Overview

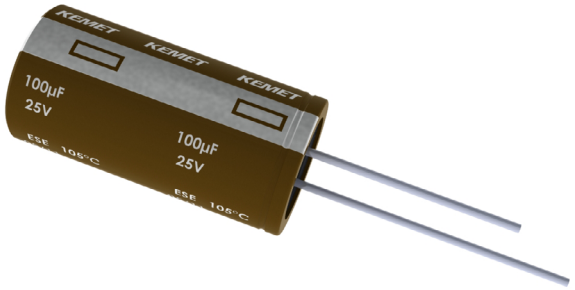
The KEMET ESE radial aluminum electrolytic capacitors are designed for general purpose applications requiring a miniature solution.

Applications

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

Benefits

- 1,000 hour operating life
- Operating temperature of up to 105°C
- Safety vent on the capacitor base



Part Number System

ESE	476	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 = ±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	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 ±0.75	LA
4 – 8	All	Tape & Reel	2.5 mm lead spacing	H_0 = 18.5 ±0.75	KA
4 – 8	All	Tape & Reel	Formed to 5 mm	H_0 = 16 ±0.75	JA
10	≤ 20	Tape & Reel	Straight	H_0 = 18.5 ±0.75	KA
Ammo Pack					
4 – 8	All	Ammo	Formed to 5 mm	H_0 = 16 ±0.75	DA
4 – 8	All	Ammo	Straight	H_0 = 18.5 ±0.75	EA
4 – 5	All	Ammo	Formed to 2.5 mm	H_0 = 16 ±0.75	FA
10 – 13	All	Ammo	5 mm lead spacing	H_0 = 18.5 ±0.75	EA
16	All	Ammo	7.5 mm lead spacing	H_0 = 18.5 ±0.75	EA
18	≤ 25	Ammo	7.5 mm lead spacing	H_0 = 18.5 ±0.75	EA
Contact KEMET for other lead and packaging options					

Environmental Compliance

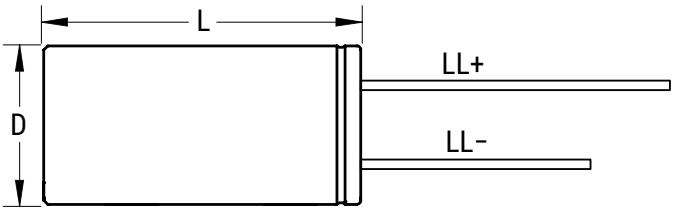
As an environmentally conscious company, KEMET is working continuously with improvements concerning the environmental effects of both our capacitors and their production. In Europe (RoHS Directive) and in some other geographical areas like China, legislation has been put in place to prevent the use of 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.

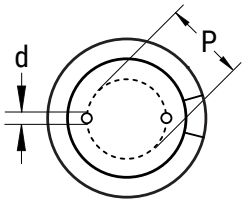
Due to customer requirements, there may appear additional markings such as lead free (LF) or lead-free wires (LFW) on the label.

Dimensions – Millimeters

SIDE VIEW



TERMINAL END VIEW



Size Code	D		L		P		d		LL+/LL–
	Nominal	Tolerance	Nominal	Tolerance	Nominal	Tolerance	Nominal	Tolerance	Minimum
C3	5.0	±0.5	11.0	±1.5	2.0	±0.5	0.5	Nominal	20/15
E3	6.3	±0.5	11.0	±1.5	2.5	±0.5	0.5	Nominal	20/15
G3	8.0	±0.5	11.0	±1.5	3.5	±0.5	0.6	Nominal	20/15
G4	8.0	±0.5	15.0	±2.0	3.5	±0.5	0.6	Nominal	20/15
G6	8.0	±0.5	20.0	±2.0	3.5	±0.5	0.6	Nominal	20/15
H9	10.0	±0.5	12.5	±1.5	5.0	±0.5	0.6	Nominal	20/15
H2	10.0	±0.5	15.0	±2.0	5.0	±0.5	0.6	Nominal	20/15
H4	10.0	±0.5	20.0	±2.0	5.0	±0.5	0.6	Nominal	20/15
H5	10.0	±0.5	25.0	±2.0	5.0	±0.5	0.6	Nominal	20/15
L3	13.0	±0.5	20.0	±2.0	5.0	±0.5	0.6	Nominal	20/15
L4	13.0	±0.5	25.0	±2.0	5.0	±0.5	0.6	Nominal	20/15
M5	16.0	±0.5	20.0	±2.0	7.5	±0.5	0.8	Nominal	20/15
M7	16.0	±0.5	25.0	±2.0	7.5	±0.5	0.8	Nominal	20/15
M2	16.0	±0.5	32.0	±2.0	7.5	±0.5	0.8	Nominal	20/15
M3	16.0	±0.5	36.0	±2.0	7.5	±0.5	0.8	Nominal	20/15
N4	18.0	±0.5	20.0	±2.0	7.5	±0.5	0.8	Nominal	20/15
N5	18.0	±0.5	25.0	±2.0	7.5	±0.5	0.8	Nominal	20/15
N1	18.0	±0.5	32.0	±2.0	7.5	±0.5	0.8	Nominal	20/15
N2	18.0	±0.5	36.0	±2.0	7.5	±0.5	0.8	Nominal	20/15
N3	18.0	±0.5	40.0	±2.0	7.5	±0.5	0.8	Nominal	20/15
N7	18.0	±0.5	45.0	±2.0	7.5	±0.5	0.8	Nominal	20/15

Performance Characteristics

Item	Performance Characteristics		
Capacitance Range	1 – 15,000 µF	1 – 470 µF	1 – 150 µF
Capacitance Tolerance	±20% at 120 Hz/20°C		
Rated Voltage	6.3 – 100 VDC	160 – 250 VDC	350 – 450 VDC
Life Test	1,000 hours (see conditions in Test Method & Performance)		
Operating Temperature	-40°C to +105°C	-40°C to +105°C	-25°C to +105°C
Leakage Current	I ≤ 0.01 CV (µA) or 3 µA, whichever is greater	I = 0.03 CV (µA) + 10 (µA)	
	C = rated capacitance (µF), 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	350	400 – 450
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	7	-	-

Compensation Factor of Ripple Current (RC) vs. Frequency

Rated Voltage (VDC)	Capacitance Range (µF)	120 Hz	300 Hz	1 kHz	10 kHz
6.3 – 100	1.0 – 68 µF	1.00	1.20	1.30	1.45
6.3 – 100	100 – 680 µF	1.00	1.10	1.15	1.25
6.3 – 100	1,000 – 15,000 µF	1.00	1.05	1.10	1.15
160 – 450	1.0 – 15,000 µF	1.00	1.05	1.10	1.50

Test Method & Performance

Conditions	Load Life Test	Shelf Life Test
Temperature	105°C	105°C
Test Duration	1,000 hours	500 hours
Ripple Current	Maximum ripple current specified at 120 Hz 105°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

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 105°C (mA)	LC 20°C 2 minutes (µA)	Part Number
6.3	8	47	5 x 11	26	60	3.0	ESE476M6R3AC3(1)
6.3	8	68	5 x 11	26	75	4.3	ESE686M6R3AC3(1)
6.3	8	100	5 x 11	26	100	6.3	ESE107M6R3AC3(1)
6.3	8	150	5 x 11	26	120	9.5	ESE157M6R3AC3(1)
6.3	8	220	5 x 11	26	140	13.9	ESE227M6R3AC3(1)
6.3	8	220	6.3 x 11	26	165	13.9	ESE227M6R3AE3(1)
6.3	8	330	6.3 x 11	26	160	20.8	ESE337M6R3AE3(1)
6.3	8	470	6.3 x 11	26	220	29.6	ESE477M6R3AE3(1)
6.3	8	680	8 x 11	26	255	42.8	ESE687M6R3AG3(1)
6.3	8	1,000	8 x 11	26	370	63.0	ESE108M6R3AG3(1)
6.3	8	1,000	10 x 12.5	26	470	63.0	ESE108M6R3AH9(1)
6.3	8	1,500	10 x 15	26	600	94.5	ESE158M6R3AH2(1)
6.3	8	2,200	10 x 20	26	740	138.6	ESE228M6R3AH4(1)
6.3	8	3,300	13 x 20	26	1100	207.9	ESE338M6R3AL3(1)
6.3	8	4,700	13 x 25	26	1100	296.1	ESE478M6R3AL4(1)
6.3	8	6,800	13 x 25	26	1250	428.4	ESE688M6R3AL4(1)
6.3	8	10,000	16 x 25	26	1560	630.0	ESE109M6R3AM7(1)
6.3	8	15,000	18 x 32	26	2100	945.0	ESE159M6R3AN1(1)
10	13	22	5 x 11	22	45	3.0	ESE226M010AC3(1)
10	13	33	5 x 11	22	60	3.3	ESE336M010AC3(1)
10	13	47	5 x 11	22	75	4.7	ESE476M010AC3(1)
10	13	68	5 x 11	22	80	6.8	ESE686M010AC3(1)
10	13	100	5 x 11	22	110	10.0	ESE107M010AC3(1)
10	13	150	5 x 11	22	110	15.0	ESE157M010AC3(1)
10	13	220	6.3 x 11	22	180	22.0	ESE227M010AE3(1)
10	13	330	6.3 x 11	22	205	33.0	ESE337M010AE3(1)
10	13	470	6.3 x 11	22	245	47.0	ESE477M010AE3(1)
10	13	470	8 x 11	22	305	47.0	ESE477M010AG3(1)
10	13	680	8 x 11	22	335	68.0	ESE687M010AG3(1)
10	13	680	10 x 12.5	22	420	68.0	ESE687M010AH9(1)
10	13	1,000	8 x 15	22	450	100.0	ESE108M010AG4(1)
10	13	1,000	10 x 12.5	22	490	100.0	ESE108M010AH9(1)
10	13	1,500	10 x 20	22	750	150.0	ESE158M010AH4(1)
10	13	2,200	10 x 20	22	800	220.0	ESE228M010AH4(1)
10	13	3,300	10 x 25	22	950	330.0	ESE338M010AH5(1)
10	13	3,300	13 x 20	22	1050	330.0	ESE338M010AL3(1)
10	13	4,700	13 x 25	22	1190	470.0	ESE478M010AL4(1)
10	13	6,800	16 x 25	22	1370	680.0	ESE688M010AM7(1)
10	13	10,000	16 x 36	22	1760	1000.0	ESE109M010AM3(1)
10	13	15,000	18 x 36	22	2150	1500.0	ESE159M010AN2(1)
16	20	10	5 x 11	18	25	3.0	ESE106M016AC3(1)
16	20	15	5 x 11	18	40	3.0	ESE156M016AC3(1)
16	20	22	5 x 11	18	55	3.5	ESE226M016AC3(1)
16	20	33	5 x 11	18	70	5.3	ESE336M016AC3(1)
16	20	47	5 x 11	18	85	7.5	ESE476M016AC3(1)
16	20	68	5 x 11	18	100	10.9	ESE686M016AC3(1)
16	20	100	5 x 11	18	110	16.0	ESE107M016AC3(1)
16	20	150	6.3 x 11	18	175	24.0	ESE157M016AE3(1)
16	20	220	6.3 x 11	18	180	35.2	ESE227M016AE3(1)
16	20	330	8 x 11	18	285	52.8	ESE337M016AG3(1)
16	20	470	8 x 11	18	310	75.2	ESE477M016AG3(1)
16	20	680	10 x 12.5	18	455	108.8	ESE687M016AH9(1)
16	20	1,000	8 x 20	18	600	160.0	ESE108M016AG6(1)
16	20	1,000	10 x 15	18	590	160.0	ESE108M016AH2(1)
16	20	1,500	10 x 20	18	680	240.0	ESE158M016AH4(1)
16	20	2,200	13 x 20	18	990	352.0	ESE228M016AL3(1)
16	20	3,300	13 x 25	18	1140	528.0	ESE338M016AL4(1)
16	20	4,700	16 x 25	18	1330	752.0	ESE478M016AM7(1)
VDC	**VDC Surge**	**Rated Capacitance**	**Case Size**	**DF**	**RC**	**1360.0**	**Part Number**

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

Table 1 – Ratings & Part Number Reference cont.

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 105°C (mA)	LC 20°C 2 minutes (µA)	Part Number
16	20	6,800	16 x 32	18	1580	1088.0	ESE688M016AM2(1)
16	20	10,000	18 x 36	18	2150	1600.0	ESE109M016AN2(1)
25	32	4.7	5 x 11	16	20	3.0	ESE475M025AC3(1)
25	32	6.8	5 x 11	16	25	3.0	ESE685M025AC3(1)
25	32	10	5 x 11	16	30	3.0	ESE106M025AC3(1)
25	32	15	5 x 11	16	45	3.8	ESE156M025AC3(1)
25	32	22	5 x 11	16	60	5.5	ESE226M025AC3(1)
25	32	33	5 x 11	16	75	8.3	ESE336M025AC3(1)
25	32	47	5 x 11	16	90	11.8	ESE476M025AC3(1)
25	32	68	6.3 x 11	16	125	17.0	ESE686M025AE3(1)
25	32	100	6.3 x 11	16	145	25.0	ESE107M025AE3(1)
25	32	150	8 x 11	16	200	37.5	ESE157M025AG3(1)
25	32	220	8 x 11	16	200	55.0	ESE227M025AG3(1)
25	32	330	8 x 11	16	265	82.5	ESE337M025AG3(1)
25	32	330	8 x 15	16	320	82.5	ESE337M025AG4(1)
25	32	470	8 x 15	16	365	117.5	ESE477M025AG4(1)
25	32	680	10 x 15	16	650	170.0	ESE687M025AH2(1)
25	32	1,000	10 x 20	16	680	250.0	ESE108M025AH4(1)
25	32	1,500	13 x 20	16	880	375.0	ESE158M025AL3(1)
25	32	2,200	13 x 25	16	1030	550.0	ESE228M025AL4(1)
25	32	3,300	16 x 25	16	1230	825.0	ESE338M025AM7(1)
25	32	4,700	16 x 32	16	1420	1175.0	ESE478M025AM2(1)
25	32	6,800	18 x 36	16	1850	1700.0	ESE688M025AN2(1)
35	44	4.7	5 x 11	14	25	3.0	ESE475M035AC3(1)
35	44	6.8	5 x 11	14	30	3.0	ESE685M035AC3(1)
35	44	10	5 x 11	14	40	3.5	ESE106M035AC3(1)
35	44	15	5 x 11	14	50	5.3	ESE156M035AC3(1)
35	44	22	5 x 11	14	65	7.7	ESE226M035AC3(1)
35	44	33	5 x 11	14	85	11.6	ESE336M035AC3(1)
35	44	47	5 x 11	14	95	16.5	ESE476M035AC3(1)
35	44	68	6.3 x 11	14	125	23.8	ESE686M035AE3(1)
35	44	100	6.3 x 11	14	150	35.0	ESE107M035AE3(1)
35	44	150	8 x 11	14	200	52.5	ESE157M035AG3(1)
35	44	220	8 x 11	14	230	77.0	ESE227M035AG3(1)
35	44	220	10 x 12.5	14	315	77.0	ESE227M035AH9(1)
35	44	330	8 x 15	14	345	115.5	ESE337M035AG4(1)
35	44	330	10 x 12.5	14	380	115.5	ESE337M035AH9(1)
35	44	470	10 x 15	14	415	164.5	ESE477M035AH2(1)
35	44	680	10 x 20	14	680	238.0	ESE687M035AH4(1)
35	44	1,000	13 x 20	14	850	350.0	ESE108M035AL3(1)
35	44	1,500	13 x 25	14	935	525.0	ESE158M035AL4(1)
35	44	2,200	16 x 25	14	1230	770.0	ESE228M035AM7(1)
35	44	3,300	16 x 36	14	1470	1155.0	ESE338M035AM3(1)
35	44	4,700	18 x 36	14	1580	1645.0	ESE478M035AN2(1)
50	63	1.0	5 x 11	12	12	3.0	ESE105M050AC3(1)
50	63	2.2	5 x 11	12	18	3.0	ESE225M050AC3(1)
50	63	3.3	5 x 11	12	25	3.0	ESE335M050AC3(1)
50	63	4.7	5 x 11	12	30	3.0	ESE475M050AC3(1)
50	63	6.8	5 x 11	12	32	3.4	ESE685M050AC3(1)
50	63	10	5 x 11	12	50	5.0	ESE106M050AC3(1)
50	63	15	5 x 11	12	60	7.5	ESE156M050AC3(1)
50	63	22	5 x 11	12	75	11.0	ESE226M050AC3(1)
50	63	33	5 x 11	12	95	16.5	ESE336M050AC3(1)
50	63	47	6.3 x 11	12	105	23.5	ESE476M050AE3(1)
50	63	68	8 x 11	12	159	34.0	ESE686M050AG3(1)
50	63	100	8 x 11	12	160	50.0	ESE107M050AG3(1)
50	63	150	10 x 12.5	12	289	75.0	ESE157M050AH9(1)
VDC	**VDC Surge**	**Rated Capacitance**	**Case Size**	**DF**	**RC**	**1360.0**	**Part Number**

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

Table 1 – Ratings & Part Number Reference cont.

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 105°C (mA)	LC 20°C 2 minutes (µA)	Part Number
50	63	220	10 x 12.5	12	340	110.0	ESE227M050AH9(1)
50	63	330	10 x 20	12	535	165.0	ESE337M050AH4(1)
50	63	470	10 x 20	12	580	235.0	ESE477M050AH4(1)
50	63	470	13 x 20	12	730	235.0	ESE477M050AL3(1)
50	63	680	13 x 25	12	860	340.0	ESE687M050AL4(1)
50	63	1,000	13 x 25	12	930	500.0	ESE108M050AL4(1)
50	63	1,500	16 x 25	12	1220	750.0	ESE158M050AM7(1)
50	63	2,200	16 x 36	12	1360	1100.0	ESE228M050AM3(1)
50	63	3,300	18 x 36	12	1540	1650.0	ESE338M050AN2(1)
63	79	1.0	5 x 11	10	13	3.0	ESE105M063AC3(1)
63	79	2.2	5 x 11	10	20	3.0	ESE225M063AC3(1)
63	79	3.3	5 x 11	10	27	3.0	ESE335M063AC3(1)
63	79	4.7	5 x 11	10	34	3.0	ESE475M063AC3(1)
63	79	6.8	5 x 11	10	37	4.3	ESE685M063AC3(1)
63	79	10	5 x 11	10	55	6.3	ESE106M063AC3(1)
63	79	15	5 x 11	10	65	9.5	ESE156M063AC3(1)
63	79	22	6.3 x 11	10	90	13.9	ESE226M063AE3(1)
63	79	33	6.3 x 11	10	110	20.8	ESE336M063AE3(1)
63	79	47	8 x 11	10	155	29.6	ESE476M063AG3(1)
63	79	100	8 x 15	10	230	63.0	ESE107M063AG4(1)
63	79	100	10 x 12.5	10	260	63.0	ESE107M063AH9(1)
63	79	150	10 x 15	10	330	94.5	ESE157M063AH2(1)
63	79	220	10 x 15	10	400	138.6	ESE227M063AH2(1)
63	79	220	10 x 20	10	460	138.6	ESE227M063AH4(1)
63	79	330	10 x 20	10	520	207.9	ESE337M063AH4(1)
63	79	470	13 x 20	10	700	296.1	ESE477M063AL3(1)
63	79	680	13 x 25	10	840	428.4	ESE687M063AL4(1)
63	79	1,000	16 x 25	10	1020	630.0	ESE108M063AM7(1)
63	79	1,500	16 x 32	10	1300	945.0	ESE158M063AM2(1)
63	79	2,200	18 x 36	10	1455	1386.0	ESE228M063AN2(1)
100	125	1.0	5 x 11	10	15	3.0	ESE105M100AC3(1)
100	125	2.2	5 x 11	10	22	3.0	ESE225M100AC3(1)
100	125	3.3	5 x 11	10	29	3.3	ESE335M100AC3(1)
100	125	4.7	5 x 11	10	37	4.7	ESE475M100AC3(1)
100	125	6.8	5 x 11	10	46	6.8	ESE685M100AC3(1)
100	125	10	5 x 11	10	55	10.0	ESE106M100AC3(1)
100	125	10	6.3 x 11	10	65	10.0	ESE106M100AE3(1)
100	125	15	6.3 x 11	10	72	15.0	ESE156M100AE3(1)
100	125	22	8 x 11	10	115	22.0	ESE226M100AG3(1)
100	125	33	8 x 11	10	120	33.0	ESE336M100AG3(1)
100	125	47	10 x 12.5	10	180	47.0	ESE476M100AH9(1)
100	125	68	10 x 15	10	241	68.0	ESE686M100AH2(1)
100	125	100	10 x 20	10	385	100.0	ESE107M100AH4(1)
100	125	150	13 x 20	10	414	150.0	ESE157M100AL3(1)
100	125	220	13 x 25	10	590	220.0	ESE227M100AL4(1)
100	125	330	13 x 25	10	600	330.0	ESE337M100AL4(1)
100	125	470	16 x 25	10	740	470.0	ESE477M100AM7(1)
100	125	680	16 x 36	10	1200	680.0	ESE687M100AM3(1)
100	125	1,000	18 x 40	10	1340	1000.0	ESE108M100AN3(1)
160	200	1.0	5 x 11	15	17	14.8	ESE105M160AC3(1)
160	200	2.2	6.3 x 11	15	25	20.6	ESE225M160AE3(1)
160	200	3.3	6.3 x 11	15	30	25.8	ESE335M160AE3(1)
160	200	4.7	6.3 x 11	15	34	32.6	ESE475M160AE3(1)
160	200	6.8	8 x 11	15	50	42.6	ESE685M160AG3(1)
160	200	10	8 x 11	15	56	58.0	ESE106M160AG3(1)
160	200	15	10 x 12.5	15	80	82.0	ESE156M160AH9(1)
160	200	22	10 x 15	15	130	115.6	ESE226M160AH2(1)
VDC	**VDC Surge**	**Rated Capacitance**	**Case Size**	**DF**	**RC**	**1360.0**	**Part Number**

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

Table 1 – Ratings & Part Number Reference cont.

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 105°C (mA)	LC 20°C 2 minutes (µA)	Part Number
160	200	33	10 x 20	15	180	168.4	ESE336M160AH4(1)
160	200	47	10 x 20	15	230	235.6	ESE476M160AH4(1)
160	200	68	13 x 20	15	270	336.4	ESE686M160AL3(1)
160	200	100	13 x 25	15	330	490.0	ESE107M160AL4(1)
160	200	150	16 x 25	15	410	730.0	ESE157M160AM7(1)
160	200	220	16 x 32	15	550	1066.0	ESE227M160AM2(1)
160	200	330	18 x 36	15	770	1594.0	ESE337M160AN2(1)
160	200	470	18 x 40	15	800	2266.0	ESE477M160AN3(1)
200	250	1.0	5 x 11	15	19	16.0	ESE105M200AC3(1)
200	250	2.2	6.3 x 11	15	22	23.2	ESE225M200AE3(1)
200	250	3.3	6.3 x 11	15	32	29.8	ESE335M200AE3(1)
200	250	4.7	8 x 11	15	40	38.2	ESE475M200AG3(1)
200	250	6.8	8 x 11	15	56	50.8	ESE685M200AG3(1)
200	250	10	10 x 12.5	15	69	70.0	ESE106M200AH9(1)
200	250	15	10 x 15	15	110	100.0	ESE156M200AH2(1)
200	250	22	10 x 15	15	140	142.0	ESE226M200AH2(1)
200	250	33	10 x 20	15	190	208.0	ESE336M200AH4(1)
200	250	47	13 x 20	15	240	292.0	ESE476M200AL3(1)
200	250	68	13 x 25	15	330	418.0	ESE686M200AL4(1)
200	250	100	16 x 25	15	410	610.0	ESE107M200AM7(1)
200	250	150	16 x 32	15	430	910.0	ESE157M200AM2(1)
200	250	220	16 x 36	15	520	1330.0	ESE227M200AM3(1)
200	250	220	18 x 32	15	520	1330.0	ESE227M200AN1(1)
200	250	330	18 x 36	15	705	1990.0	ESE337M200AN2(1)
250	300	1.0	6.3 x 11	15	19	17.5	ESE105M250AE3(1)
250	300	2.2	6.3 x 11	15	23	26.5	ESE225M250AE3(1)
250	300	3.3	8 x 11	15	33	34.8	ESE335M250AG3(1)
250	300	4.7	8 x 11	15	41	45.3	ESE475M250AG3(1)
250	300	6.8	8 x 11	15	57	61.0	ESE685M250AG3(1)
250	300	10	10 x 12.5	15	78	85.0	ESE106M250AH9(1)
250	300	15	10 x 15	15	120	122.5	ESE156M250AH2(1)
250	300	22	10 x 20	15	155	175.0	ESE226M250AH4(1)
250	300	33	13 x 20	15	170	257.5	ESE336M250AL3(1)
250	300	47	13 x 25	15	330	362.5	ESE476M250AL4(1)
250	300	68	13 x 25	15	340	520.0	ESE686M250AL4(1)
250	300	100	16 x 25	15	415	760.0	ESE107M250AM7(1)
250	300	150	16 x 32	15	435	1135.0	ESE157M250AM2(1)
250	300	220	18 x 36	15	600	1660.0	ESE227M250AN2(1)
350	400	1.0	6.3 x 11	20	20	20.5	ESE105M350AE3(1)
350	400	2.2	8 x 11	20	35	33.1	ESE225M350AG3(1)
350	400	3.3	8 x 11	20	37	44.7	ESE335M350AG3(1)
350	400	4.7	8 x 11	20	47	59.4	ESE475M350AG3(1)
350	400	10	10 x 15	20	95	115.0	ESE106M350AH2(1)
350	400	15	10 x 20	20	140	167.5	ESE156M350AH4(1)
350	400	22	13 x 20	20	165	241.0	ESE226M350AL3(1)
350	400	33	13 x 25	20	220	356.5	ESE336M350AL4(1)
350	400	47	16 x 25	20	340	503.5	ESE476M350AM7(1)
350	400	100	18 x 32	20	430	1060.0	ESE107M350AN1(1)
350	400	150	18 x 40	20	480	1585.0	ESE157M350AN3(1)
400	450	1.0	6.3 x 11	20	16	22.0	ESE105M400AE3(1)
400	450	1.0	8 x 11	20	20	22.0	ESE105M400AG3(1)
400	450	2.2	6.3 x 11	20	20	36.4	ESE225M400AE3(1)
400	450	2.2	8 x 11	20	28	36.4	ESE225M400AG3(1)
400	450	3.3	8 x 11	20	38	49.6	ESE335M400AG3(1)
400	450	4.7	8 x 11	20	40	66.4	ESE475M400AG3(1)
400	450	4.7	10 x 12.5	20	49	66.4	ESE475M400AH9(1)
400	450	6.8	8 x 15	20	50	91.6	ESE685M400AG4(1)
VDC	**VDC Surge**	**Rated Capacitance**	**Case Size**	**DF**	**RC**	**1360.0**	**Part Number**

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

Table 1 – Ratings & Part Number Reference cont.

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 105°C (mA)	LC 20°C 2 minutes (µA)	Part Number
400	450	6.8	10 x 12.5	20	52	91.6	ESE685M400AH9(1)
400	450	10	10 x 15	20	65	130.0	ESE106M400AH2(1)
400	450	15	10 x 20	20	100	190.0	ESE156M400AH4(1)
400	450	22	13 x 20	20	150	274.0	ESE226M400AL3(1)
400	450	33	13 x 25	20	190	406.0	ESE336M400AL4(1)
400	450	33	16 x 20	20	195	406.0	ESE336M400AM5(1)
400	450	47	16 x 25	20	280	574.0	ESE476M400AM7(1)
400	450	47	18 x 20	20	275	574.0	ESE476M400AN4(1)
400	450	68	16 x 32	20	320	826.0	ESE686M400AM2(1)
400	450	68	18 x 25	20	305	826.0	ESE686M400AN5(1)
400	450	100	18 x 32	20	430	1210.0	ESE107M400AN1(1)
400	450	120	18 x 32	20	440	1450.0	ESE127M400AN1(1)
400	450	150	18 x 36	20	450	1810.0	ESE157M400AN2(1)
400	450	150	18 x 40	20	460	1810.0	ESE157M400AN3(1)
400	450	180	18 x 45	20	480	2170.0	ESE187M400AN7(1)
450	500	1	8 x 11	20	20	23.5	ESE105M450AG3(1)
450	500	2.2	8 x 11	20	28	39.7	ESE225M450AG3(1)
450	500	2.2	10 x 12.5	20	35	39.7	ESE225M450AH9(1)
450	500	3.3	10 x 12.5	20	49	54.6	ESE335M450AH9(1)
450	500	4.7	10 x 12.5	20	55	73.5	ESE475M450AH9(1)
450	500	6.8	10 x 15	20	65	101.8	ESE685M450AH2(1)
450	500	10	10 x 20	20	75	145.0	ESE106M450AH4(1)
450	500	15	13 x 20	20	125	212.5	ESE156M450AL3(1)
450	500	22	13 x 25	20	160	307.0	ESE226M450AL4(1)
450	500	33	16 x 25	20	210	455.5	ESE336M450AM7(1)
450	500	47	16 x 32	20	270	644.5	ESE476M450AM2(1)
450	500	68	18 x 32	20	305	928.0	ESE686M450AN1(1)
450	500	100	18 x 36	20	380	1360.0	ESE107M450AN2(1)
VDC	**VDC Surge**	**Rated Capacitance**	**Case Size**	**DF**	**RC**	**1360.0**	**Part Number**

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

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

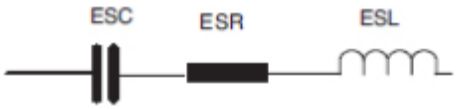
It is recommended that capacitors always be mounted with the safety device uppermost or in the upper part of the capacitor.

- 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 ≤ 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 ≤ 0.5 V at a frequency of 120 or 100 Hz and 20°C (IEC 384-1, 384-4).

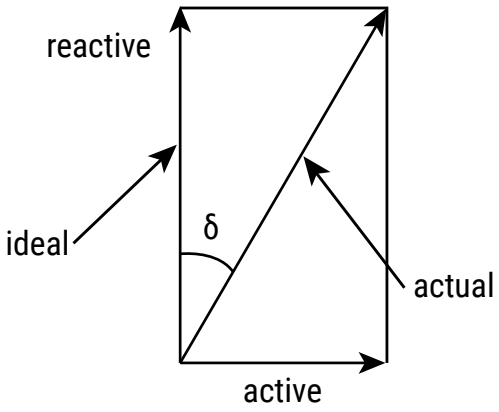
Temperature Dependence of the Capacitance
Capacitance of an electrolytic capacitor depends upon temperature: with decreasing temperature the viscosity of the electrolyte increases, thereby reducing its conductivity.
Capacitance will decrease if temperature decreases. Furthermore, temperature drifts cause 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 (Ω)

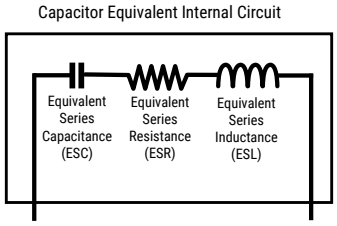
Dissipation Factor tan δ (DF)
Dissipation Factor tan δ is the ratio between the active and reactive power for a sinusoidal waveform voltage. It can be thought of as a measurement of the gap between an actual and ideal capacitor.



Tan δ is measured with the same set-up used for the series capacitance ESC.
Tan δ = ω x ESC x 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.



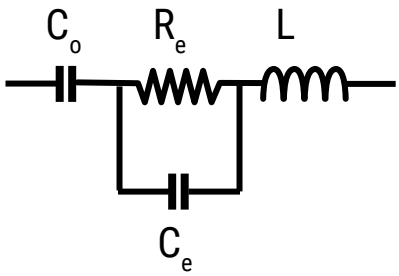
Equivalent Series Resistance (ESR)
Equivalent series resistance is the resistive component of the equivalent series circuit. ESR value depends on frequency and temperature, and is related to the tan δ by the following equation:

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

ESR = Equivalent series resistance (Ω)
tan δ = 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.

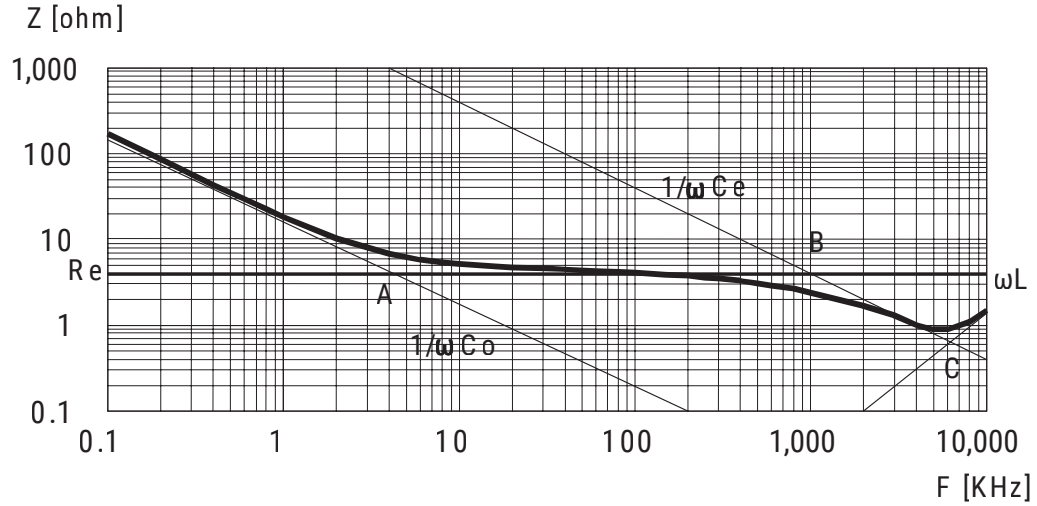
Impedance (Z)
Impedance of an electrolytic capacitor results from a circuit formed by the following individual equivalent series components:



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.

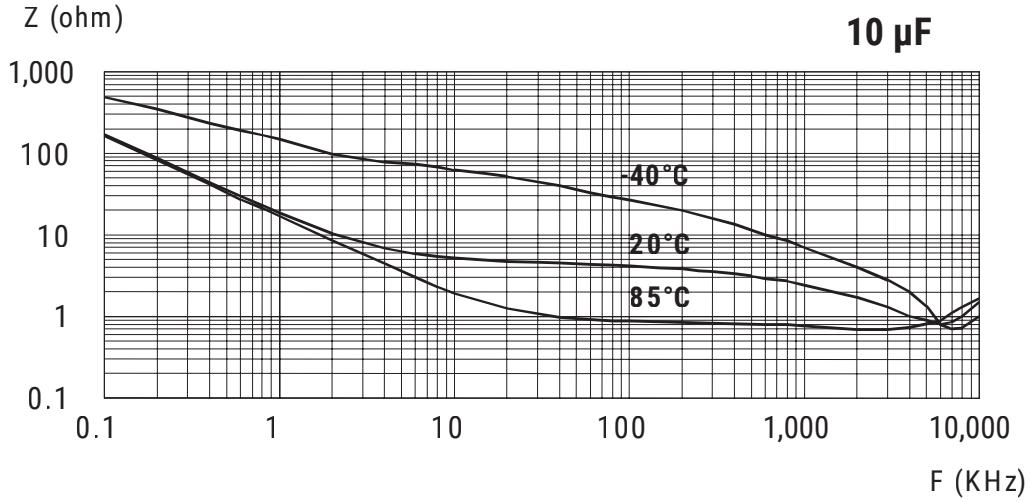
Impedance (Z) cont.



- Capacitive reactance predominates at low frequencies.
- With increasing frequency, capacitive reactance Xc = $1/\omega C_o$ 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 $1/\omega C_e = \omega L$, $\omega_0 = 1/SQR(LC_e)$
- Above this frequency, inductive reactance of the winding and its terminals (XL = Z = ωL) 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.

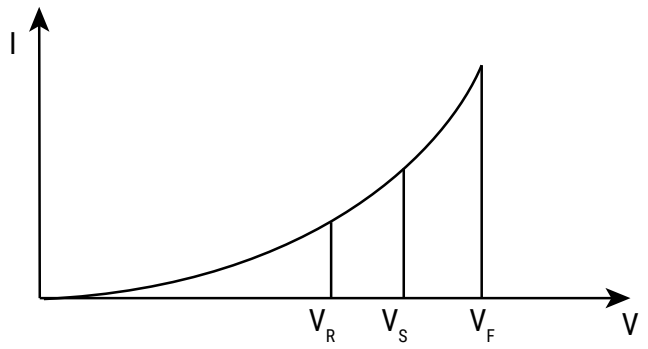
Application & Operation Guidelines cont.

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 δ or ESR
- Frequency

The capacitor's life depends on the thermal stress.

Application & Operation Guidelines cont.

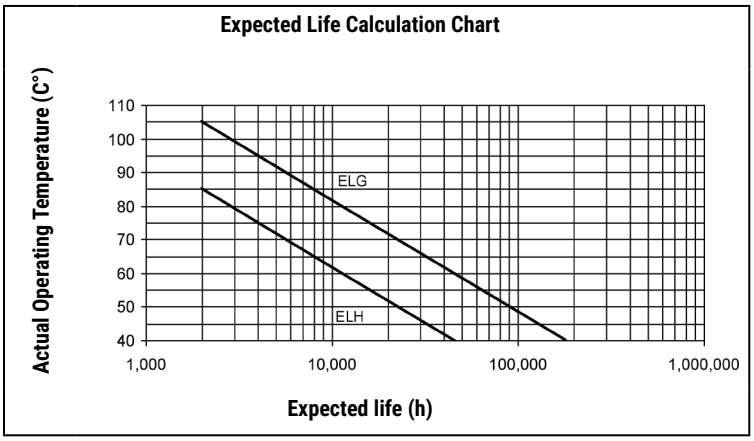
Frequency Dependence of the Ripple Current
ESR and, thus, the tan δ depend on the frequency of the applied voltage. This indicates that the allowed ripple current is also a function of the frequency.

Temperature Dependence of the Ripple Current
The data sheet specifies maximum ripple current at the upper category temperature for each capacitor.

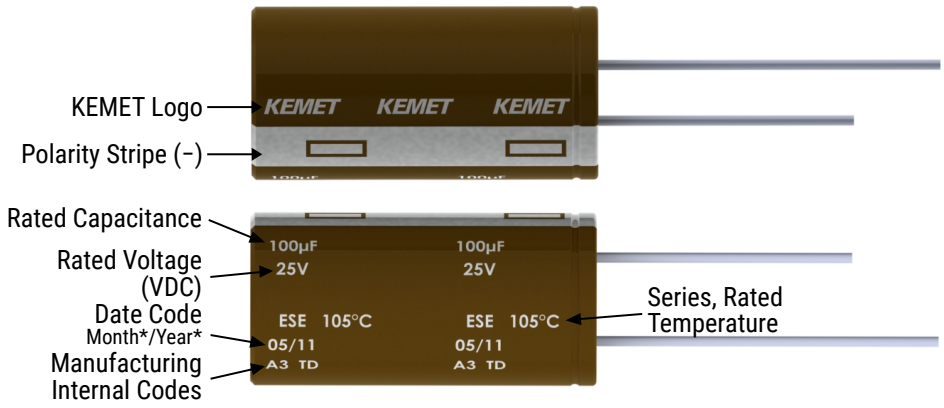
Expected Life Calculation
Expected life depends on operating temperature according to the following formula: $L = Lo \times 2^{(To-T)/10}$
Where:

L: Expected life
Lo: Load life at a maximum permissible operating temperature
T: Actual operating temperature
To: Maximum permissible operating temperature

This formula is applicable between 40°C and To.



Marking



*Y = Year

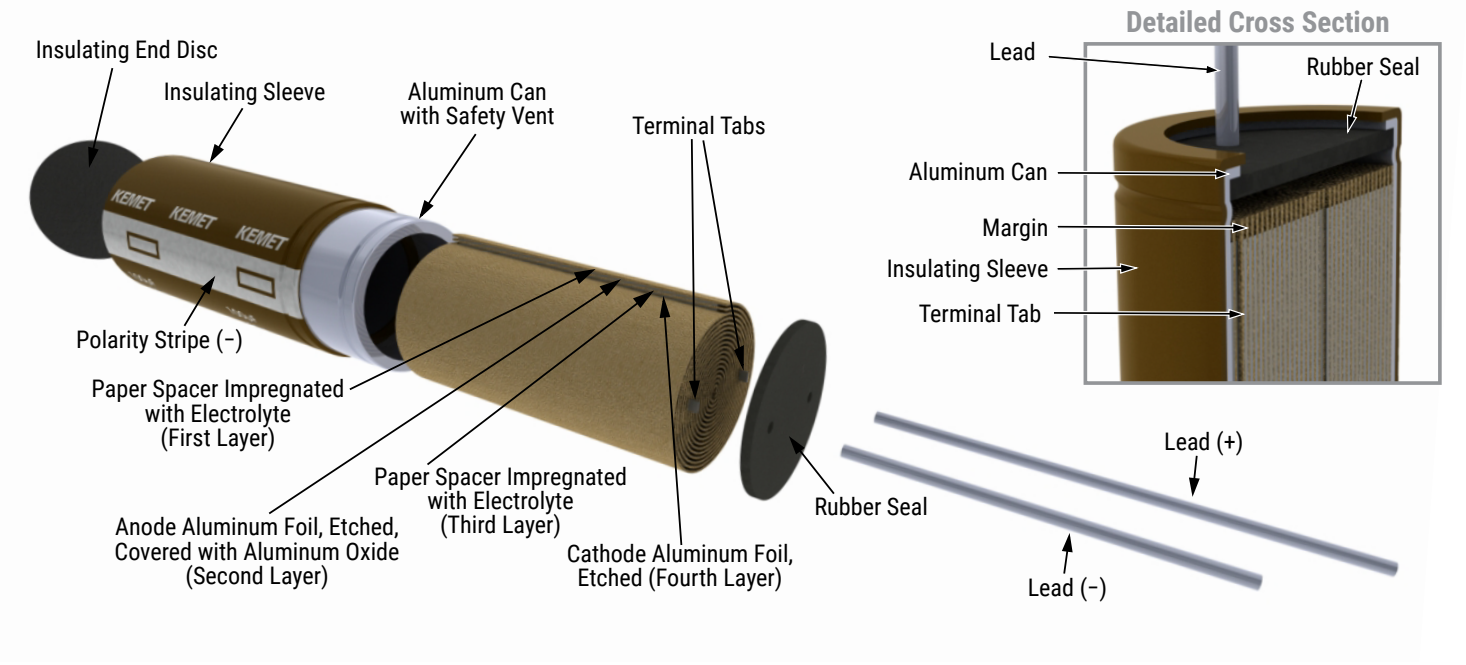
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Year	2011	2012	2013	2014	2015	2016	2017	2018	2019

*M = Month

Code	01	02	03	04	05	06	07	08	09	10	11	12
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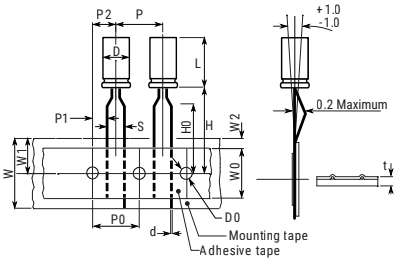
** Image for reference only. A slight change in the layout can occur, not affecting the marking content. This change will not impact the product's form, fit, or function, as the products remain equivalent in physical, mechanical, quality, and reliability characteristics.

Construction

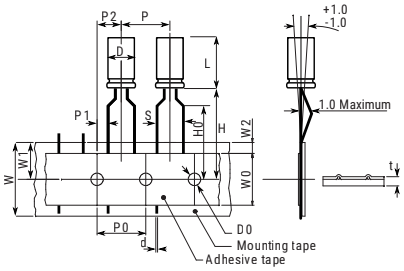


Taping for Automatic Insertion Machines

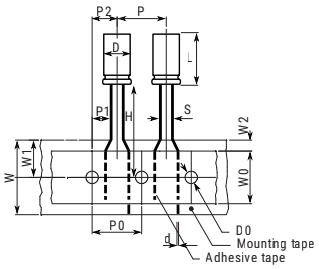
Formed to 2.5 mm
(Lead and packaging code LA and FA)



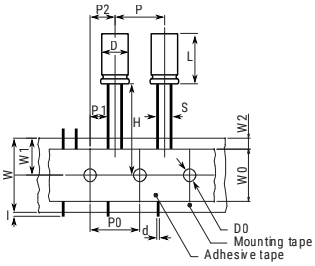
Formed to 5 mm
(Lead and packaging code JA and DA)



Straight Leads (Diameter: 4 – 8 mm)
Lead and packaging code EA and KA



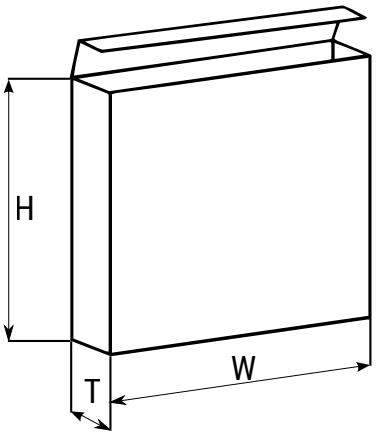
Straight Leads (Diameter > 8)
Lead and packaging code EA and KA



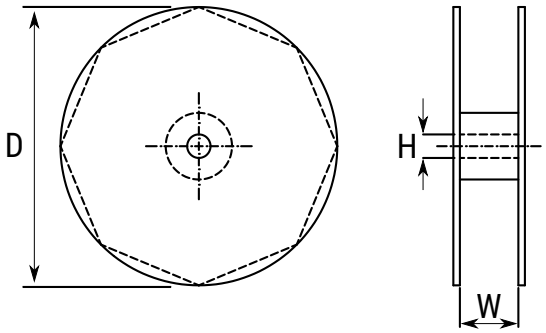
Dimensions (mm)	D	L	S	d	P	P0	P1	P2	W	W0	W1	W2	H0	H1	I	D0	t
Tolerance	+0.5		+0.8/−0.2	±0.05	±1.0	±0.3	±0.7	±1.3	+1/−0.5	±0.5	Maximum	Maximum	±0.75	±0.5	Maximum	±0.2	±0.2
Formed to 2.5 mm	4	5 – 7	2.5	0.45	12.7	12.7	5.1	6.35	18	12	11	3	16.0	18.5		4	0.7
	5	≤ 7	2.5	0.45	12.7	12.7	5.1	6.35	18	12	11	3	16.0	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

Ammo Box



Reel



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	NA	NA	NA
12	All	270	340	57			
13	All	285	340	62			
16	All	265	340	62			
18	All	288	340	65			

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.

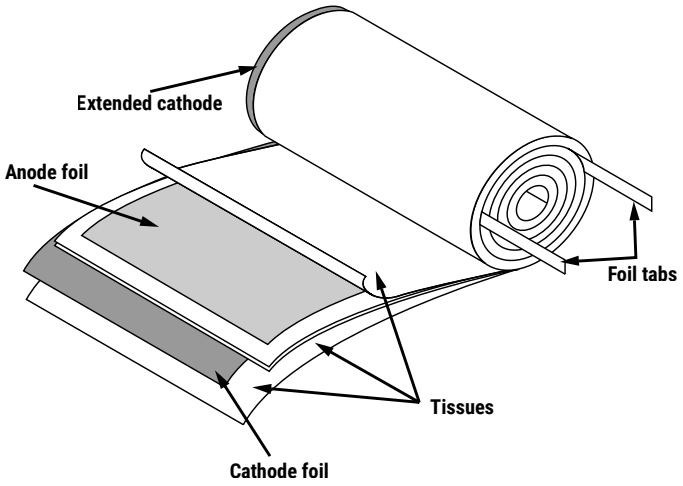
Damage to the oxide layer can occur due to variety of reasons:
- Slitting of the anode foil after forming
- Attaching the tabs to the anode foil
- Minor mechanical damage caused during winding

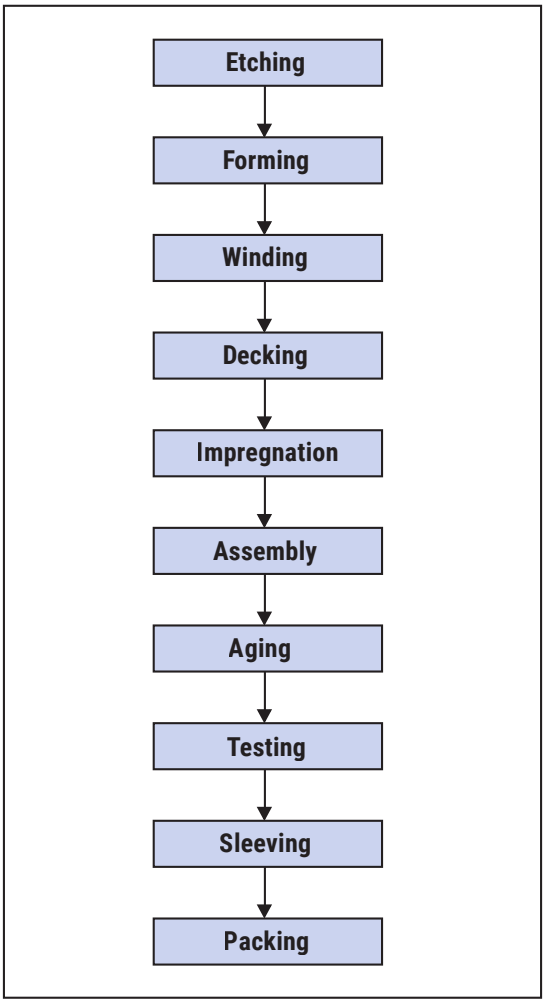
A sample from each batch is taken by the quality department after completion of the production process. This sample size is controlled by the use of recognized sampling tables defined in BS 6001.

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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