

Overview

The KEMET ELX aluminum electrolytic snap-in capacitors are designed with snap-lock terminals for printed circuit board mounting. The case is aluminum with an insulated sleeve and safety vent at the bottom.

Applications

Typical applications include general purpose power electronics, UPS, SMPS, and battery chargers.

Benefits

- Suited for high reliability, low ESR applications
- Operating temperature of up to 105°C
- 5,000 hour operating life
- RoHS compliant and lead-free



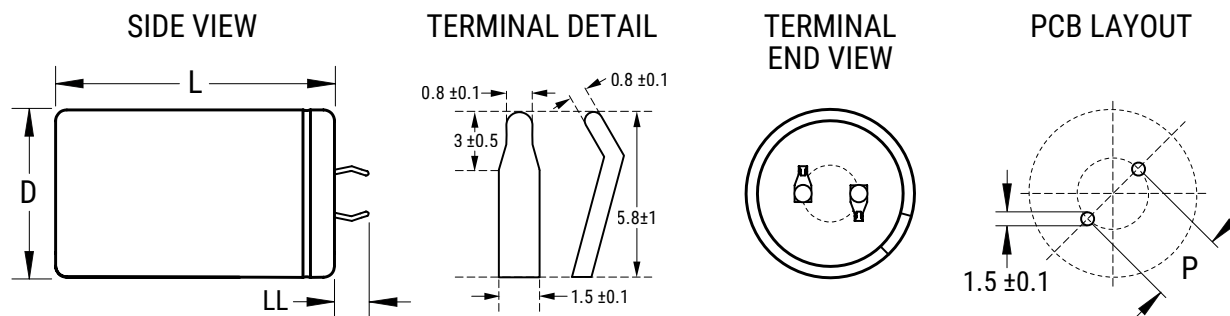
Part Number System

ELX	277	M	160		A	Q1	AA
Series	Capacitance Code (pF)	Tolerance	Rated Voltage (VDC)		Electrical Parameters	Size Code	Packaging
Snap-In type 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	160 = 160 180 = 180 200 = 200 250 = 250 350 = 350 400 = 400 420 = 420 450 = 450 500 = 500 550 = 550	A = Standard	See Dimension Table	See Ordering Options Table

Ordering Options Table

Packaging Type	Lead Length (mm)	Lead and Packaging Code
Standard Bulk Packaging Options		
Bulk (box)	5.8 ± 1.0	AA
Bulk (box)	4.0 ± 1.0	AV

Dimensions – Millimeters



Size Code	D		L		p	
	Nominal	Tolerance	Nominal	Tolerance	Nominal	Tolerance
Q7	22	+1.0/-0	20	+2.0/-0	10	±0.5
Q1	22	+1.0/-0	25	+2.0/-0	10	±0.5
Q2	22	+1.0/-0	30	+2.0/-0	10	±0.5
Q3	22	+1.0/-0	35	+2.0/-0	10	±0.5
Q4	22	+1.0/-0	40	+2.0/-0	10	±0.5
Q5	22	+1.0/-0	45	+2.0/-0	10	±0.5
Q6	22	+1.0/-0	50	+2.0/-0	10	±0.5
R7	25	+1.0/-0	20	+2.0/-0	10	±0.5
R1	25	+1.0/-0	25	+2.0/-0	10	±0.5
R2	25	+1.0/-0	30	+2.0/-0	10	±0.5
R3	25	+1.0/-0	35	+2.0/-0	10	±0.5
R4	25	+1.0/-0	40	+2.0/-0	10	±0.5
R5	25	+1.0/-0	45	+2.0/-0	10	±0.5
R6	25	+1.0/-0	50	+2.0/-0	10	±0.5
S1	30	+1.0/-0	25	+2.0/-0	10	±0.5
S2	30	+1.0/-0	30	+2.0/-0	10	±0.5
S3	30	+1.0/-0	35	+2.0/-0	10	±0.5
S4	30	+1.0/-0	40	+2.0/-0	10	±0.5
S5	30	+1.0/-0	45	+2.0/-0	10	±0.5
S6	30	+1.0/-0	50	+2.0/-0	10	±0.5
S8	30	+1.0/-0	60	+2.0/-0	10	±0.5
T1	35	+1.0/-0	25	+2.0/-0	10	±0.5
T2	35	+1.0/-0	30	+2.0/-0	10	±0.5
T3	35	+1.0/-0	35	+2.0/-0	10	±0.5
T4	35	+1.0/-0	40	+2.0/-0	10	±0.5
T5	35	+1.0/-0	45	+2.0/-0	10	±0.5
T6	35	+1.0/-0	50	+2.0/-0	10	±0.5
T8	35	+1.0/-0	60	+2.0/-0	10	±0.5
T9	35	+1.0/-0	65	+2.0/-0	10	±0.5

Environmental Compliance

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

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

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

Performance Characteristics

Item	Performance Characteristics
Capacitance Range	56 – 2,200 μ F
Capacitance Tolerance	\pm 20% at 120 Hz / 20°C
Rated Voltage	160 – 550 VDC
Life Test	5,000 hours (see conditions in Test Methods & Performance)
Operating Temperature	-25°C to +105°C
Leakage Current	I = 0.02 CV (mA) or 3 mA, whichever is smaller C = rated capacitance (μ F), V = rated voltage (VDC). Voltage applied for 5 minutes at 20°C.

Compensation Factor of Ripple Current (RC) vs. Frequency

Rated Voltage (VDC)	50 Hz	60 Hz	120 Hz	400 Hz	1 kHz	2.4 kHz	5 kHz	10 kHz
160 – 450	0.80	0.85	1.00	1.14	1.23	1.30	1.36	1.40
500 - 550	0.70	0.72	1.00	1.16	1.30	1.32	1.36	1.41

Test Method & Performance

Conditions	Load Life Test	Shelf Life Test
Temperature	105°C	105°C
Test Duration	5,000 hours	1,000 hours
Ripple Current	Maximum ripple current specified at 120 kHz 105°C specified in table	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 25°C:	
Capacitance Change	Within ±20% of the initial value	
Dissipation Factor	Does not exceed 200% of the specified value	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 (A)	LC 20°C 5 Minutes (mA)	ESR 120 Hz 20°C (Ω)	Part Number
160	200	270	22 x 25	15	0.85	697.1	0.737	ELX277M160AQ1AA
160	200	330	22 x 30	15	1.00	770.7	0.603	ELX337M160AQ2AA
160	200	390	22 x 30	15	1.15	837.9	0.510	ELX397M160AQ2AA
160	200	390	25 x 25	15	1.15	837.9	0.510	ELX397M160AR1AA
160	200	470	22 x 35	15	1.30	919.8	0.423	ELX477M160AQ3AA
160	200	470	25 x 30	15	1.30	919.8	0.423	ELX477M160AR2AA
160	200	560	22 x 40	15	1.57	1004.0	0.355	ELX567M160AQ4AA
160	200	560	25 x 30	15	1.50	1004.0	0.355	ELX567M160AR2AA
160	200	560	30 x 25	15	1.54	1004.0	0.355	ELX567M160AS1AA
160	200	680	22 x 45	15	1.75	1106.3	0.293	ELX687M160AQ5AA
160	200	680	25 x 35	15	1.70	1106.3	0.293	ELX687M160AR3AA
160	200	680	30 x 30	15	1.77	1106.3	0.293	ELX687M160AS2AA
160	200	820	22 x 50	15	2.03	1214.9	0.243	ELX827M160AQ6AA
160	200	820	25 x 40	15	1.97	1214.9	0.243	ELX827M160AR4AA
160	200	820	30 x 30	15	1.95	1214.9	0.243	ELX827M160AS2AA
160	200	820	35 x 25	15	1.99	1214.9	0.243	ELX827M160AT1AA
160	200	1000	25 x 45	15	2.15	1341.6	0.199	ELX108M160AR5AA
160	200	1000	30 x 35	15	2.15	1341.6	0.199	ELX108M160AS3AA
160	200	1000	35 x 30	15	2.21	1341.6	0.199	ELX108M160AT2AA
160	200	1200	30 x 40	15	2.45	1469.7	0.166	ELX128M160AS4AA
160	200	1200	35 x 35	15	2.52	1469.7	0.166	ELX128M160AT3AA
160	200	1500	30 x 50	15	2.75	1643.2	0.133	ELX158M160AS6AA
160	200	1500	35 x 40	15	2.75	1643.2	0.133	ELX158M160AT4AA
160	200	1800	35 x 45	15	3.00	1800.0	0.111	ELX188M160AT5AA
160	200	2200	35 x 50	15	3.50	1990.0	0.090	ELX228M160AT6AA
180	225	270	22 x 25	15	0.85	739.4	0.737	ELX277M180AQ1AA
180	225	330	22 x 30	15	1.10	817.5	0.603	ELX337M180AQ2AA
180	225	390	22 x 35	15	1.32	888.7	0.510	ELX397M180AQ3AA
180	225	390	25 x 25	15	1.25	888.7	0.510	ELX397M180AR1AA
180	225	470	22 x 40	15	1.47	975.6	0.423	ELX477M180AQ4AA
180	225	470	25 x 30	15	1.40	975.6	0.423	ELX477M180AR2AA
180	225	560	22 x 45	15	1.70	1064.9	0.355	ELX567M180AQ5AA
180	225	560	25 x 35	15	1.63	1064.9	0.355	ELX567M180AR3AA
180	225	560	30 x 25	15	1.60	1064.9	0.355	ELX567M180AS1AA
180	225	680	22 x 50	15	1.87	1173.5	0.293	ELX687M180AQ6AA
180	225	680	25 x 40	15	1.82	1173.5	0.293	ELX687M180AR4AA
180	225	680	30 x 30	15	1.80	1173.5	0.293	ELX687M180AS2AA
180	225	680	35 x 25	15	1.84	1173.5	0.293	ELX687M180AT1AA
180	225	820	25 x 45	15	2.05	1288.6	0.243	ELX827M180AR5AA
180	225	820	30 x 35	15	2.05	1288.6	0.243	ELX827M180AS3AA
180	225	820	35 x 30	15	2.11	1288.6	0.243	ELX827M180AT2AA
180	225	1000	25 x 50	15	2.27	1423.0	0.199	ELX108M180AR6AA
180	225	1000	30 x 40	15	2.29	1423.0	0.199	ELX108M180AS4AA
180	225	1000	35 x 30	15	2.25	1423.0	0.199	ELX108M180AT2AA
180	225	1200	30 x 45	15	2.57	1558.8	0.166	ELX128M180AS5AA
180	225	1200	35 x 35	15	2.55	1558.8	0.166	ELX128M180AT3AA
180	225	1500	35 x 40	15	2.85	1742.8	0.133	ELX158M180AT4AA
180	225	1800	35 x 50	15	3.10	1909.2	0.111	ELX188M180AT6AA
200	250	220	22 x 25	15	0.85	703.6	0.905	ELX227M200AQ1AA
200	250	270	22 x 30	15	1.00	779.4	0.737	ELX277M200AQ2AA
200	250	330	22 x 30	15	1.15	861.7	0.603	ELX337M200AQ2AA
200	250	330	25 x 25	15	1.15	861.7	0.603	ELX337M200AR1AA
200	250	390	22 x 35	15	1.30	936.7	0.510	ELX397M200AQ3AA
200	250	390	25 x 30	15	1.30	936.7	0.510	ELX397M200AR2AA
200	250	470	22 x 40	15	1.52	1028.3	0.423	ELX477M200AQ4AA
200	250	470	25 x 35	15	1.54	1028.3	0.423	ELX477M200AR3AA
200	250	470	30 x 25	15	1.49	1028.3	0.423	ELX477M200AS1AA
VDC	VDC Surge	Rated Capacitance	Case Size	DF	RC	LC	ESR	Part Number

AA Insert packaging code. See table for available options.

Table 1 – Ratings & Part Number Reference cont.

VDC	VDC Surge Voltage	Rated Capacitance 120 Hz 20°C (μ F)	Case Size D x L (mm)	DF 120 Hz 20°C ($\tan \delta$ %)*	RC 120 Hz 105°C (A)	LC 20°C 5 Minutes (mA)	ESR 120 Hz 20°C (Ω)	Part Number
200	250	560	22 x 45	15	1.70	1122.5	0.355	ELX567M200AQ5AA
200	250	560	25 x 35	15	1.65	1122.5	0.355	ELX567M200AR3AA
200	250	560	30 x 30	15	1.72	1122.5	0.355	ELX567M200AS2AA
200	250	680	25 x 45	15	1.98	1236.9	0.293	ELX687M200AR5AA
200	250	680	30 x 35	15	1.98	1236.9	0.293	ELX687M200AS3AA
200	250	680	35 x 30	15	2.02	1236.9	0.293	ELX687M200AT2AA
200	250	820	25 x 45	15	2.20	1358.3	0.243	ELX827M200AR5AA
200	250	820	30 x 35	15	2.10	1358.3	0.243	ELX827M200AS3AA
200	250	820	35 x 30	15	2.16	1358.3	0.243	ELX827M200AT2AA
200	250	1000	30 x 45	15	2.32	1500.0	0.199	ELX108M200AS5AA
200	250	1000	35 x 35	15	2.30	1500.0	0.199	ELX108M200AT3AA
200	250	1200	30 x 50	15	2.75	1643.2	0.166	ELX128M200AS6AA
200	250	1200	35 x 40	15	2.75	1643.2	0.166	ELX128M200AT4AA
200	250	1500	35 x 45	15	2.90	1837.1	0.133	ELX158M200AT5AA
250	300	150	22 x 25	15	0.75	636.4	1.327	ELX157M250AQ1AA
250	300	180	22 x 30	15	0.85	697.1	1.106	ELX187M250AQ2AA
250	300	220	22 x 30	15	1.00	770.7	0.905	ELX227M250AQ2AA
250	300	220	25 x 25	15	1.00	770.7	0.905	ELX227M250AR1AA
250	300	270	22 x 35	15	1.22	853.8	0.737	ELX277M250AQ3AA
250	300	270	25 x 25	15	1.15	853.8	0.737	ELX277M250AR1AA
250	300	330	22 x 40	15	1.36	943.9	0.603	ELX337M250AQ4AA
250	300	330	25 x 30	15	1.30	943.9	0.603	ELX337M250AR2AA
250	300	390	22 x 45	15	1.54	1026.2	0.510	ELX397M250AQ5AA
250	300	390	25 x 35	15	1.48	1026.2	0.510	ELX397M250AR3AA
250	300	390	30 x 25	15	1.45	1026.2	0.510	ELX397M250AS1AA
250	300	390	35 x 25	15	1.59	1026.2	0.510	ELX397M250AT1AA
250	300	470	22 x 50	15	1.78	1126.5	0.423	ELX477M250AQ6AA
250	300	470	25 x 40	15	1.75	1126.5	0.423	ELX477M250AR4AA
250	300	470	30 x 30	15	1.72	1126.5	0.423	ELX477M250AS2AA
250	300	470	35 x 30	15	1.88	1126.5	0.423	ELX477M250AT2AA
250	300	560	25 x 40	15	1.80	1229.6	0.355	ELX567M250AR4AA
250	300	560	30 x 35	15	1.89	1229.6	0.355	ELX567M250AS3AA
250	300	560	35 x 30	15	1.94	1229.6	0.355	ELX567M250AT2AA
250	300	680	25 x 50	15	2.10	1355.0	0.293	ELX687M250AR6AA
250	300	680	30 x 40	15	2.10	1355.0	0.293	ELX687M250AS4AA
250	300	680	35 x 35	15	2.18	1355.0	0.293	ELX687M250AT3AA
250	300	820	30 x 45	15	2.30	1488.0	0.243	ELX827M250AS5AA
250	300	820	35 x 40	15	2.39	1488.0	0.243	ELX827M250AT4AA
250	300	1000	30 x 50	15	2.55	1643.2	0.199	ELX108M250AS6AA
250	300	1000	35 x 45	15	2.65	1643.2	0.199	ELX108M250AT5AA
250	300	1200	35 x 50	15	2.90	1800.0	0.166	ELX128M250AT6AA
315	365	82	22 x 25	15	0.55	519.0	2.427	ELX826M315AQ1AA
315	365	100	22 x 30	15	0.65	573.1	1.990	ELX107M315AQ2AA
315	365	120	22 x 30	15	0.75	627.9	1.659	ELX127M315AQ2AA
315	365	120	25 x 25	15	0.75	627.9	1.659	ELX127M315AR1AA
315	365	150	22 x 35	15	0.80	702.0	1.327	ELX157M315AQ3AA
315	365	150	25 x 30	15	0.80	702.0	1.327	ELX157M315AR2AA
315	365	180	22 x 40	15	1.01	769.0	1.106	ELX187M315AQ4AA
315	365	180	25 x 35	15	1.02	769.0	1.106	ELX187M315AR3AA
315	365	180	30 x 25	15	1.00	769.0	1.106	ELX187M315AS1AA
315	365	220	22 x 45	15	1.10	850.1	0.905	ELX227M315AQ5AA
315	365	220	25 x 40	15	1.12	850.1	0.905	ELX227M315AR4AA
315	365	220	30 x 30	15	1.10	850.1	0.905	ELX227M315AS2AA
315	365	270	25 x 45	15	1.25	941.8	0.737	ELX277M315AR5AA
315	365	270	30 x 35	15	1.25	941.8	0.737	ELX277M315AS3AA
315	365	330	25 x 50	15	1.53	1041.2	0.603	ELX337M315AR6AA
315	365	330	30 x 40	15	1.53	1041.2	0.603	ELX337M315AS4AA
VDC	VDC Surge	Rated Capacitance	Case Size	DF	RC	LC	ESR	Part Number

AA Insert packaging code. See 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 (A)	LC 20°C 5 Minutes (mA)	ESR 120 Hz 20°C (Ω)	Part Number
315	365	330	35 x 30	15	1.50	1041.2	0.603	ELX337M315AT2AA
315	365	390	30 x 45	15	1.71	1131.9	0.510	ELX397M315AS5AA
315	365	390	35 x 30	15	1.60	1131.9	0.510	ELX397M315AT2AA
315	365	470	30 x 50	15	1.85	1242.6	0.423	ELX477M315AS6AA
315	365	470	35 x 35	15	1.75	1242.6	0.423	ELX477M315AT3AA
315	365	560	35 x 40	15	2.00	1356.3	0.355	ELX567M315AT4AA
315	365	680	35 x 45	15	2.20	1494.6	0.293	ELX687M315AT5AA
350	400	82	22 x 25	15	0.60	543.3	2.427	ELX826M350AQ1AA
350	400	100	22 x 30	15	0.70	600.0	1.990	ELX107M350AQ2AA
350	400	100	25 x 25	15	0.70	600.0	1.990	ELX107M350AR1AA
350	400	120	22 x 35	15	0.80	657.3	1.659	ELX127M350AQ3AA
350	400	120	25 x 30	15	0.80	657.3	1.659	ELX127M350AR2AA
350	400	150	22 x 40	15	0.86	734.8	1.327	ELX157M350AQ4AA
350	400	150	25 x 35	15	0.87	734.8	1.327	ELX157M350AR3AA
350	400	150	30 x 25	15	0.85	734.8	1.327	ELX157M350AS1AA
350	400	180	22 x 45	15	1.05	805.0	1.106	ELX187M350AQ5AA
350	400	180	25 x 40	15	1.07	805.0	1.106	ELX187M350AR4AA
350	400	180	30 x 30	15	1.05	805.0	1.106	ELX187M350AS2AA
350	400	220	22 x 50	15	1.16	889.9	0.905	ELX227M350AQ6AA
350	400	220	25 x 45	15	1.20	889.9	0.905	ELX227M350AR5AA
350	400	220	30 x 35	15	1.18	889.9	0.905	ELX227M350AS3AA
350	400	220	35 x 25	15	1.15	889.9	0.905	ELX227M350AT1AA
350	400	270	25 x 50	15	1.31	985.9	0.737	ELX277M350AR6AA
350	400	270	30 x 40	15	1.33	985.9	0.737	ELX277M350AS4AA
350	400	270	35 x 30	15	1.30	985.9	0.737	ELX277M350AT2AA
350	400	330	30 x 45	15	1.46	1090.0	0.603	ELX337M350AS5AA
350	400	330	35 x 35	15	1.45	1090.0	0.603	ELX337M350AT3AA
350	400	390	30 x 50	15	1.65	1184.9	0.510	ELX397M350AS6AA
350	400	390	35 x 40	15	1.65	1184.9	0.510	ELX397M350AT4AA
350	400	470	35 x 45	15	1.85	1300.8	0.423	ELX477M350AT5AA
350	400	560	35 x 50	15	2.10	1419.9	0.355	ELX567M350AT6AA
400	450	68	22 x 25	25	0.55	524.8	4.879	ELX686M400AQ1AA
400	450	82	22 x 30	25	0.65	576.3	4.046	ELX826M400AQ2AA
400	450	82	25 x 25	25	0.65	576.3	4.046	ELX826M400AR1AA
400	450	100	22 x 35	25	0.79	636.4	3.317	ELX107M400AQ3AA
400	450	100	25 x 25	25	0.75	636.4	3.317	ELX107M400AR1AA
400	450	120	22 x 40	25	0.89	697.1	2.765	ELX127M400AQ4AA
400	450	120	25 x 30	25	0.85	697.1	2.765	ELX127M400AR2AA
400	450	120	30 x 25	25	0.87	697.1	2.765	ELX127M400AS1AA
400	450	150	22 x 45	25	0.93	779.4	2.212	ELX157M400AQ5AA
400	450	150	25 x 35	25	0.90	779.4	2.212	ELX157M400AR3AA
400	450	150	30 x 30	25	0.94	779.4	2.212	ELX157M400AS2AA
400	450	150	35 x 25	25	0.96	779.4	2.212	ELX157M400AT1AA
400	450	180	22 x 50	25	1.14	853.8	1.843	ELX187M400AQ6AA
400	450	180	25 x 40	25	1.11	853.8	1.843	ELX187M400AR4AA
400	450	180	30 x 30	25	1.10	853.8	1.843	ELX187M400AS2AA
400	450	180	35 x 25	25	1.12	853.8	1.843	ELX187M400AT1AA
400	450	220	25 x 45	25	1.20	943.9	1.508	ELX227M400AR5AA
400	450	220	30 x 35	25	1.20	943.9	1.508	ELX227M400AS3AA
400	450	220	35 x 30	25	1.24	943.9	1.508	ELX227M400AT2AA
400	450	270	25 x 50	25	1.36	1045.7	1.229	ELX277M400AR6AA
400	450	270	30 x 40	25	1.38	1045.7	1.229	ELX277M400AS4AA
400	450	270	35 x 30	25	1.38	1045.7	1.229	ELX277M400AT2AA
400	450	330	30 x 45	25	1.51	1156.1	1.005	ELX337M400AS5AA
400	450	330	35 x 35	25	1.50	1156.1	1.005	ELX337M400AT3AA
400	450	390	30 x 50	25	1.70	1256.8	0.851	ELX397M400AS6AA
400	450	390	35 x 40	25	1.70	1256.8	0.851	ELX397M400AT4AA
VDC	VDC Surge	Rated Capacitance	Case Size	DF	RC	LC	ESR	Part Number

AA Insert packaging code. See 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 (A)	LC 20°C 5 Minutes (mA)	ESR 120 Hz 20°C (Ω)	Part Number
400	450	470	35 x 45	25	1.90	1379.7	0.706	ELX477M400AT5AA
450	500	56	22 x 25	25	0.55	502.0	5.924	ELX566M450AQ1AA
450	500	68	22 x 30	25	0.65	553.2	4.879	ELX686M450AQ2AA
450	500	82	22 x 35	25	0.80	607.5	4.046	ELX826M450AQ3AA
450	500	82	25 x 25	25	0.75	607.5	4.046	ELX826M450AR1AA
450	500	100	22 x 40	25	0.89	670.8	3.317	ELX107M450AQ4AA
450	500	100	25 x 30	25	0.85	670.8	3.317	ELX107M450AR2AA
450	500	120	22 x 45	25	0.95	734.8	2.765	ELX127M450AQ5AA
450	500	120	25 x 35	25	0.92	734.8	2.765	ELX127M450AR3AA
450	500	120	30 x 25	25	0.90	734.8	2.765	ELX127M450AS1AA
450	500	150	22 x 50	25	1.14	821.6	2.212	ELX157M450AQ6AA
450	500	150	25 x 40	25	1.11	821.6	2.212	ELX157M450AR4AA
450	500	150	30 x 30	25	1.10	821.6	2.212	ELX157M450AS2AA
450	500	180	25 x 45	25	1.12	900.0	1.843	ELX187M450AR5AA
450	500	180	30 x 35	25	1.24	900.0	1.843	ELX187M450AS3AA
450	500	180	35 x 25	25	1.20	900.0	1.843	ELX187M450AT1AA
450	500	220	25 x 50	25	1.36	995.0	1.508	ELX227M450AR6AA
450	500	220	30 x 40	25	1.38	995.0	1.508	ELX227M450AS4AA
450	500	220	35 x 30	25	1.35	995.0	1.508	ELX227M450AT2AA
450	500	270	30 x 45	25	1.51	1102.3	1.229	ELX277M450AS5AA
450	500	270	35 x 35	25	1.50	1102.3	1.229	ELX277M450AT3AA
450	500	330	30 x 50	25	1.70	1218.6	1.005	ELX337M450AS6AA
450	500	330	35 x 40	25	1.70	1218.6	1.005	ELX337M450AT4AA
450	500	390	35 x 45	25	1.90	1324.8	0.851	ELX397M450AT5AA
450	500	470	35 x 50	25	2.10	1454.3	0.706	ELX477M450AT6AA
500	550	100	30 x 25	25	0.82	703.6	3.317	ELX107M500AS1AA
500	550	120	30 x 30	25	0.91	770.7	2.765	ELX127M500AS2AA
500	550	120	35 x 25	25	0.88	770.7	2.765	ELX127M500AT1AA
500	550	150	30 x 35	25	1.04	861.7	2.212	ELX157M500AS3AA
500	550	180	30 x 40	25	1.17	943.9	1.843	ELX187M500AS4AA
500	550	180	35 x 30	25	1.10	943.9	1.843	ELX187M500AT2AA
500	550	220	30 x 45	25	1.33	1043.6	1.508	ELX227M500AS5AA
500	550	220	35 x 35	25	1.23	1043.6	1.508	ELX227M500AT3AA
500	550	270	30 x 50	25	1.50	1156.1	1.229	ELX277M500AS6AA
500	550	270	35 x 40	25	1.42	1156.1	1.229	ELX277M500AT4AA
500	550	330	35 x 45	25	1.60	1278.1	1.005	ELX337M500AT5AA
500	550	390	35 x 50	25	1.78	1389.4	0.851	ELX397M500AT6AA
500	550	470	35 x 60	25	2.03	1525.3	0.706	ELX477M500AT8AA
550	600	180	30x45	25	1.23	1980.0	1.8	ELX187M550AS5(1)
550	600	180	35x35	25	1.21	1980	1.842	ELX187M550AT3(1)
550	600	220	30x50	25	1.42	2420	1.507	ELX227M550AS6(1)
550	600	220	35x40	25	1.41	2420	1.507	ELX227M550AT4(1)
550	600	270	35x45	25	1.56	2970	1.228	ELX277M550AT5(1)
550	600	330	35x50	25	1.81	3630	1.005	ELX337M550AT6(1)
550	600	390	35x60	25	2.12	4290	0.85	ELX397M550AT8(1)
550	600	470	35x65	25	2.25	5170	0.705	ELX477M550AT9(1)
VDC	VDC Surge	Rated Capacitance	Case Size	DF	RC	LC	ESR	Part Number

AA Insert packaging code. See 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 $V_R \leq 160$ 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 ≤ 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

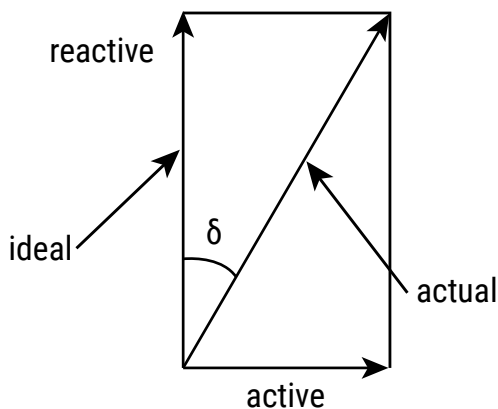
Effective capacitance value is derived from the impedance curve, as long as impedance is still in the range where the capacitance component is dominant.

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

C = capacitance (F)
 f = frequency (Hz)
 Z = impedance (Ω)

Dissipation Factor $\tan \delta$ (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:

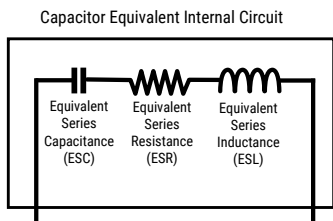
ESC = Equivalent series capacitance

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:

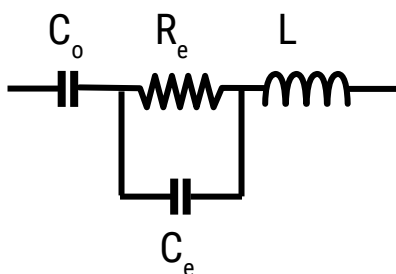
$$ESR = \frac{\tan \delta}{2\pi f ESC}$$

ESR = Equivalent series resistance (Ω)
 $\tan \delta$ = Dissipation factor
 ESC = Equivalent series capacitance (F)
 f = Frequency (Hz)

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

Impedance (Z)

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



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

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

C_e = Electrolyte soaked paper capacitance.

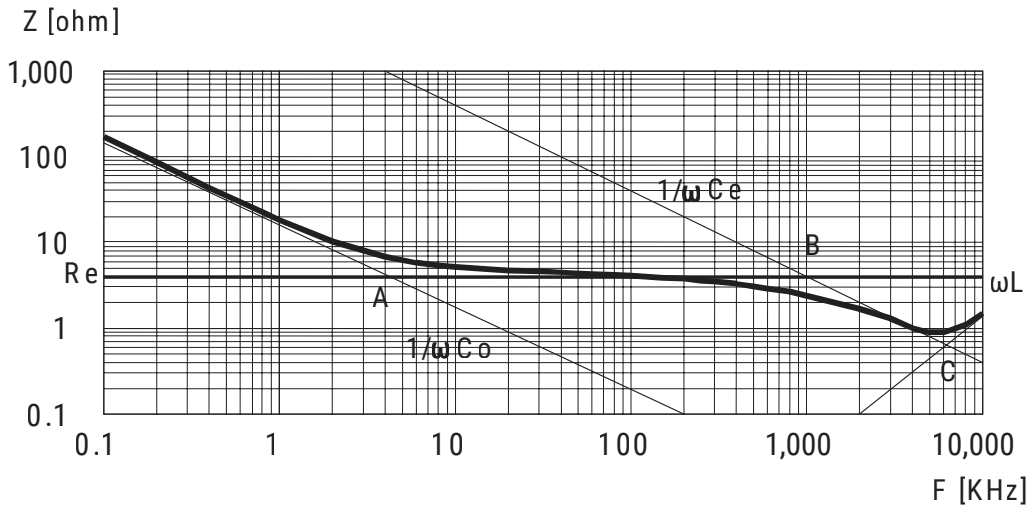
L = Inductive reactance of the capacitor winding and terminals.

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

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

Application & Operation Guidelines cont.

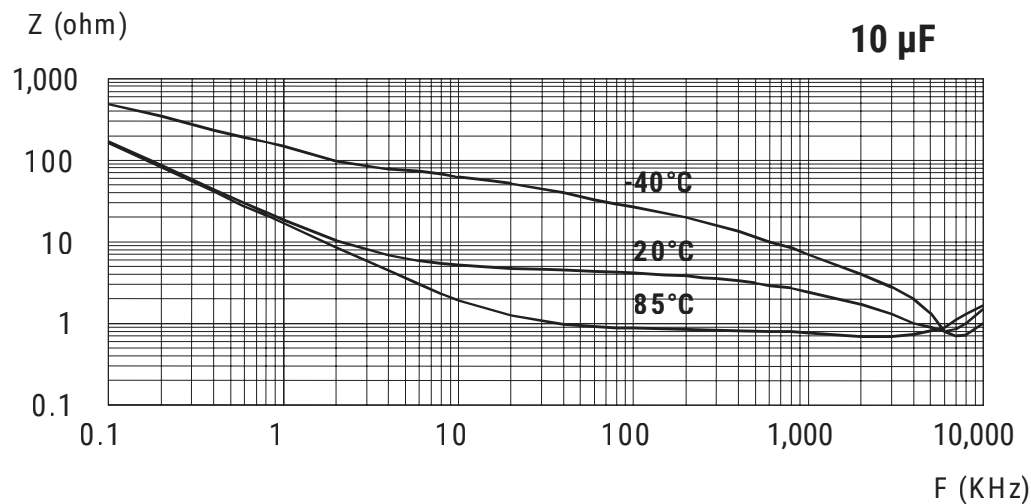
Impedance (Z) cont.



- 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 (ω_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)

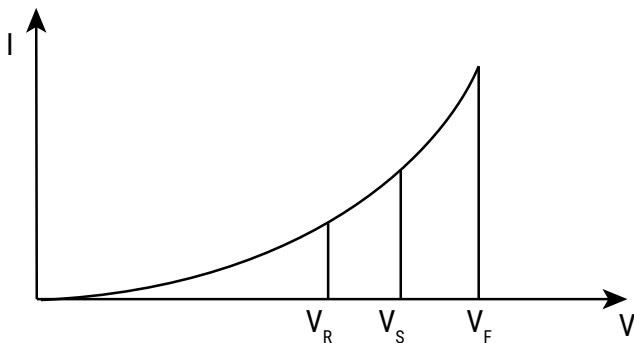
Due to the aluminum oxide layer that serves as a dielectric, a small current will continue to flow even after a DC voltage has been applied for long periods. This current is called leakage current.

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 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 $\tan \delta$ 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.

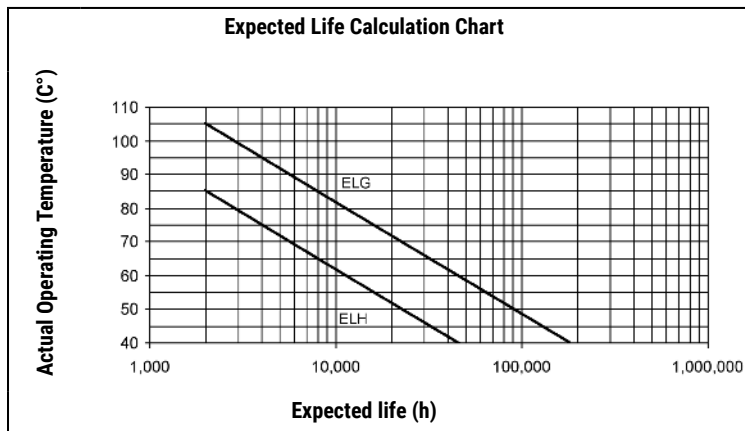
Expected Life Calculation

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

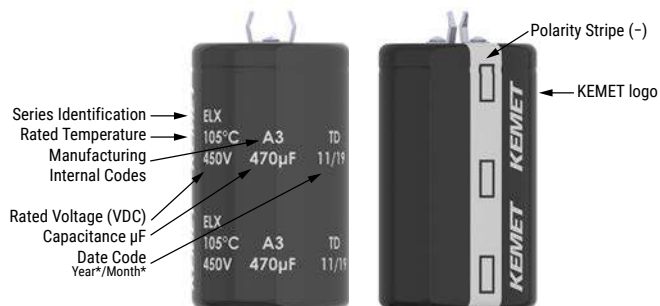
This formula is applicable between 40°C and T_0 .



Packaging Quantities

Size Code	Diameter (mm)	Length (mm)	Bulk Standard Leads
Q7	22	20	400
Q1	22	25	400
Q2	22	30	400
Q3	22	35	400
Q4	22	40	400
Q5	22	45	400
Q6	22	50	400
R7	25	20	200
R1	25	25	200
R2	25	30	200
R3	25	35	200
R4	25	40	200
R5	25	45	200
R6	25	50	200
S1	30	25	200
S2	30	30	200
S3	30	35	200
S4	30	40	200
S5	30	45	200
S6	30	50	200
S8	30	60	200
T1	35	25	200
T2	35	30	200
T3	35	35	200
T4	35	40	200
T5	35	45	200
T6	35	50	200
T8	35	60	200
T9	35	65	200

Marking



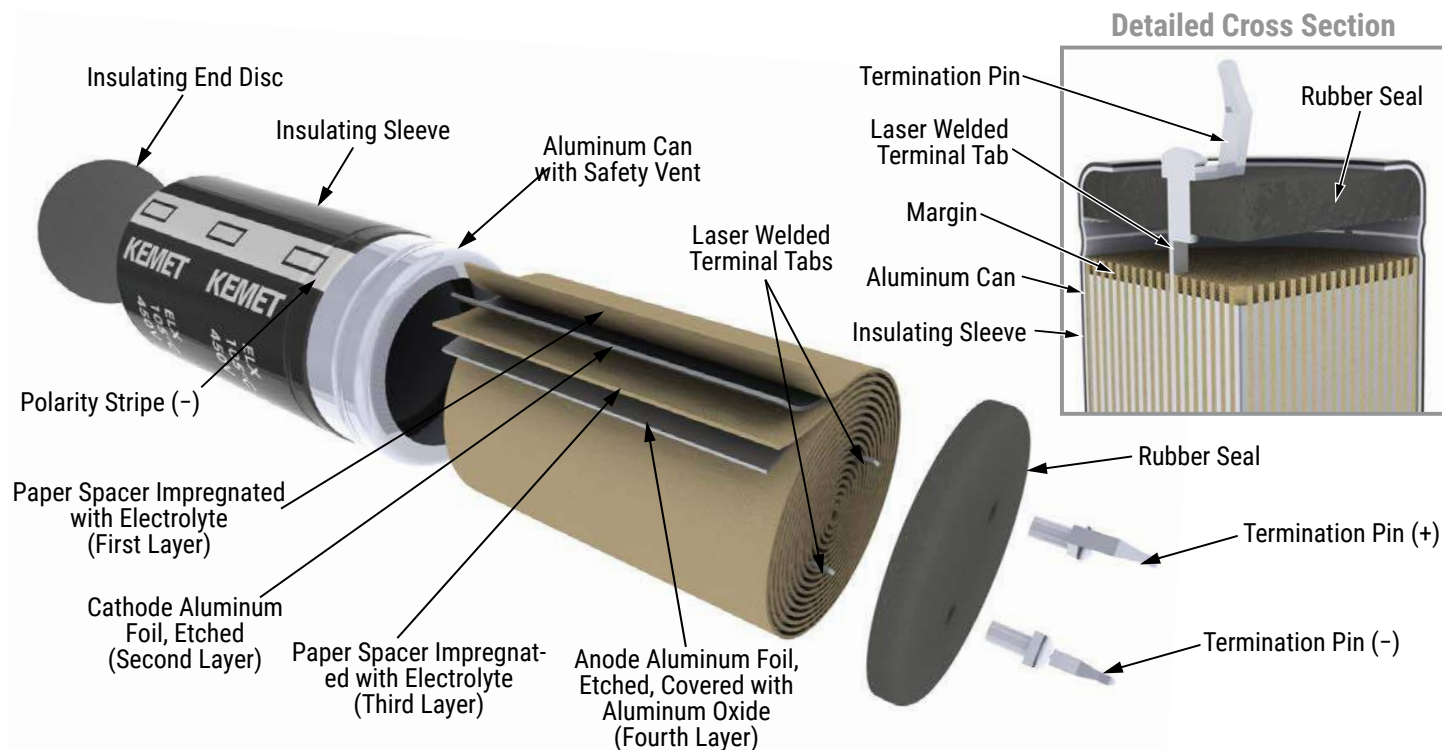
*Y = Year

Code	19	20	21	22	23	24	25	26	27
Year	2019	2020	2021	2022	2023	2024	2025	2026	2027

*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



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.

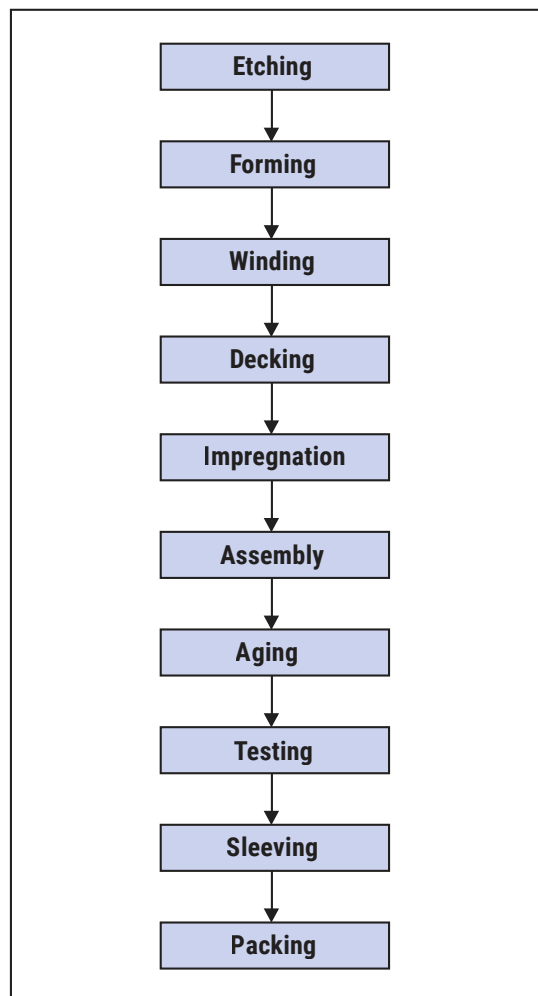
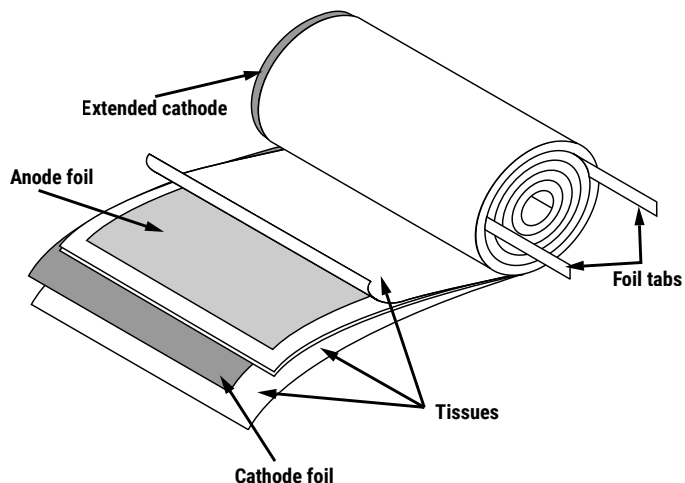
The following tests are applied and may be varied at the request of the customer. In this case the batch, or special procedure, will determine the course of action.

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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