ESX, +105°C

Electronic Components
KEMET
CHARGED®

Overview

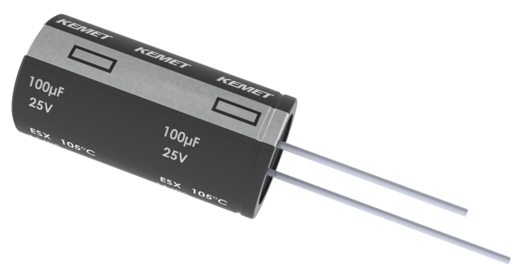
The KEMET ESX single-ended aluminum electrolytic capacitors are designed for long life (up to 5,000 hours) and high frequency applications.

Applications

Typical applications include high frequency switch mode circuits.

Benefits

- Low impedance
- Suited for long life, high reliability applications
- Operating temperature of up to 105°C
- 5,000 hour operating life
- High ripple current
- Safety vent on the capacitor base



Click image above for interactive 3D content
Open PDF in Adobe Reader for full functionality

Part Number System

ESX	107	M	6R3		A	C3	AA
Series	Capacitance Code (pF)	Tolerance	Rated Voltage (VDC)		Electrical Parameters	Size Code	Packaging
Single-Ended 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 = 63 080 = 80 100 = 100	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					

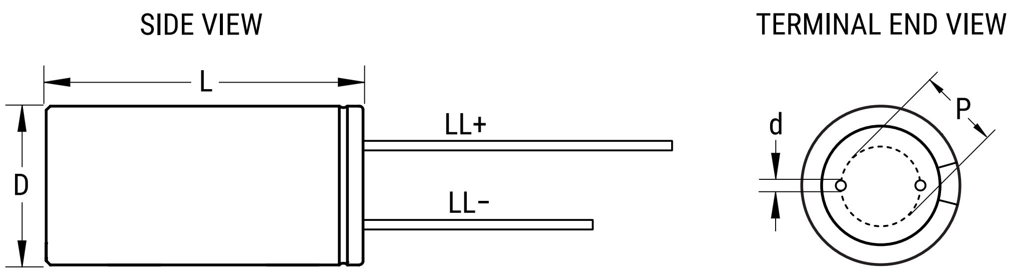
Environmental Compliance

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



Size Code	D		L		p		d		LL+/LL-	
	Nominal	Tolerance	Nominal	Tolerance	Nominal	Tolerance	Nominal	Tolerance	Nominal	Tolerance
B2	4	±0.5	7	+1.5/−0	1.5	±0.5	0.5	Nominal	20/15	Minimum
C3	5	±0.5	11	+1.5/−0	2.0	±0.5	0.5	Nominal	20/15	Minimum
E3	6.	±0.5	11	+1.5/−0	2.5	±0.5	0.5	Nominal	20/15	Minimum
G1	8	±0.5	7	+1.5/−0	3.5	±0.5	0.6	Nominal	20/15	Minimum
G3	8	±0.5	11	+1.5/−0	3.5	±0.5	0.6	Nominal	20/15	Minimum
G4	8	±0.5	15	+2.0/−0	3.5	±0.5	0.6	Nominal	20/15	Minimum
G6	8	±0.5	20	+2.0/−0	3.5	±0.5	0.6	Nominal	20/15	Minimum
H1	10	±0.5	12	+2.0/−0	5.0	±0.5	0.6	Nominal	20/15	Minimum
H2	10	±0.5	15	+2.0/−0	5.0	±0.5	0.6	Nominal	20/15	Minimum
H4	10	±0.5	20	+2.0/−0	5.0	±0.5	0.6	Nominal	20/15	Minimum
H5	10	±0.5	25	+2.0/−0	5.0	±0.5	0.6	Nominal	20/15	Minimum
H6	10	±0.5	30	+2.0/−0	5.0	±0.5	0.6	Nominal	20/15	Minimum
JD	12	±0.5	16	+2.0/−0	5.0	±0.5	0.6	Nominal	20/15	Minimum
JH	12	±0.5	20	+2.0/−0	5.0	±0.5	0.6	Nominal	20/15	Minimum
JK	12	±0.5	25	+2.0/−0	5.0	±0.5	0.6	Nominal	20/15	Minimum
JM	12	±0.5	30	+2.0/−0	5.0	±0.5	0.6	Nominal	20/15	Minimum
JP	12	±0.5	35	+2.0/−0	5.0	±0.5	0.6	Nominal	20/15	Minimum
JS	12	±0.5	40	+2.0/−0	5.0	±0.5	0.6	Nominal	20/15	Minimum
K5	12	±0.5	20	+2.0/−0	5.0	±0.5	0.6	Nominal	20/15	Minimum
L3	13	±0.5	20	+2.0/−0	5.0	±0.5	0.6	Nominal	20/15	Minimum
L4	13	±0.5	25	+2.0/−0	5.0	±0.5	0.6	Nominal	20/15	Minimum
L7	13	±0.5	40	+2.0/−0	5.0	±0.5	0.6	Nominal	20/15	Minimum
M2	16	±0.5	32	+2.0/−0	7.5	±0.5	0.8	Nominal	20/15	Minimum
M3	16	±0.5	36	+2.0/−0	7.5	±0.5	0.8	Nominal	20/15	Minimum
M4	16	±0.5	40	+2.0/−0	7.5	±0.5	0.8	Nominal	20/15	Minimum
M7	16	±0.5	25	+2.0/−0	7.5	±0.5	0.8	Nominal	20/15	Minimum
N2	18	±0.5	36	+2.0/−0	7.5	±0.5	0.8	Nominal	20/15	Minimum
N3	18	±0.5	40	+2.0/−0	7.5	±0.5	0.8	Nominal	20/15	Minimum

Performance Characteristics

Item	Performance Characteristics
Capacitance Range	4.7 – 15,000 µF
Capacitance Tolerance	±20% at 120 Hz/20°C
Rated Voltage	6.3 – 100 VDC
Life Test	2,000 – 5,000 hours (see conditions in Test Method & Performance)
Operating Temperature	−40°C to +105°C
Leakage Current	I ≤ 0.01 CV or 3 µA, whichever is greater
	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)	6.3	10	16	25	35	50	63	80 –100
Z (-25°C)/Z (20°C)	5	3	3	3	3	2	2	2
Z (-40°C)/Z (20°C)	10	6	5	4	4	4	4	4

Compensation Factor of Ripple Current (RC) vs. Frequency

Capacitance Range (µF)	50 Hz	120 Hz	300 Hz	1 kHz	10 kHz	100 kHz
< 4.7	0.3	0.40	0.50	0.70	0.80	1.00
5.6 – 33	0.4	0.50	0.60	0.80	0.90	1.00
34 – 330	0.6	0.70	0.80	0.90	0.95	1.00
331 – 1,000	0.65	0.90	0.90	0.98	1.00	1.00
≥ 1,200	0.85	0.90	0.95	0.98	1.00	1.00

Test Method & Performance

Conditions	Load Life Test		Shelf Life Test
Temperature	105°C		105°C
Test Duration	Can Ø = 8.0 mm	2,000 hours	1,000 hours
	Can Ø = 10.0 mm	3,000 hours	
	Can Ø ≥ 12 mm	5,000 hours	
Ripple Current	Maximum ripple current specified at 100 kHz 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 100 kHz 105°C (mA)	ESR 100 kHz 25°C (Ω)	LC 20°C 2 Minutes (µA)	Part Number
6.3	8	100	5x11	22	166	1.500	8	ESX107M6R3AC3(1)
6.3	8	100	8x11	22	180	0.610	8	ESX107M6R3AG3(1)
6.3	8	120	5x11	22	175	1.300	9.6	ESX127M6R3AC3(1)
6.3	8	120	8x11	22	200	0.610	9.6	ESX127M6R3AG3(1)
6.3	8	150	6.3x11	22	225	0.920	12	ESX157M6R3AE3(1)
6.3	8	220	8x11	22	285	0.610	17.6	ESX227M6R3AG3(1)
6.3	8	330	8x11	22	410	0.400	26.4	ESX337M6R3AG3(1)
6.3	8	470	10x12	22	550	0.280	37.6	ESX477M6R3AH1(1)
6.3	8	680	10x15	22	735	0.220	54.4	ESX687M6R3AH2(1)
6.3	8	820	10x15	22	795	0.190	65.6	ESX827M6R3AH2(1)
6.3	8	1000	10x20	22	950	0.170	80	ESX108M6R3AH4(1)
6.3	8	1200	10x20	22	1020	0.140	96	ESX128M6R3AH4(1)
6.3	8	1500	10x20	22	1000	0.140	120	ESX158M6R3AH4(1)
6.3	8	1500	10x25	22	1200	0.120	120	ESX158M6R3AH5(1)
6.3	8	2200	10x30	22	1450	0.095	176	ESX228M6R3AH6(1)
6.3	8	3300	12x35	22	1700	0.081	264	ESX338M6R3AJP(1)
6.3	8	4700	12x35	22	2110	0.063	376	ESX478M6R3AJP(1)
6.3	8	6800	16x32	22	2350	0.055	544	ESX688M6R3AM2(1)
6.3	8	8200	16x36	22	2550	0.047	656	ESX828M6R3AM3(1)
6.3	8	10000	16x40	22	2750	0.039	800	ESX109M6R3AM4(1)
6.3	8	15000	18x40	22	2950	0.037	1200	ESX159M6R3AN3(1)
10	13	10	5x11	19	20	5.900	3	ESX106M010AC3(1)
10	13	22	5x11	19	44	5.400	3	ESX226M010AC3(1)
10	13	33	5x11	19	66	3.300	4.29	ESX336M010AC3(1)
10	13	47	5x11	19	94	2.200	6.11	ESX476M010AC3(1)
10	13	68	5x11	19	136	1.300	8.84	ESX686M010AC3(1)
10	13	100	5x11	19	170	1.150	13	ESX107M010AC3(1)
10	13	100	6.3x11	19	200	1.150	13	ESX107M010AE3(1)
10	13	100	8x7	19	195	1.000	13	ESX107M010AG1(1)
10	13	120	6.3x11	19	240	0.910	15.6	ESX127M010AE3(1)
10	13	150	6.3x11	19	265	0.700	19.5	ESX157M010AE3(1)
10	13	180	6.3x11	19	275	0.650	23.4	ESX187M010AE3(1)
10	13	220	6.3x11	19	290	0.590	28.6	ESX227M010AE3(1)
10	13	220	8x11	19	370	0.480	28.6	ESX227M010AG3(1)
10	13	330	8x11	19	470	0.330	42.9	ESX337M010AG3(1)
10	13	470	8x11	19	480	0.300	61.1	ESX477M010AG3(1)
10	13	470	10x12	19	590	0.240	61.1	ESX477M010AH1(1)
10	13	680	8x20	19	790	0.180	88.4	ESX687M010AG6(1)
10	13	680	10x15	19	750	0.170	88.4	ESX687M010AH2(1)
10	13	820	10x20	19	990	0.140	106.6	ESX827M010AH4(1)
10	13	1000	10x15	19	900	0.135	130	ESX108M010AH2(1)
10	13	1000	10x20	19	1060	0.120	130	ESX108M010AH4(1)
10	13	1200	10x25	19	1290	0.120	156	ESX128M010AH5(1)
10	13	1500	10x30	19	1450	0.093	195	ESX158M010AH6(1)
10	13	2200	12x30	19	1570	0.087	286	ESX228M010AJM(1)
10	13	2200	13x20	19	1900	0.073	286	ESX228M010AL3(1)
10	13	3300	10x30	19	1690	0.077	429	ESX338M010AH6(1)
10	13	3300	12x35	19	2110	0.062	429	ESX338M010AJP(1)
10	13	4700	13x40	19	2300	0.057	611	ESX478M010AL7(1)
10	13	4700	16x32	19	2450	0.054	611	ESX478M010AM2(1)
10	13	6800	16x36	19	2680	0.046	884	ESX688M010AM3(1)
10	13	8200	16x40	19	2850	0.038	1066	ESX828M010AM4(1)
10	13	10000	16x40	19	3050	0.037	1300	ESX109M010AM4(1)
16	20	10	5x11	16	42	1.180	3	ESX106M016AC3(1)
16	20	22	5x11	16	53	3.300	4.4	ESX226M016AC3(1)
16	20	33	5x11	16	79	2.100	6.6	ESX336M016AC3(1)
16	20	47	5x11	16	113	1.300	9.4	ESX476M016AC3(1)
VDC	VDC Surge	Rated Capacitance	Case Size	DF	RC	ESR	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'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 100 kHz 105°C (mA)	ESR 100 kHz 25°C (Ω)	LC 20°C 2 Minutes (µA)	Part Number
16	20	68	5x11	16	145	0.920	13.6	ESX686M016AC3(1)
16	20	68	6.3x11	16	163	0.920	13.6	ESX686M016AE3(1)
16	20	100	6.3x11	16	190	1.100	20	ESX107M016AE3(1)
16	20	100	8x11	16	241	0.890	20	ESX107M016AG3(1)
16	20	120	8x11	16	290	0.580	24	ESX127M016AG3(1)
16	20	150	8x11	16	380	0.470	30	ESX157M016AG3(1)
16	20	220	8x11	16	410	0.330	44	ESX227M016AG3(1)
16	20	330	10x12	16	600	0.230	66	ESX337M016AH1(1)
16	20	470	8x20	16	710	0.180	94	ESX477M016AG6(1)
16	20	470	10x15	16	750	0.180	94	ESX477M016AH2(1)
16	20	560	10x15	16	890	0.160	112	ESX567M016AH2(1)
16	20	680	10x20	16	1050	0.140	136	ESX687M016AH4(1)
16	20	820	10x25	16	1220	0.120	164	ESX827M016AH5(1)
16	20	1000	10x30	16	1400	0.091	200	ESX108M016AH6(1)
16	20	1200	10x25	16	1240	0.100	240	ESX128M016AH5(1)
16	20	1200	12x25	16	1450	0.086	240	ESX128M016AJK(1)
16	20	1500	12x25	16	1650	0.072	300	ESX158M016AJK(1)
16	20	2200	12x30	16	1820	0.069	440	ESX228M016AJM(1)
16	20	2200	13x25	16	2000	0.063	440	ESX228M016AL4(1)
16	20	3300	13x40	16	2400	0.055	660	ESX338M016AL7(1)
16	20	4700	16x36	16	2650	0.046	940	ESX478M016AM3(1)
16	20	6800	18x36	16	2900	0.040	1360	ESX688M016AN2(1)
16	20	8200	18x40	16	3050	0.036	1640	ESX828M016AN3(1)
25	32	22	5x11	14	66	3.300	7.04	ESX226M025AC3(1)
25	32	33	5x11	14	33	1.300	10.56	ESX336M025AC3(1)
25	32	47	5x11	14	141	1.100	15.04	ESX476M025AC3(1)
25	32	68	8x11	14	204	0.570	21.76	ESX686M025AG3(1)
25	32	100	6.3X11	14	240	0.53	32	ESX107M025AE3(1)
25	32	100	8x11	14	300	0.42	32	ESX107M025AG3(1)
25	32	120	8x11	14	400	0.38	38.4	ESX127M025AG3(1)
25	32	150	10x12	14	460	0.33	48	ESX157M025AH1(1)
25	32	220	10x15	14	630	0.23	70.4	ESX227M025AH2(1)
25	32	330	10x12	14	690	0.22	105.6	ESX337M025AH1(1)
25	32	330	10x15	14	800	0.19	105.6	ESX337M025AH2(1)
25	32	470	10x15	14	590	0.165	150.4	ESX477M025AH2(1)
25	32	470	10x20	14	1050	0.14	150.4	ESX477M025AH4(1)
25	32	560	10x20	14	1170	0.12	179.2	ESX567M025AH4(1)
25	32	560	12x16	14	1200	0.12	179.2	ESX567M025AJD(1)
25	32	680	10x30	14	1400	0.09	217.6	ESX687M025AH6(1)
25	32	820	12x25	14	1450	0.085	262.4	ESX827M025AJK(1)
25	32	1000	12x20	14	1420	0.091	320	ESX108M025AJH(1)
25	32	1000	12x25	14	1650	0.078	320	ESX108M025AJK(1)
25	32	1200	12x30	14	1700	0.07	384	ESX128M025AJM(1)
25	32	1500	12x30	14	1950	0.062	480	ESX158M025AJM(1)
25	32	2200	12x40	14	2240	0.054	704	ESX228M025AJS(1)
25	32	3300	16x36	14	2700	0.045	1056	ESX338M025AM3(1)
25	32	3900	18x36	14	2820	0.042	1248	ESX398M025AN2(1)
25	32	4700	18x40	14	3000	0.036	1504	ESX478M025AN3(1)
35	44	6.8	4X7	12	20	7.700	3	ESX685M035AB2(1)
35	44	6.8	5x11	12	31	5.200	3	ESX685M035AC3(1)
35	44	10	5x11	12	42	3.1	4.4	ESX106M035AC3(1)
35	44	22	5x11	12	101	1.3	9.68	ESX226M035AC3(1)
35	44	33	6.3X11	12	151	0.87	14.52	ESX336M035AE3(1)
35	44	47	5x11	12	216	0.87	20.68	ESX476M035AC3(1)
35	44	68	8x11	12	312	0.37	29.92	ESX686M035AG3(1)
35	44	100	8x11	12	370	0.39	44	ESX107M035AG3(1)
35	44	100	10x12	12	460	0.32	44	ESX107M035AH1(1)
VDC	VDC Surge	Rated Capacitance	Case Size	DF	RC	ESR	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'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 100 kHz 105°C (mA)	ESR 100 kHz 25°C (Ω)	LC 20°C 2 Minutes (µA)	Part Number
35	44	120	10x12	12	550	0.26	52.8	ESX127M035AH1(1)
35	44	150	10x12	12	600	0.23	66	ESX157M035AH1(1)
35	44	220	10x12	12	690	0.21	96.8	ESX227M035AH1(1)
35	44	220	10x15	12	800	0.18	96.8	ESX227M035AH2(1)
35	44	330	10x20	12	1060	0.13	145.2	ESX337M035AH4(1)
35	44	470	10x30	12	990	0.089	206.8	ESX477M035AH6(1)
35	44	470	13x25	12	1060	0.086	206.8	ESX477M035AL4(1)
35	44	560	12.5x20	12	1500	0.081	246.4	ESX567M035AK5(1)
35	44	680	12x25	12	1650	0.07	299.2	ESX687M035AJK(1)
35	44	820	12x30	12	1750	0.066	360.8	ESX827M035AJM(1)
35	44	1000	12x25	12	2000	0.061	440	ESX108M035AJK(1)
35	44	1200	12x35	12	2200	0.049	528	ESX128M035AJP(1)
35	44	1500	12x40	12	2350	0.046	660	ESX158M035AJS(1)
35	44	2200	16x36	12	2700	0.044	968	ESX228M035AM3(1)
35	44	3300	18x40	12	3050	0.035	1452	ESX338M035AN3(1)
50	63	6.8	5x11	10	39	3.100	4.284	ESX685M050AC3(1)
50	63	10	5x11	10	58	2.000	6.3	ESX106M050AC3(1)
50	63	22	6.3X11	10	129	0.9	13.86	ESX226M050AE3(1)
50	63	33	8x11	10	194	0.72	20.79	ESX336M050AG3(1)
50	63	47	8x11	10	276	0.66	29.61	ESX476M050AG3(1)
50	63	68	10x12	10	400	0.31	42.84	ESX686M050AH1(1)
50	63	100	8x15	10	230	0.24	63	ESX107M050AG4(1)
50	63	100	10x15	10	635	0.2	63	ESX107M050AH2(1)
50	63	120	10x15	10	670	0.17	75.6	ESX127M050AH2(1)
50	63	150	10x20	10	860	0.15	94.5	ESX157M050AH4(1)
50	63	220	10x15	10	780	0.15	138.6	ESX227M050AH2(1)
50	63	220	10x25	10	1030	0.11	138.6	ESX227M050AH5(1)
50	63	330	10x30	10	1070	0.11	207.9	ESX337M050AH6(1)
50	63	330	12x20	10	1220	0.092	207.9	ESX337M050AJH(1)
50	63	330	13x25	10	1300	0.086	207.9	ESX337M050AL4(1)
50	63	470	12x25	10	1500	0.068	296.1	ESX477M050AJK(1)
50	63	680	12x35	10	1850	0.058	428.4	ESX687M050AJP(1)
50	63	820	12x40	10	2020	0.052	516.6	ESX827M050AJS(1)
50	63	1000	16x25	10	1800	0.06	630	ESX108M050AM7(1)
50	63	1000	16x32	10	2120	0.05	630	ESX108M050AM2(1)
50	63	1200	16x36	10	2260	0.043	756	ESX128M050AM3(1)
50	63	1500	16x40	10	2420	0.035	945	ESX158M050AM4(1)
63	79	4.7	5x11	9	36	4.600	3.713	ESX475M063AC3(1)
63	79	6.8	5x11	9	52	4.300	5.372	ESX685M063AC3(1)
63	79	10	5x11	9	77	2.000	7.9	ESX106M063AC3(1)
63	79	15	6.3x11	9	116	1.400	11.85	ESX156M063AE3(1)
63	79	22	8x11	9	170	1.200	17.38	ESX226M063AG3(1)
63	79	33	8X11	9	256	0.660	26.07	ESX336M063AG3(1)
63	79	47	10x12	9	365	0.560	37.13	ESX476M063AH1(1)
63	79	68	10x15	9	500	0.360	53.72	ESX686M063AH2(1)
63	79	100	10x15	9	750	0.31	79	ESX107M063AH2(1)
63	79	120	10x20	9	820	0.27	94.8	ESX127M063AH4(1)
63	79	150	10x25	9	950	0.2	118.5	ESX157M063AH5(1)
63	79	220	12x25	9	1150	0.16	173.8	ESX227M063AJK(1)
63	79	330	12x30	9	1360	0.14	260.7	ESX337M063AJM(1)
63	79	330	13x25	9	1420	0.13	260.7	ESX337M063AL4(1)
63	79	470	12x35	9	1780	0.091	371.3	ESX477M063AJP(1)
63	79	680	16x32	9	2050	0.065	537.2	ESX687M063AM2(1)
63	79	820	16x36	9	2200	0.056	647.8	ESX827M063AM3(1)
63	79	1000	18x36	9	2330	0.049	790	ESX108M063AN2(1)
63	79	1200	18x40	9	2520	0.046	948	ESX128M063AN3(1)
80	100	4.7	5x11	8	43	4.200	4.7	ESX475M080AC3(1)
VDC	VDC Surge	Rated Capacitance	Case Size	DF	RC	ESR	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'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 100 kHz 105°C (mA)	ESR 100 kHz 25°C (Ω)	LC 20°C 2 Minutes (µA)	Part Number
80	100	6.8	5x11	8	62	1.900	6.8	ESX685M080AC3(1)
80	100	10	6.3x11	8	92	1.4	10	ESX106M080AE3(1)
80	100	15	8x11	8	138	1.1	15	ESX156M080AG3(1)
80	100	22	8x11	8	203	0.64	22	ESX226M080AG3(1)
80	100	33	10x12	8	305	0.54	33	ESX336M080AH1(1)
80	100	47	10x15	8	410	0.36	47	ESX476M080AH2(1)
80	100	68	10x20	8	600	0.26	68	ESX686M080AH4(1)
80	100	100	10x25	8	795	0.19	100	ESX107M080AH5(1)
80	100	120	10x30	8	900	0.17	120	ESX127M080AH6(1)
80	100	150	10x30	8	955	0.15	150	ESX157M080AH6(1)
80	100	220	12x30	8	1200	0.13	220	ESX227M080AJM(1)
80	100	330	12x35	8	1450	0.088	330	ESX337M080AJP(1)
80	100	470	16x32	8	1790	0.063	470	ESX477M080AM2(1)
80	100	680	16x40	8	1990	0.058	680	ESX687M080AM4(1)
80	100	820	18x36	8	2200	0.05	820	ESX827M080AN2(1)
80	100	1000	18x40	8	2370	0.044	1000	ESX108M080AN3(1)
100	125	4.7	5x11	8	65	4.100	5.875	ESX475M100AC3(1)
100	125	6.8	8x11	8	94	1.300	8.5	ESX685M100AG3(1)
100	125	10	8x11	8	138	1.100	12.5	ESX106M100AG3(1)
100	125	15	8x11	8	207	0.8	18.75	ESX156M100AG3(1)
100	125	22	10x12	8	305	0.53	27.5	ESX226M100AH1(1)
100	125	33	10x15	8	500	0.35	41.25	ESX336M100AH2(1)
100	125	47	10x20	8	600	0.3	58.75	ESX476M100AH4(1)
100	125	68	10x25	8	795	0.19	85	ESX686M100AH5(1)
100	125	100	10x30	8	870	0.17	125	ESX107M100AH6(1)
100	125	100	13x20	8	955	0.15	125	ESX107M100AL3(1)
100	125	120	12x30	8	1040	0.13	150	ESX127M100AJM(1)
100	125	150	12x30	8	1200	0.11	187.5	ESX157M100AJM(1)
100	125	220	16x32	8	1440	0.086	275	ESX227M100AM2(1)
100	125	330	16x32	8	1610	0.07	412.5	ESX337M100AM2(1)
100	125	330	16x36	8	1790	0.062	412.5	ESX337M100AM3(1)
100	125	470	16x40	8	2160	0.048	587.5	ESX477M100AM4(1)
100	125	470	18x36	8	2200	0.047	587.5	ESX477M100AN2(1)
VDC	**VDC Surge**	**Rated Capacitance**	**Case Size**	**DF**	**RC**	**ESR**	**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 and 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).

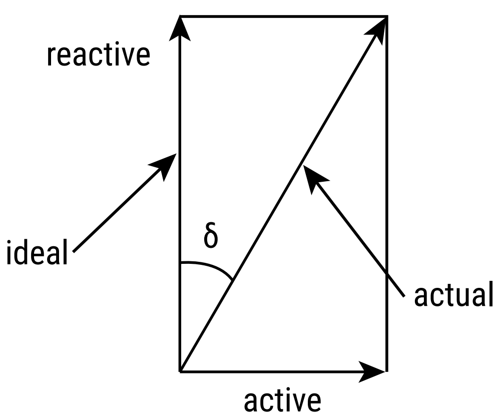
Temperature Dependence of the Capacitance
Capacitance of an electrolytic capacitor depends upon temperature: with decreasing temperature the viscosity of the electrolyte increases, thereby reducing its conductivity.
Capacitance will decrease if temperature decreases. Furthermore, temperature drifts cause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

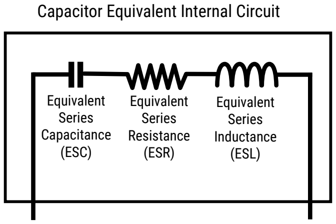
Dissipation Factor tan δ (DF)
Dissipation Factor tan δ is the ratio between the active and reactive power for a sinusoidal waveform voltage. It can be thought of as a measurement of the gap between an actual and ideal capacitor.



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

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:

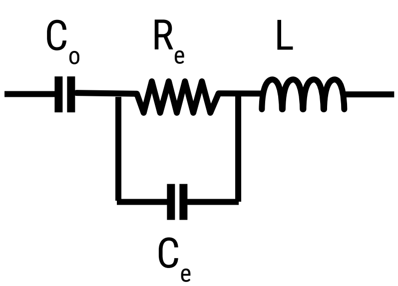
$$ESR = \frac{\tan \delta}{2\pi f \, ESC}$$

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.

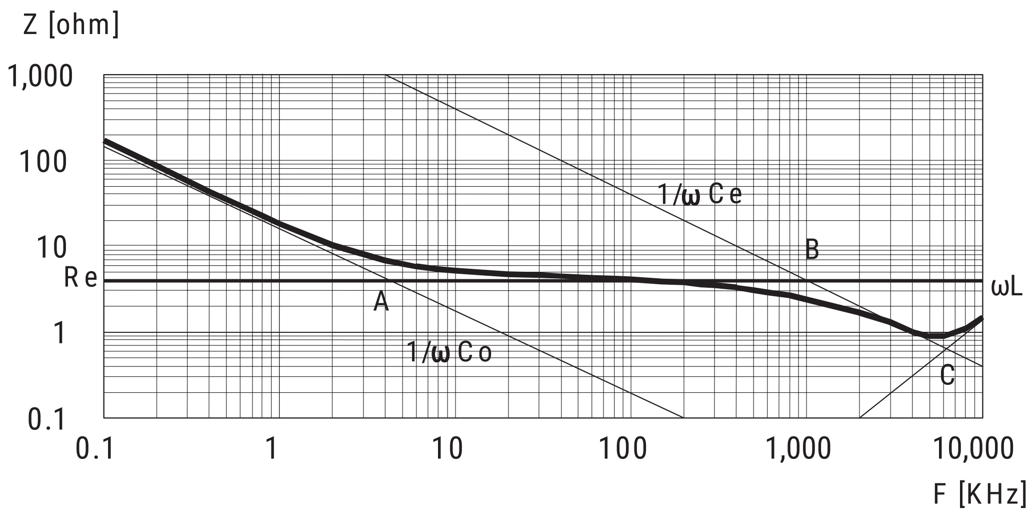
Impedance (Z)

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:

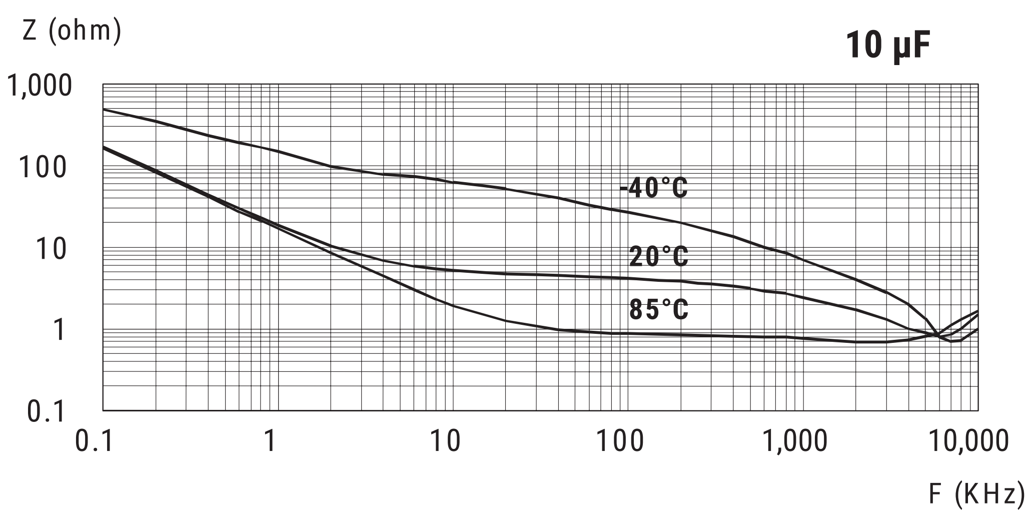
Impedance (Z) cont'd



- 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.

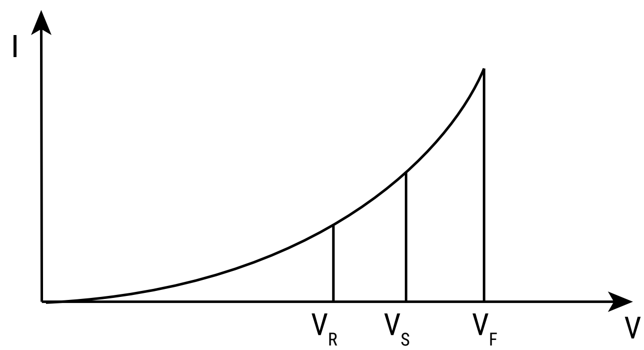
Leakage Current (LC)

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.

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.

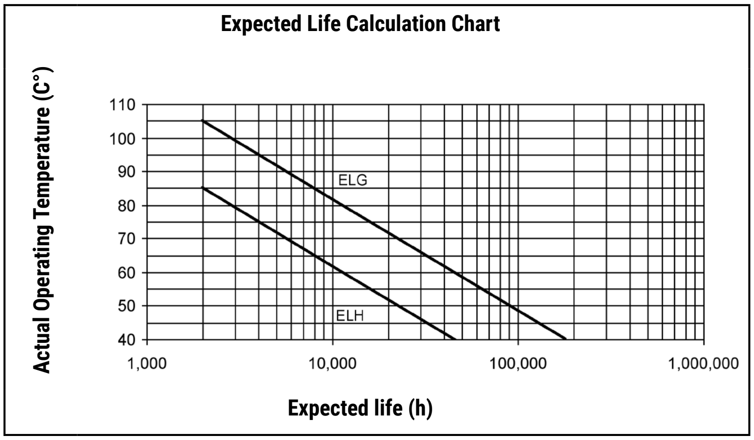
Expected Life Calculation

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

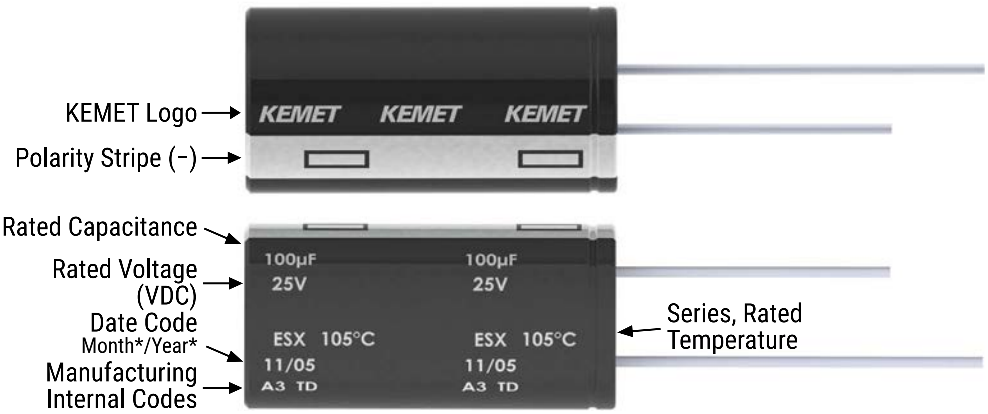
This formula is applicable between 40°C and To.



Packaging Quantities

Size Code	Diameter (mm)	Length (mm)	Bulk		Auto-insertion	
			Standard Leads	Cut Leads	Ammo	Tape & Reel
B2	4.0	7.0	10,000	15,000	2,500	3,000
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
G1	8.0	7.0	6,000	8,000	1,000	1,500
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
G6	8.0	20.0	4,000	4,000	1,000	1,500
H1	10	12	4,000	4,000	700	1,200
H2	10.0	15.0	3,000	4,000	700	1,200
H4	10	20.0	2,400	3,000	700	1,200
H5	10.0	25.0	2,400	2,400	500	-
H6	10.0	30.0	2,000	2,000	500	-
JD	12	16	2,000	2,000	500	-
JH	12	20	2,000	2,000	500	-
JK	12	25	2,000	2,000	500	-
JM	12	30	2,000	2,000	500	-
JP	12	35	2,000	2,000	500	-
JS	12	40	2,000	2,000	500	-
K5	12.5	20.0	2,000	2,000	500	-
L3	13.0	20.0	2,000	2,000	500	-
L4	13.0	25.0	1,600	1,600	500	-
L7	13.0	40.0	1,000	500	500	-
M2	16.0	32.0	800	500	300	-
M3	16.0	36.0	600	500	300	-
M4	16.0	40.0	600	500	300	-
M7	16	25.0	1,000	500	300	-
N2	18	36.0	500	500	-	-
N3	18	40.0	500	500	-	-

Marking



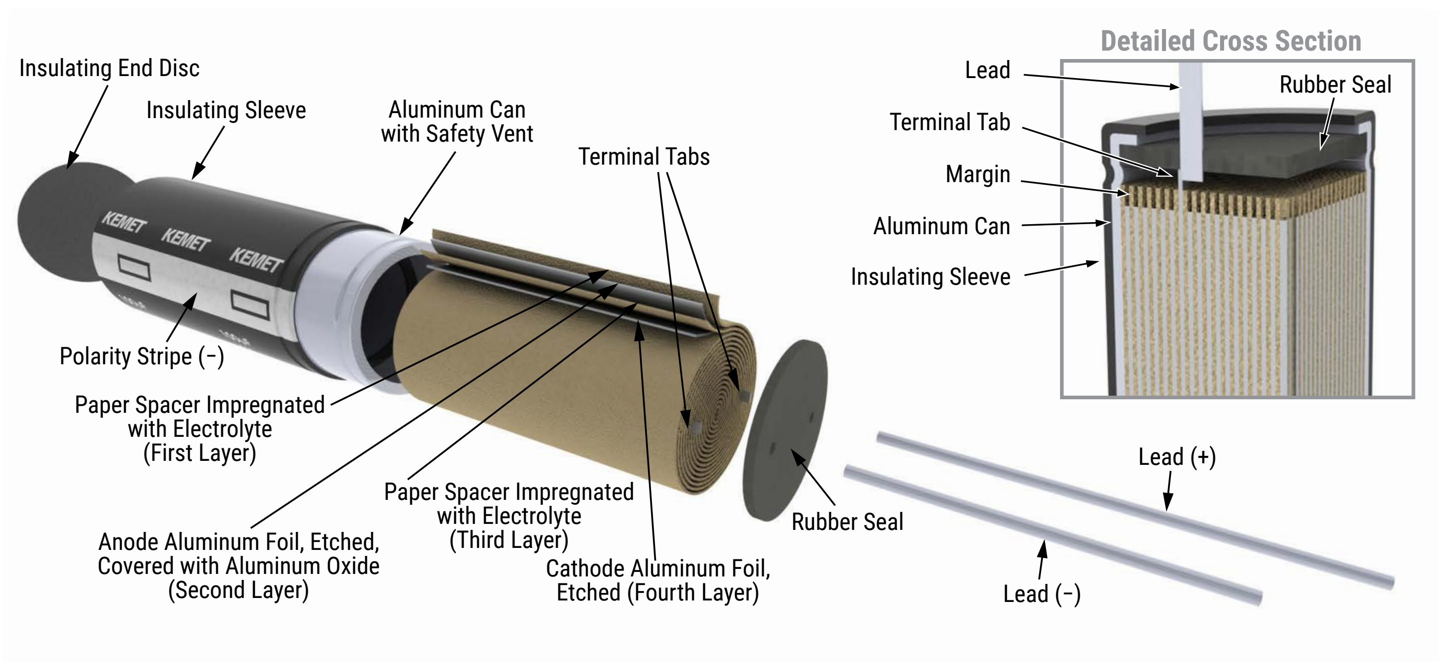
*Y = Year

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

*M = Month

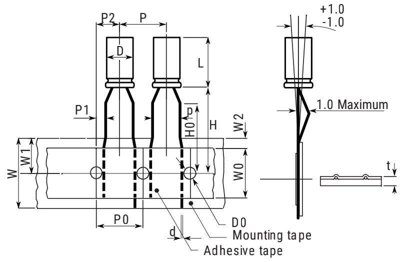
Code	01	02	03	04	05	06	07	08	09	10	11	12
Month	1	2	3	4	5	6	7	8	9	10	11	12

Construction

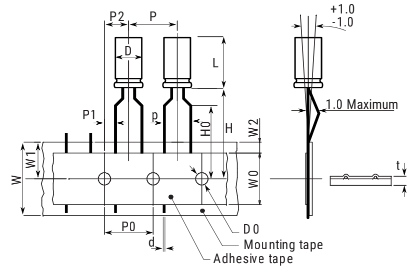


Taping for Automatic Insertion Machines

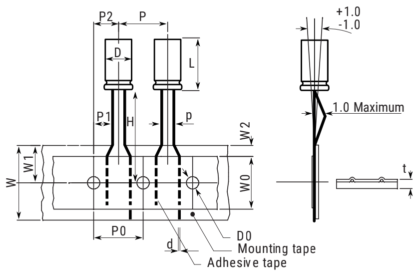
Formed to 2.5 mm
(Lead and packaging code LA and FA)



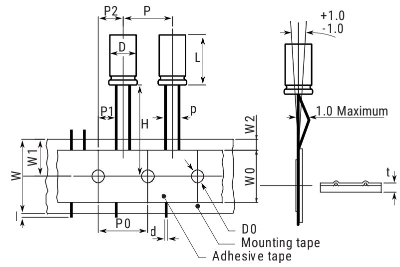
Formed to 5 mm
(Lead and packaging code JA and DA)



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



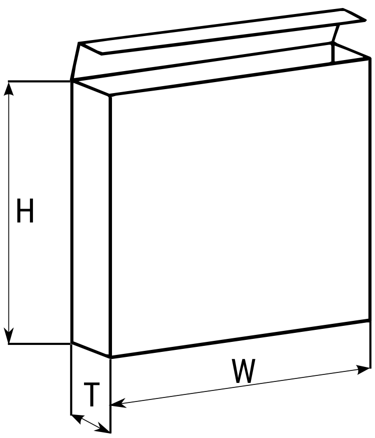
Straight Leads (Diameter > 8)
Lead and packaging code EA and KA



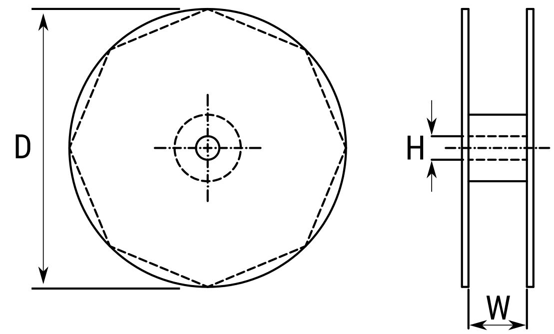
Dimensions (mm)	D	L	p	d	P	P0	P1	P2	W	W0	W1	W2	H0	H1	l	D0	t
Tolerance	+0.5		+0.8/–0.2	±0.05	±1.0	±0.3	±0.7	±1.3	+1/–0.5	±0.5	Maximum	Maximum	±0.75	±0.5	Maximum	±0.2	±0.2
Formed to 2.5 mm	4	5 – 7	2.5	0.45	12.7	12.7	5.1	6.35	18	12	11	3	16.0	18.5		4	0.7
	5	≤ 7	2.5	0.45	12.7	12.7	5.1	6.35	18	12	11	3	16.0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



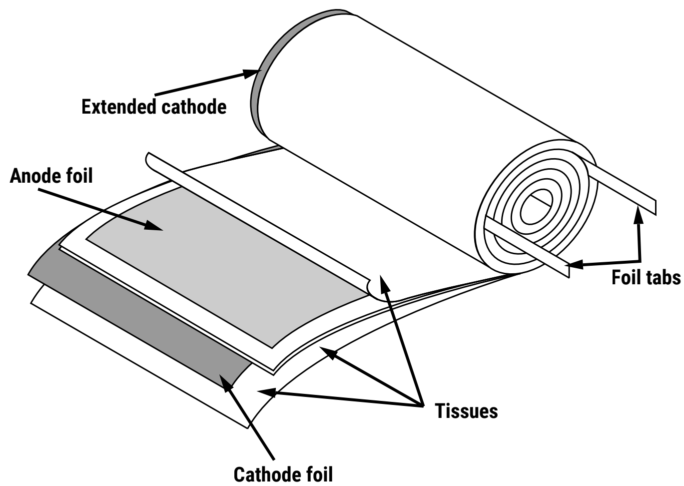
Reel



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			
12	All	270	340	57			
13	All	285	340	62			
16	All	265	340	62			

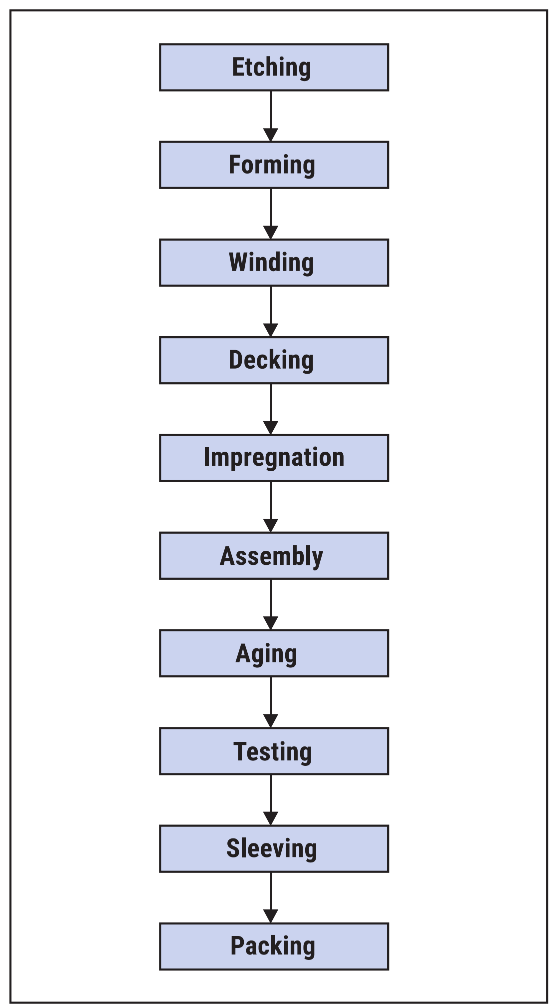
Construction Data

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

KEMET Electronics Corporation Sales Offices

For a complete list of our global sales offices, please visit www.kemet.com/sales.

Disclaimer

All product specifications, statements, information and data (collectively, the "Information") in this datasheet are subject to change. The customer is responsible for checking and verifying the extent to which the Information contained in this publication is applicable to an order at the time the order is placed. All Information given herein is believed to be accurate and reliable, but it is presented without guarantee, warranty, or responsibility of any kind, expressed or implied.

Statements of suitability for certain applications are based on KEMET Electronics Corporation's ("KEMET") knowledge of typical operating conditions for such applications, but are not intended to constitute – and KEMET specifically disclaims – any warranty concerning suitability for a specific customer application or use. The Information is intended for use only by customers who have the requisite experience and capability to determine the correct products for their application. Any technical advice inferred from this Information or otherwise provided by KEMET with reference to the use of KEMET's products is given gratis, and KEMET assumes no obligation or liability for the advice given or results obtained.

Although KEMET designs and manufactures its products to the most stringent quality and safety standards, given the current state of the art, isolated component failures may still occur. Accordingly, customer applications which require a high degree of reliability or safety should employ suitable designs or other safeguards (such as installation of protective circuitry or redundancies) in order to ensure that the failure of an electrical component does not result in a risk of personal injury or property damage.

Although all product–related warnings, cautions and notes must be observed, the customer should not assume that all safety measures are indicted or that other measures may not be required.