used.
- Verify the correct polarization of the capacitor on the board.
- Verify that the space around the pressure relief device is according to the following guideline:

Case Diameter	Space Around Safety Vent
≤ 16 mm	> 2 mm
> 16 to ≤ 40 mm	> 3 mm
> 40 mm	> 5 mm

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 kΩ for capacitors with  $V_R \leq 160$  V (5 W resistor) and 10 kΩ for the other rated voltages.
- In the case of capacitors connected in a 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 & Operation Guidelines

### Electrical Ratings:

#### Capacitance (ESC)



*Simplified equivalent circuit diagram of an electrolytic capacitor*

The capacitive component of the equivalent series circuit, (equivalent series capacitance - ESC), is determined by applying an alternate voltage of  $\leq 0.5$  V at a frequency of 120 or 100 Hz and 20°C (IEC 384-1, 384-4).

#### 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

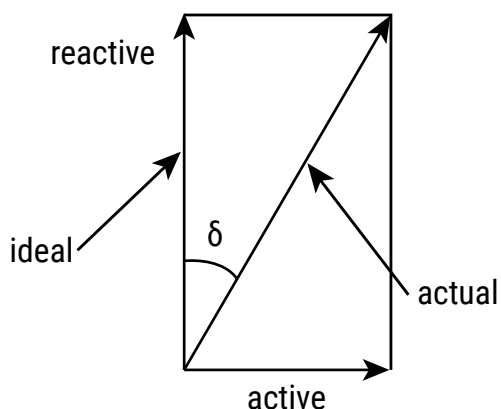
Effective capacitance value is derived from the impedance curve, as long as impedance is still in the range where the capacitance component is dominant.

$$C = \frac{1}{2\pi fZ}$$

$C$  = capacitance (F)  
 $f$  = frequency (Hz)  
 $Z$  = 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:

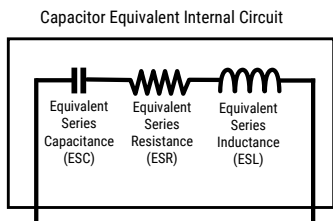
ESC = Equivalent series capacitance

ESR = Equivalent series resistance

## Application & Operation Guidelines cont.

### Equivalent Series Inductance (ESL)

Equivalent series inductance or self 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:

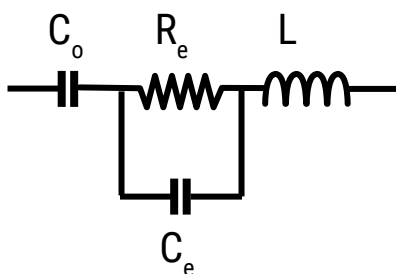
$$ESR = \frac{\tan \delta}{2\pi f ESC}$$

ESR = Equivalent series resistance ( $\Omega$ )  
 $\tan \delta$  = 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.

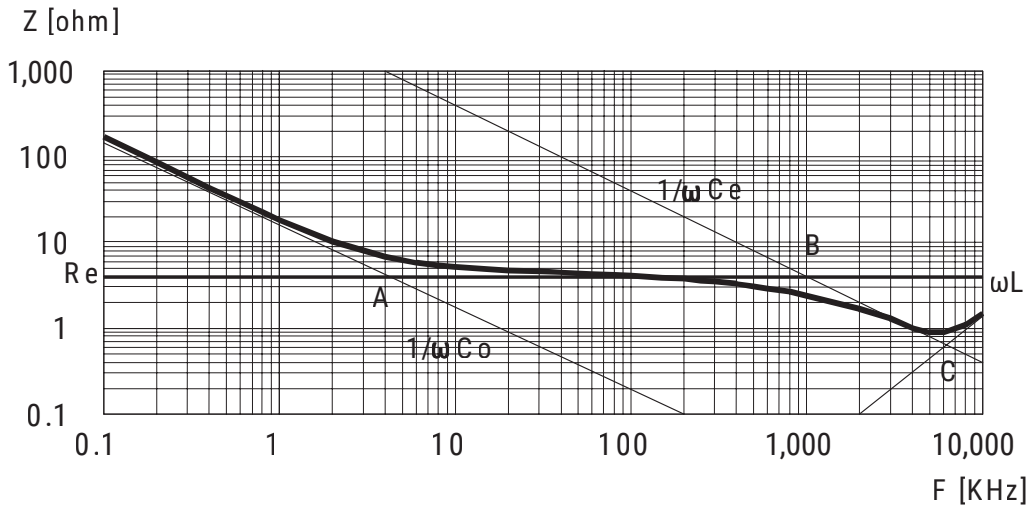
L = Inductive reactance of the capacitor winding and terminals.

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:

## Application & Operation Guidelines cont.

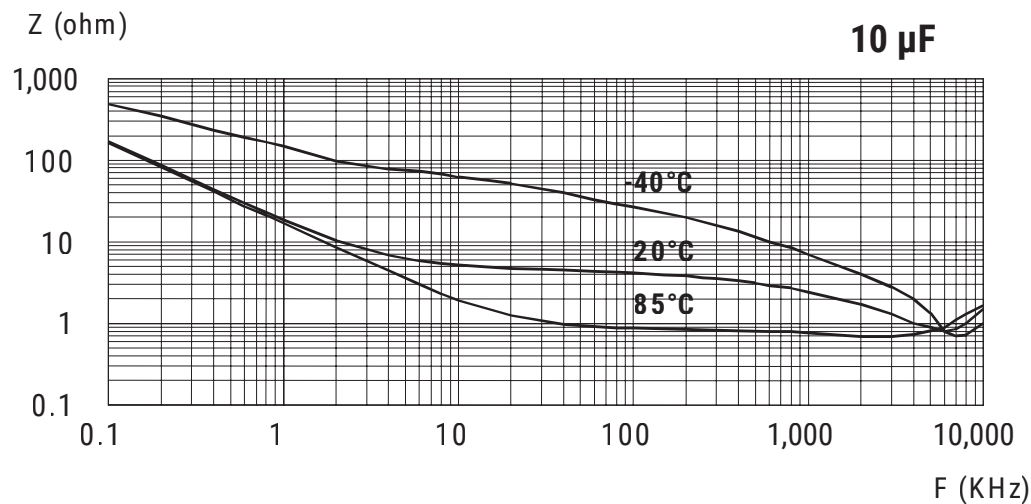
### Impedance (Z) cont.



- 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 ( $\omega_o$ ), capacitive and inductive reactance mutually cancel each other  $1/\omega C_e = \omega L$ ,  $\omega_o = 1/\text{SQR}(LC_e)$
- 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.

## Application & Operation Guidelines cont.

### Leakage Current (LC)

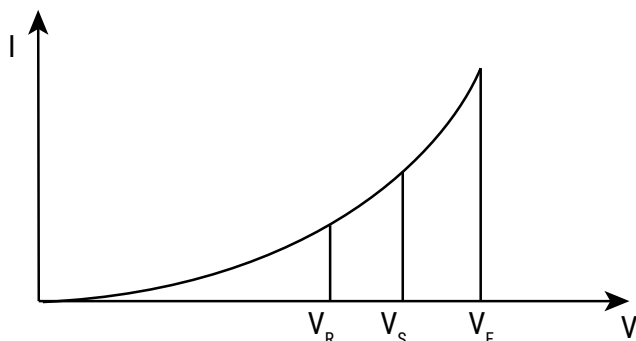
Due to the aluminum oxide layer that serves as a dielectric, a small current will continue to flow even after a DC voltage has been applied for long periods. This current is called leakage current.

A high leakage current flows after applying voltage to the capacitor then decreases in a few minutes, for example, 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 a 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.



## Application & Operation Guidelines cont.

### 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.

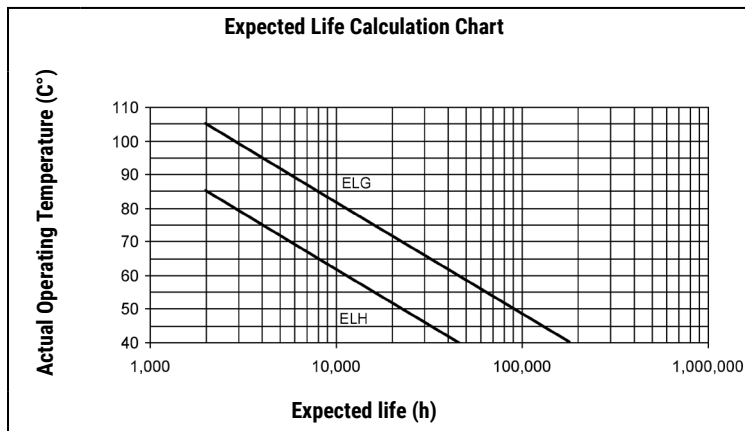
### Expected Life Calculation

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 a maximum permissible operating temperature
- T: Actual operating temperature
- $T_0$ : Maximum permissible operating temperature

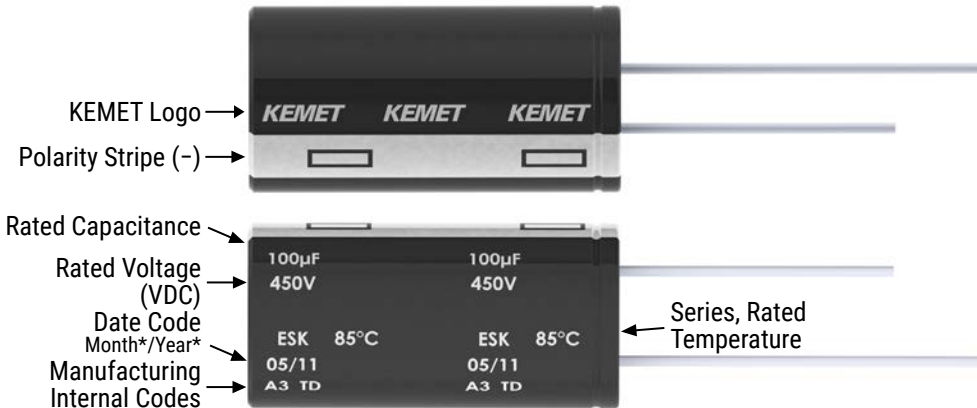
This formula is applicable between 40°C and  $T_0$ .



## Packaging Quantities

Size Code	Diameter (mm)	Length (mm)	Bulk		Auto-insertion	
			Standard Leads	Cut Leads	Ammo	Tape & Reel
C3	5.0	11.0	10,000	15,000	2,000	2,600
E3	6.3	11.0	10,000	15,000	2,000	2,200
G3	8.0	11.0	6,000	8,000	1,000	1,500
G4	8.0	15.0	5,000	5,000	1,000	1,500
G7	8.0	14.0	5,000	5,000	1,000	1,500
H9	10.0	12.5	4,000	4,000	700	1,200
H1	10.0	12.0	4,000	4,000	700	1,200
H2	10.0	15.0	3,000	4,000	700	1,200
H4	10.0	20.0	2,400	3,000	700	1,200
L2	13.0	16.0	2,400	2,400	500	
L3	13.0	20.0	2,000	2,000	500	
L4	13.0	25.0	1,600	1,600	500	
M7	16.0	25.0	1,000	500	300	
M1	16.0	26.0	1,000	500	300	
M2	16.0	32.0	800	500	300	
M3	16.0	36.0	600	500	300	
M4	16.0	40.0	600	500	300	
N5	18.0	25.0	800	500	300	
N1	18.0	32.0	500	500		
N2	18.0	36.0	500	500		
N3	18.0	40.0	500	500		
Q3	22.0	35.0	400	400		
Q4	22.0	40.0	300	400		

## Marking



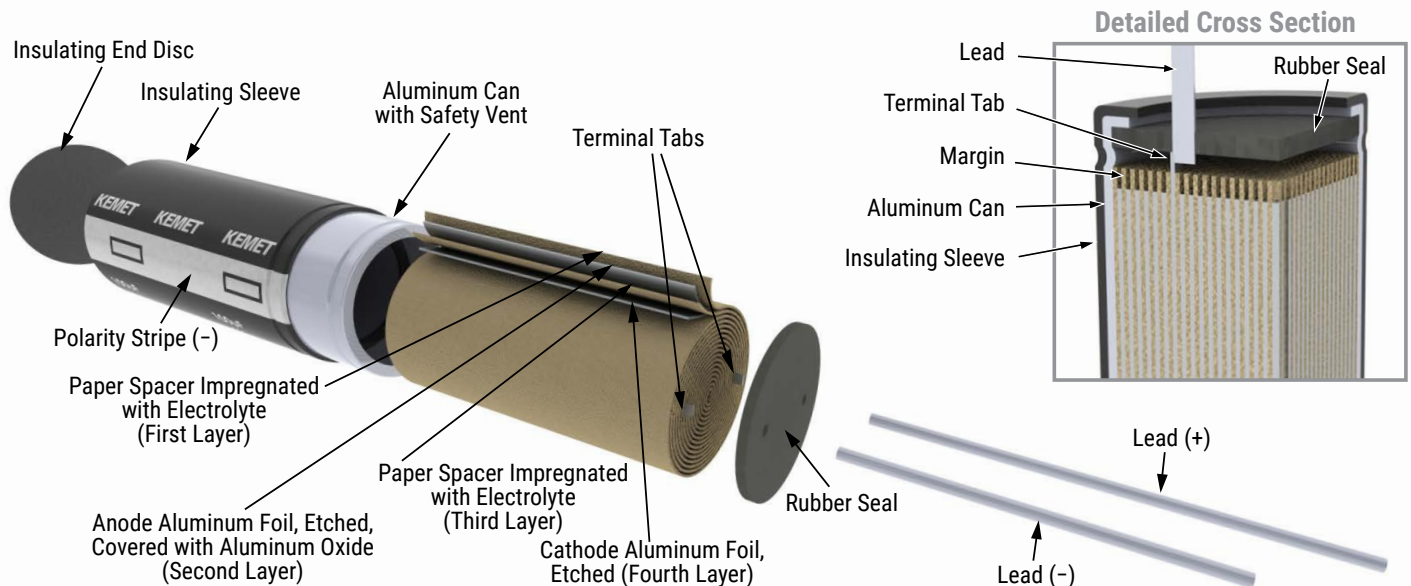
\*Y = Year

Code	01	02	03	04	05	06	07	08	09
Year	2011	2012	2013	2014	2015	2016	2017	2018	2019

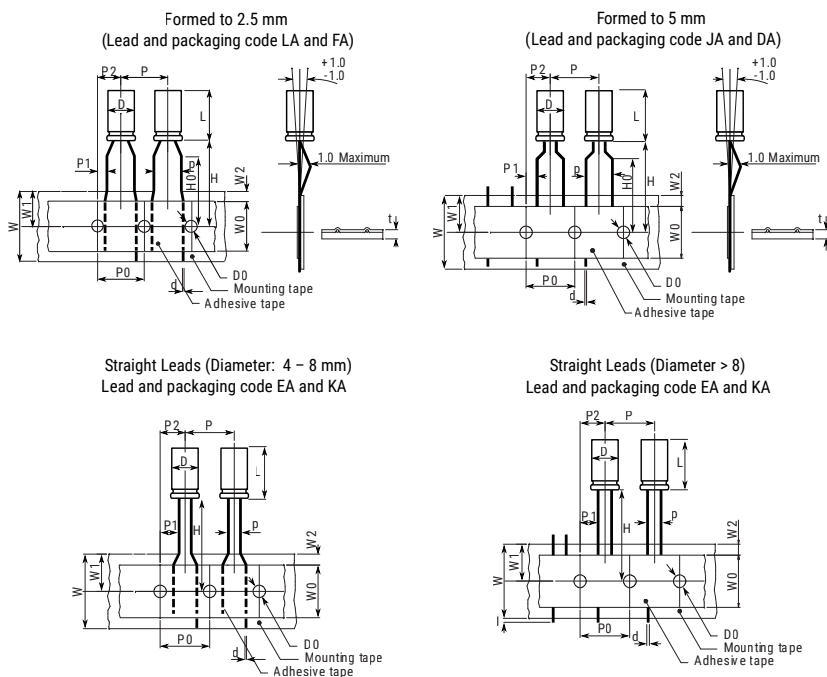
\*M = Month

Code	01	02	03	04	05	06	07	08	09	10	11	12
Month	1	2	3	4	5	6	7	8	9	10	11	12

## Construction

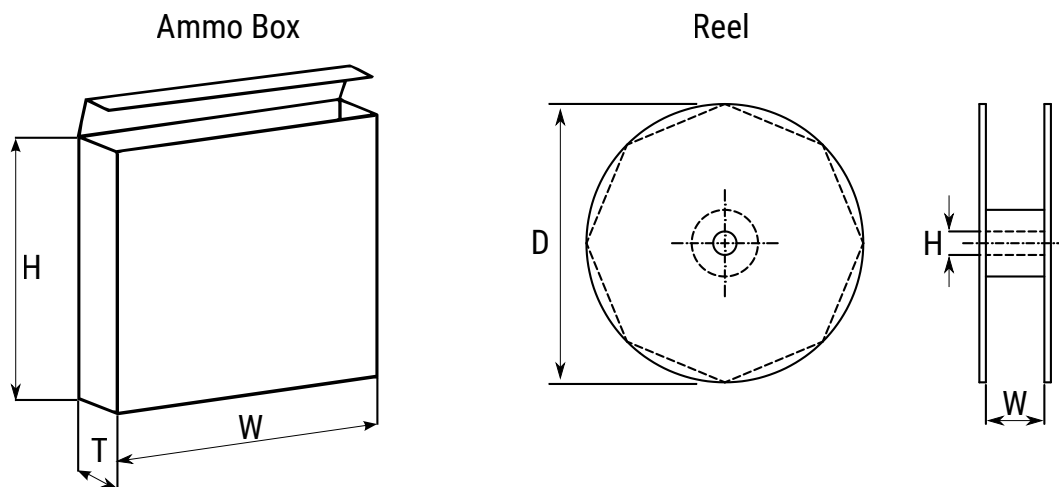


## Taping for Automatic Insertion Machines



Dimensions (mm)	D	L	p	d	P	P0	P1	P2	W	W0	W1	W2	H0	H1	I	D0	t
<b>Tolerance</b>	<b>+0.5</b>		<b>+0.8/-0.2</b>	<b>±0.05</b>	<b>±1.0</b>	<b>±0.3</b>	<b>±0.7</b>	<b>±1.3</b>	<b>+1/-0.5</b>	<b>±0.5</b>	<b>Maximum</b>	<b>Maximum</b>	<b>±0.75</b>	<b>±0.5</b>	<b>Maximum</b>	<b>±0.2</b>	<b>±0.2</b>
Formed to 2.5 mm	4	5 – 7	2.5	0.45	12.7	12.7	5.1	6.35	18	12	11	3	16.0	18.5		4	0.7
	5	≤ 7	2.5	0.45	12.7	12.7	5.1	6.35	18	12	11	3	16.0	18.5		4	0.7
		> 7	2.5	0.50	12.7	12.7	5.1	6.35	18	12	11	3	16.0	18.5		4	0.7
Formed to 5 mm	4	5 – 7	5.0	0.45	12.7	12.7	3.85	6.35	18	12	11	3	16.0	18.5		4	0.7
	5	≤ 7	5.0	0.45	12.7	12.7	3.85	6.35	18	12	11	3	16.0	18.5		4	0.7
		> 7	5.0	0.50	12.7	12.7	3.85	6.35	18	12	11	3	16.0	18.5		4	0.7
	6	≤ 7	5.0	0.50	12.7	12.7	3.85	6.35	18	12	11	3	16.0	18.5		4	0.7
		> 7	5.0	0.50	12.7	12.7	3.85	6.35	18	12	11	3	16.0	18.5		4	0.7
	8	≤ 7	5.0	0.50	12.7	12.7	3.85	6.35	18	12	11	3	16.0	18.5		4	0.7
> 7	5.0	0.50	12.7	12.7	3.85	6.35	18	12	11	3	16.0	18.5		4	0.7		
Straight leads	4	5 – 7	1.5	0.45	12.7	12.7	5.6	6.35	18	12	11	3	18.5			4	0.7
	5	≤ 7	2.0	0.45	12.7	12.7	5.35	6.35	18	12	11	3	18.5			4	0.7
		> 7	2.0	0.50	12.7	12.7	5.35	6.35	18	12	11	3	18.5			4	0.7
	6	≤ 7	2.5	0.50	12.7	12.7	5.1	6.35	18	12	11	3	18.5			4	0.7
		> 7	2.5	0.50	12.7	12.7	5.1	6.35	18	12	11	3	18.5			4	0.7
	8	≤ 7	3.5	0.50	12.7	12.7	4.6	6.35	18	12	11	3	18.5			4	0.7
		> 7	3.5	0.50	12.7	12.7	4.6	6.35	18	12	11	3	18.5			4	0.7
10	≤ 20	5.0	0.60	12.7	12.7	3.85	6.35	18	12	11	3	18.5		1	4	1.0	

## Lead Taping & Packaging



Diameter	Length	Ammo			Reel		
		H	W	T	D	H	W
			Maximum	Maximum	±2	±0.5	+1/-0.1
4	All	230	340	42	350	30	50
5	≤ 7	230	340	42			
5	11	275	340	42			
6.3	≤ 7	235	340	45			
6.3	11	230	340	48			
8	≤ 7	270	340	48			
8	11	235	340	48			
8	>11 ≤ 20	240	340	57			
10	≤ 13	250	340	52			
10	>13 ≤ 20	256	340	57			
10	>20	250	340	60			
12	All	270	340	57			
13	All	285	340	62			
16	All	265	340	62			

## Construction Data

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. This sample size is controlled by the use of recognized sampling tables defined in BS 6001.

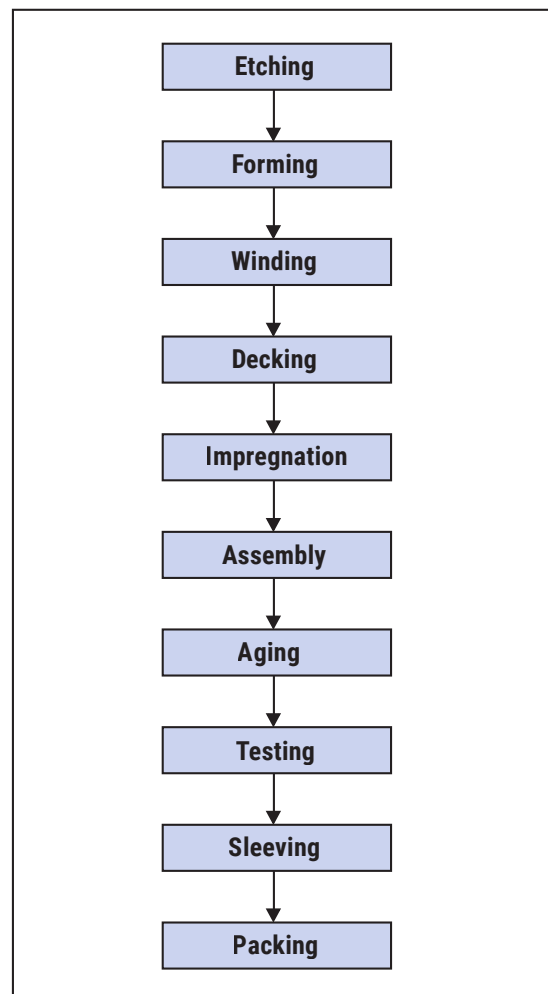
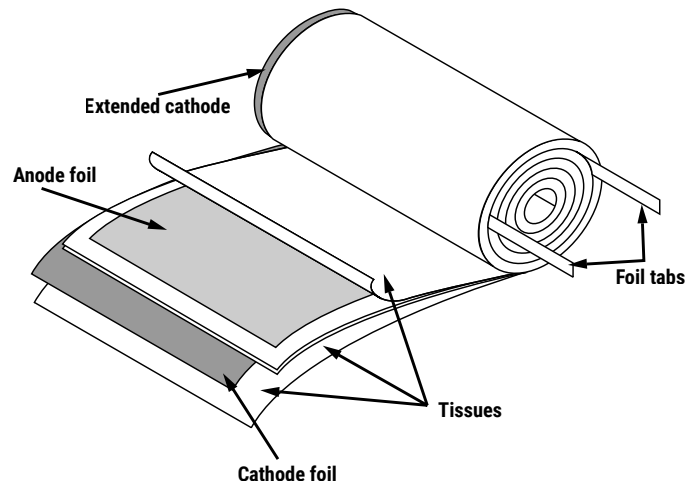
The following tests are applied and may be varied at the request of the customer. In this case the batch, or special procedure, will determine the course of action.

### 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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