# **EST, +105°C**



### **Overview**

The KEMET EST radial aluminum electrolytic capacitors are designed for low impedance and long life (up to 10,000 hours) applications.

### **Applications**

Typical applications include SMPS, power supplies, adaptors, chargers, monitors, and computers.

## **Benefits**

- · Long life, up to 10,000 hours
- Low impedance
- · Operating temperature of up to +105°C
- Case with  $\emptyset$  D  $\geq$  5 mm
- · Safety vent on the capacitor base



## **Part Number System**

EST	157	M	6R3		Α	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	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 <sub>0</sub> = 16 ±0.75	LA						
4 - 8	All	Tape & Reel	2.5 mm lead spacing	H <sub>0</sub> = 18.5 ±0.75	KA						
4 - 8	All	Tape & Reel	Formed to 5 mm	H <sub>0</sub> = 16 ±0.75	JA						
10	≤ 20	Tape & Reel	Straight	$H_0 = 18.5 \pm 0.75$	KA						
		An	nmo Pack								
4 - 8	All	Ammo	Formed to 5 mm	H <sub>0</sub> = 16 ±0.75	DA						
4 - 8	All	Ammo	Straight	$H_0 = 18.5 \pm 0.75$	EA						
4 - 5	All	Ammo	Formed to 2.5 mm	$H_0 = 16 \pm 0.75$	FA						
10 - 13	All	Ammo	5 mm lead spacing	H <sub>0</sub> = 18.5 ±0.75	EA						
16	All	Ammo	7.5 mm lead spacing	H <sub>0</sub> = 18.5 ±0.75	EA						
18	≤ 25	Ammo	7.5 mm lead spacing	H <sub>0</sub> = 18.5 ±0.75	EA						
		Contact KEMET for oth	er lead and packaging op	tions							

### **Environmental Compliance**

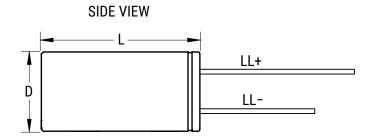
As an environmentally conscious company, KEMET is working continuously with improvements concerning the environmental effects of both our capacitors and their production. In Europe (RoHS Directive) and in some other geographical areas like China, legislation has been put in place to prevent the use of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

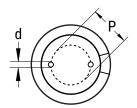
Due to customer requirements, there may appear additional markings such as lead free (LF) or lead-free wires (LFW) on the label.



## **Dimensions - Millimeters**



### **TERMINAL END VIEW**



D D		)		L		P	d		LL+/LL-
Size Code	Nominal	Tolerance	Nominal	Tolerance	Nominal	Tolerance	Nominal	Tolerance	Minimum
C3	5.0	±0.5	11.0	+1.5/-0	2.0	±0.5	0.5	Nominal	20/15
E3	6.3	±0.5	11.0	+1.5/-0	2.5	±0.5	0.5	Nominal	20/15
G3	8.0	±0.5	11.0	+1.5/-0	3.5	±0.5	0.6	Nominal	20/15
G4	8.0	±0.5	15.0	+2.0/-0	3.5	±0.5	0.6	Nominal	20/15
G6	8.0	±0.5	20.0	+2.0/-0	3.5	±0.5	0.6	Nominal	20/15
H1	10.0	±0.5	12.0	+1.5/-0	5.0	±0.5	0.6	Nominal	20/15
H9	10.0	±0.5	12.5	+1.5/-0	5.0	±0.5	0.6	Nominal	20/15
H2	10.0	±0.5	15.0	+2.0/-0	5.0	±0.5	0.6	Nominal	20/15
Н8	10.0	±0.5	16.0	+2.0/-0	5.0	±0.5	0.6	Nominal	20/15
H4	10.0	±0.5	20.0	+2.0/-0	5.0	±0.5	0.6	Nominal	20/15
H5	10.0	±0.5	25.0	+2.0/-0	5.0	±0.5	0.6	Nominal	20/15
H6	10.0	±0.5	30.0	+2.0/-0	5.0	±0.5	0.6	Nominal	20/15
L3	13.0	±0.5	20.0	+2.0/-0	5.0	±0.5	0.6	Nominal	20/15
L4	13.0	±0.5	25.0	+2.0/-0	5.0	±0.5	0.6	Nominal	20/15
L8	13.0	±0.5	30.0	+2.0/-0	5.0	±0.5	0.6	Nominal	20/15
L6	13.0	±0.5	35.0	+2.0/-0	5.0	±0.5	0.6	Nominal	20/15
L7	13.0	±0.5	40.0	+2.0/-0	5.0	±0.5	0.6	Nominal	20/15
M7	16.0	±0.5	25.0	+2.0/-0	7.5	±0.5	0.8	Nominal	20/15
M2	16.0	±0.5	32.0	+2.0/-0	7.5	±0.5	0.8	Nominal	20/15
М3	16.0	±0.5	36.0	+2.0/-0	7.5	±0.5	0.8	Nominal	20/15
M4	16.0	±0.5	40.0	+2.0/-0	7.5	±0.5	0.8	Nominal	20/15
N5	18.0	±0.5	25.0	+2.0/-0	7.5	±0.5	0.8	Nominal	20/15
N1	18.0	±0.5	32.0	+2.0/-0	7.5	±0.5	0.8	Nominal	20/15
N2	18.0	±0.5	36.0	+2.0/-0	7.5	±0.5	0.8	Nominal	20/15
N3	18.0	±0.5	40.0	+2.0/-0	7.5	±0.5	0.8	Nominal	20/15



### **Performance Characteristics**

ltem	Performance Characteristics			
Capacitance Range	2.2 – 15,000 μF			
Capacitance Tolerance	±20% at 120 Hz/20°C			
Rated Voltage	6.3 - 100 VDC			
Life Test	4,000 – 10,000 hours (see conditions in Test Method & Performance)			
Operating Temperature	-40°C to +105°C			
Laskana Cumant	I ≤ 0.01 CV or 3 μA, whichever is greater			
Leakage Current	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	50	63	100
Z (-25°C)/Z (20°C)	4	3	2	2	2	2	2	2
Z (-40°C)/Z (20°C)	8	6	4	3	3	3	3	3

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

Capacitance Range (μF)	120 Hz	1 kHz	10 kHz	100 kHz
6.8 - 180	0.40	0.75	0.90	1.00
220 - 560	0.50	0.85	0.94	1.00
680 - 1,800	0.60	0.87	0.95	1.00
2,200 - 3,900	0.75	0.90	0.95	1.00
≥ 4,700	0.85	0.95	0.98	1.00



### **Test Method & Performance**

Conditions		Shelf Life Test				
Temperature		105°C				
	Can Ø ≤ 6.3 mm	V ≤ 10 VDC	4,000 hours			
	Can Ø ≤ 6.3 mm	V ≥ 16 VDC	5,000 hours			
Total Donation	Can Ø = 8, 10 mm	V ≤ 10 VDC	6,000 hours	1 000 h		
Test Duration	Can Ø = 8, 10 mm	V ≥16 VDC	7,000 hours	1,000 hours		
	Can Ø ≥ 12.5 mm	V ≤ 10 VDC	8,000 hours			
	Can Ø ≥ 12.5 mm	V ≥ 16 VDC	10,000 hours			
Ripple Current	Maximum ripple current s	specified at 100 kHz 105	°C	No ripple current applied		
Voltage	The sum of DC voltage an rated voltage of the capa		nust not exceed the	No voltage applied		
Performance	The following specif	fications will be sati	sfied when the capa	citor is restored to 20°C:		
Capacitance Change	Within ±25% of the initial value					
Dissipation Factor	Does not exceed 200% of the specified value					
Leakage Current	Does not exceed specifie	d 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** 

6.3 6.3 6.3 6.3 6.3 6.3 6.3 6.3 6.3 6.3	VDC Surge Voltage	Rated Capacitance	Case	DF	Z				
6.3 6.3 6.3 6.3 6.3 6.3 6.3 6.3 6.3 6.3	_	Gapacitance	Size	120 Hz	100 kHz	RC 100 kHz	ESR 100 kHz	LC 20°C	
6.3 6.3 6.3 6.3 6.3 6.3 6.3 6.3 6.3 6.3	Voltage	120 Hz 20°C		20°C	20°C	100 km2	25°C	2 Minutes	Part Number
6.3 6.3 6.3 6.3 6.3 6.3 6.3 6.3 6.3 6.3	T OI LUIGE		DxL					(µA)	
6.3 6.3 6.3 6.3 6.3 6.3 6.3 6.3 6.3	<b>.</b>	(μ <b>F</b> )	(mm)	(tan δ %)*	(Ω)	(mA)	(Ω)		
6.3 6.3 6.3 6.3 6.3 6.3 6.3 6.3	8	150	5 x 11	22	0.720	210	0.72	9.5	EST157M6R3AC3(1)
6.3 6.3 6.3 6.3 6.3 6.3 6.3	8	330	6.3 x 11	22	0.380	340	0.38	20.8	EST337M6R3AE3(1)
6.3 6.3 6.3 6.3 6.3 6.3	8	680 820	8 x 11 8 x 15	22 22	0.200 0.160	640 840	0.2 0.16	42.8 51.7	EST687M6R3AG3(1) EST827M6R3AG4(1)
6.3 6.3 6.3 6.3 6.3	8	1000	10 x 12	22	0.120	865	0.10	63.0	EST108M6R3AH1(1)
6.3 6.3 6.3	8	1000	10 x 12.5	22	0.120	865	0.12	63.0	EST108M6R3AH9(1)
6.3 6.3	8	1500	8 x 20	22	0.110	1050	0.11	94.5	EST158M6R3AG6(1)
6.3	8	1500	10 x 15	22	0.084	1210	0.084	94.5	EST158M6R3AH2(1)
	8	2200	10 x 20	22	0.062	1400	0.062	138.6	EST228M6R3AH4(1)
0.3	8	2700 3300	10 x 25 13 x 20	22 22	0.052 0.046	1650 1900	0.052 0.046	170.1 207.9	EST278M6R3AH5(1) EST338M6R3AL3(1)
6.3	8	3900	13 x 20 13 x 25	22	0.046	2230	0.046	245.7	EST398M6R3AL4(1)
6.3	8	4700	13 x 30	22	0.030	2650	0.03	296.1	EST478M6R3AL8(1)
6.3	8	5600	13 x 35	22	0.027	2880	0.027	352.8	EST568M6R3AL6(1)
6.3	8	6800	13 x 40	22	0.024	3350	0.024	428.4	EST688M6R3AL7(1)
6.3	8	6800	16 x 25	22	0.028	2930	0.028	428.4	EST688M6R3AM7(1)
6.3	8	8200	16 x 32	22	0.025	3450	0.025	516.6	EST828M6R3AM2(1)
6.3 6.3	8 8	10000 12000	16 x 36 18 x 32	22 22	0.018 0.015	3610 4170	0.018 0.015	630.0 756.0	EST109M6R3AM3(1) EST129M6R3AN1(1)
6.3	8	15000	18 x 36	22	0.013	4220	0.013	945.0	EST159M6R3AN2(1)
10	13	100	5 x 11	19	0.720	210	0.72	10.0	EST107M010AC3(1)
10	13	220	6.3 x 11	19	0.380	340	0.38	22.0	EST227M010AE3(1)
10	13	470	8 x 11	19	0.200	640	0.2	47.0	EST477M010AG3(1)
10	13	680	8 x 15	19	0.160	840	0.16	68.0	EST687M010AG4(1)
10	13	1000	10 x 15	19	0.084	1210	0.084	100.0	EST108M010AH2(1)
10 10	13 13	1000	18 x 36 10 x 20	19 19	0.014 0.062	4220 1400	0.014	100.0 150.0	EST108M010AN2(1)
10	13	1500 2200	10 x 20 10 x 25	19	0.062	1650	0.062 0.052	220.0	EST158M010AH4(1) EST228M010AH5(1)
10	13	2700	13 x 20	19	0.046	1900	0.046	270.0	EST278M010AL3(1)
10	13	3300	13 x 25	19	0.034	2230	0.034	330.0	EST338M010AL4(1)
10	13	3900	13 x 30	19	0.030	2650	0.03	390.0	EST398M010AL8(1)
10	13	4700	13 x 35	19	0.027	2880	0.027	470.0	EST478M010AL6(1)
10	13	5600	13 x 40	19	0.024	3350	0.024	560.0	EST568M010AL7(1)
10 10	13 13	5600 6800	16 x 25 16 x 32	19 19	0.028 0.025	2930 3450	0.028 0.025	560.0 680.0	EST568M010AM7(1) EST688M010AM2(1)
10	13	8200	16 x 36	19	0.023	3610	0.023	820.0	EST828M010AM3(1)
10	13	10000	18 X 36	19	0.014	4220	0.014	1000.0	EST109M010AN2(1)
16	20	56	5 x 11	16	0.720	210	0.72	9.0	EST566M016AC3(1)
16	20	100	6.3 x 11	16	0.380	340	0.38	16.0	EST107M016AE3(1)
16	20	220	8 x 11	16	0.200	640	0.2	35.2	EST227M016AG3(1)
16	20 20	330 470	8 x 15	16 16	0.160	701	0.16	52.8 75.2	EST337M016AG4(1)
16 16	20	470 680	8 x 15 10 x 15	16 16	0.160 0.084	840 1210	0.16 0.084	75.2 108.8	EST477M016AG4(1) EST687M016AH2(1)
16	20	1000	10 x 13	16	0.062	1400	0.062	160.0	EST108M016AH4(1)
16	20	1500	10 x 25	16	0.052	1650	0.052	240.0	EST158M016AH5(1)
16	20	2200	13 x 25	16	0.034	2230	0.034	352.0	EST228M016AL4(1)
16	20	2700	13 x 30	16	0.030	2650	0.03	432.0	EST278M016AL8(1)
16	20	3300	13 x 35	16	0.027	2880	0.027	528.0	EST338M016AL6(1)
16 16	20 20	3900 4700	13 x 40 16 x 32	16 16	0.024 0.028	3350 3450	0.024 0.028	624.0 752.0	EST398M016AL7(1) EST478M016AM2(1)
16	20	5600	16 x 32	16	0.028	3450	0.028	896.0	EST568M016AM3(1)
16	20	5600	18 x 32	16	0.015	4170	0.015	896.0	EST568M016AN1(1)
16	20	6800	18 x 36	16	0.014	4220	0.014	1088.0	EST688M016AN2(1)
25	32	47	5 x 11	14	0.720	210	0.72	11.8	EST476M025AC3(1)
25	32	100	6.3 x 11	14	0.380	340	0.38	25.0	EST107M025AE3(1)
25 25	32 32	150 220	8 x 11	14 14	0.200	640 640	0.2 0.2	37.5 55.0	EST157M025AG3(1) EST227M025AG3(1)
			8 x 11		0.200	040			LOTZZ/WIUZDAUD(1)
VDC	VDC Surge	Rated Capacitance	Case Size	DF	Z	RC	ESR	LC	Part Number

 $<sup>(1) \</sup> Insert \ packaging \ code. \ See \ Ordering \ Options \ Table \ for \ available \ options.$ 

<sup>\*</sup> When capacitance exceeds 1,000  $\mu$ F, the DF value (%) is increased by 2% for every additional 1,000  $\mu$ F.



Table 1 - Ratings & Part Number Reference cont.

VDC   Voltage			Rated	Case	DF	Z	RC	ESR		
Voltage (µF) (µF) (µmm) (tan 6 %)* (µ) (mA) (µA) (µA) (µA) (µA) (µA) (µA) (µA) (µ		VDC							LC 20°C	
Voltage	VDC	Surge							2 Minutes	Part Number
Color   Colo		_							(IIA)	
25 32 689 10.2 0 14 0.094 1710 0.094 1775 ESTATAMOSAHQTI) 25 32 689 10.2 0 14 0.062 1650 0.052 20.5 0 ESTSENMOSAHQTI) 25 32 1000 13.2 0 14 0.062 1650 0.052 20.5 0 ESTSENMOSAHQTI) 25 32 1500 13.2 0 14 0.046 1900 0.046 20.0 EST 0.052AHQTI) 25 32 1500 13.2 0 14 0.046 1900 0.046 20.0 EST 0.052AHQTI) 25 32 2700 13.2 35 14 0.034 2290 0.034 375.0 ESTSENMOSALQTI) 25 32 2700 18.2 14 0.02 2 2880 0.02 2 57.0 ESTSENMOSALQTI) 26 32 32 2700 18.2 14 0.02 2 2880 0.02 2 57.0 ESTSENMOSALQTI) 27 32 32 270 16.2 2 14 0.02 2 2880 0.02 2 57.0 ESTSENMOSALQTI) 28 32 27 350 18.2 2 14 0.02 2 2880 0.02 2 57.0 ESTSENMOSALQTI) 29 32 32 350 18.2 2 14 0.02 2 2880 0.02 2 57.0 ESTSENMOSALQTI) 20 32 32 350 18.2 2 14 0.01 0.05 2 2880 0.02 2 57.0 ESTSENMOSALQTI) 21 32 32 350 18.2 2 14 0.01 0.05 2 2880 0.02 2 57.0 ESTSENMOSALQTI) 22 32 32 350 18.2 2 14 0.01 0.05 2 2880 0.02 2 57.0 ESTSENMOSALQTI) 23 35 44 33 5.11 12 0.70 0.01 4 4780 0.014 1175.0 ESTSENMOSALQTI) 24 470 0.01 8.2 11 12 0.380 3.0 0.03 15.5 ESTSENMOSALQTI) 25 32 470 0.8 11 1 12 0.380 3.0 0.03 15.5 ESTSENMOSALQTI) 25 35 44 4 150 8.11 12 0.300 640 0.2 2 5 ESTSENMOSALQTI] 26 35 44 320 0.02 12 0.00 0.00 1.00 0.00 1.0 ESTSENMOSALQTI] 27 4 8 8 8 15 12 0.10 0.00 8.0 0.16 7.70 ESTSENMOSALQTI] 28 35 44 50 0.00 18.2 10 0.00 18.2 10.00 0.00 0.00 18.2 10.00 0.00 0.00 18.2 10.00 0.00 0.00 0.00 0.00 0.00 0.00 0		Voltage	(μF)	(mm)	(tan δ %)*	(Ω)	(mA)	(Ω)	( <b>µ</b> /\	
25 32 820 10 x 20 14 0.062 1400 0.062 170 0 EST8PMOSAH4(1) 25 32 820 10 x 5 14 0.062 1650 0.052 250 EST8PMOSAH5(1) 25 32 1500 13 x 25 14 0.034 2230 0.044 250 0 EST18MOSAH5(1) 25 32 2700 16 x 25 14 0.027 2880 0.027 550 0 EST18MOSAH5(1) 25 32 2700 16 x 25 14 0.027 2880 0.027 550 0 EST18MOSAH5(1) 25 32 2700 16 x 25 14 0.028 2930 0.029 650 0 EST18MOSAH5(1) 25 32 390 18 x 32 14 0.028 3450 0.029 650 0 EST18MOSAH5(1) 25 32 390 18 x 32 14 0.028 3450 0.029 650 0 EST18MOSAH5(1) 25 32 390 18 x 32 14 0.015 470 0.015 975 0 EST18MOSAH5(1) 25 32 390 18 x 32 14 0.015 470 0.015 975 0 EST18MOSAH5(1) 25 32 390 18 x 32 14 0.015 470 0.015 975 0 EST18MOSAH5(1) 26 32 470 18 x 31 11 12 0.030 340 0.028 650 0 EST18MOSAH5(1) 27 32 470 18 x 31 11 12 0.030 640 0.2 55 5 EST18MOSAH5(1) 28 5 44 150 8 x 11 1 12 0.030 640 0.2 55 5 EST18MOSAH5(1) 35 44 150 8 x 11 1 12 0.030 640 0.2 55 5 EST18MOSAH5(1) 35 44 4 70 0.1 1 10 12 0.060 140 0.062 115 5 EST18MOSAH5(1) 35 44 660 10 x 20 12 0.062 1400 0.062 115 5 EST18MOSAH5(1) 35 44 660 13 x 20 12 0.062 1400 0.062 115 5 EST3PMOSAH5(1) 35 44 660 13 x 20 12 0.064 1910 0.062 155 EST3PMOSAH5(1) 35 44 660 13 x 20 12 0.064 1910 0.062 155 EST3PMOSAH5(1) 35 44 660 13 x 20 12 0.064 1910 0.062 155 EST3PMOSAH5(1) 35 44 660 13 x 20 12 0.044 1910 0.044 28.0 EST8PMOSAH5(1) 35 44 660 13 x 20 12 0.045 100 0.062 155 EST3PMOSAH5(1) 35 44 1000 13 x 25 12 0.045 2230 0.045 28.0 EST8PMOSAH5(1) 35 44 1000 13 x 25 12 0.045 2230 0.045 28.0 EST8PMOSAH5(1) 35 44 1000 13 x 25 12 0.045 2230 0.045 28.0 EST8PMOSAH5(1) 35 44 1000 13 x 25 12 0.045 2230 0.045 28.0 EST8PMOSAH5(1) 35 44 1000 13 x 25 12 0.045 2230 0.045 28.0 EST8PMOSAH5(1) 35 44 1000 13 x 25 12 0.045 2230 0.045 28.0 EST8PMOSAH5(1) 35 44 1000 13 x 25 12 0.045 2230 0.045 28.0 EST8PMOSAH5(1) 35 44 1000 13 x 25 12 0.045 2230 0.045 28.0 EST8PMOSAH5(1) 35 44 1000 13 x 25 12 0.045 2230 0.045 28.0 EST8PMOSAH5(1) 35 44 1000 13 x 25 12 0.045 2230 0.045 28.0 EST8PMOSAH5(1) 35 44 1000 13 x 25 12 0.045 2230 0.045 28.0 EST8PMOSAH5(1) 35 44 1000 13 x 25 12 0.045 2230 0.045 28.0 EST8PMOSAH										` ′
255 32 1000 13 x 20 14 0.052 1059 0.052 205.0 EST82M05SA1(1) 255 32 1000 13 x 20 14 0.046 230 0.046 230 EST80M05SA1(3) 255 32 2000 13 x 25 14 0.034 2230 0.034 375.0 EST158M02SA1(1) 255 32 2200 13 x 35 14 0.027 250 0.027 550 EST25M05SA1(3) 256 32 2780 16 x 25 14 0.028 2939 0.028 675.0 EST25M05SA1(3) 255 32 32 3100 16 x 25 14 0.023 2939 0.028 675.0 EST25M05SA1(3) 255 32 32 3100 16 x 25 14 0.023 2939 0.028 675.0 EST25M05SA1(3) 255 32 32 3100 16 x 25 14 0.023 2939 0.028 675.0 EST25M05SA1(3) 255 32 32 3100 16 x 25 14 0.025 25 0.028 2										` ′
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50         63         33         6.3 x 11         14         1.200         340         1.2         16.5         EST336M050AE3(1)           50         63         47         6.3 x 11         14         1.200         340         1.2         23.5         EST167M050AE3(1)           50         63         120         8 x 15         14         0.630         555         0.63         50.0         EST127M050AG4(1)           50         63         120         8 x 15         14         0.450         730         0.45         60.0         EST127M050AG4(1)           50         63         150         8 x 20         14         0.330         910         0.33         75.0         EST27M050AH2(1)           50         63         220         10 x 16         14         0.310         1050         #NA         1110.0         EST227M050AH2(1)           50         63         320         10 x 16         14         0.310         1050         0.31         110.0         EST227M050AH2(1)           50         63         320         10 x 16         14         0.310         1050         0.31         110.0         EST227M050AH2(1)           50         63         30										` ,
50         63         47         6.3 x 11         14         1.200         340         1.2         23.5         EST476M50AE3(1)           50         63         100         8 x 11         14         0.630         555         0.63         50.0         EST107M050AG3(1)           50         63         120         8 x 15         14         0.450         730         0.45         60.0         EST157M050AG4(1)           50         63         150         8 x 20         14         0.330         910         0.33         75.0         EST157M050AG6(1)           50         63         220         10 x 16         14         0.310         1050         #NA         110.0         EST227M050AH2(1)           50         63         320         10 x 16         14         0.310         1050         0.31         110.0         EST227M050AH2(1)           50         63         330         10 x 20         14         0.150         1690         0.15         235.0         EST477M050AH6(1)           50         63         470         13 x 20         14         0.160         1660         0.16         235.0         EST477M050AH6(1)           50         63         560 </td <td></td> <td>1</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>		1								
50         63         120         8 x 15         14         0.450         730         0.45         60.0         EST127M050AG4(1)           50         63         150         8 x 20         14         0.330         910         0.33         75.0         EST157M050A66(1)           50         63         220         10 x 16         14         0.310         1050         0.31         110.0         EST227M050AH8(1)           50         63         220         10 x 16         14         0.310         1050         0.31         110.0         EST227M050AH8(1)           50         63         330         10 x 20         14         0.210         1400         0.21         165.0         EST377M050AH4(1)           50         63         470         10 x 30         14         0.150         1600         0.16         235.0         EST477M050AL3(1)           50         63         560         13 x 25         14         0.120         1950         0.12         280.0         EST677M050AL3(1)           50         63         680         13 x 35         14         0.100         2310         0.1         340.0         EST687M050AL6(1)           50         63 <t< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>										
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50         63         330         10 x 20         14         0.210         1400         0.21         165.0         EST337M050AH4(1)           50         63         470         10 x 30         14         0.150         1690         0.15         235.0         EST477M050AH3(1)           50         63         470         13 x 20         14         0.160         1660         0.16         235.0         EST477M050AL3(1)           50         63         560         13 x 25         14         0.120         1950         0.12         280.0         EST567M050AL4(1)           50         63         680         13 x 30         14         0.100         2310         0.1         340.0         EST687M050AL8(1)           50         63         820         13 x 35         14         0.083         2510         0.083         410.0         EST827M050AL6(1)           50         63         1000         16 x 32         14         0.073         2555         0.073         500.0         EST108M050AM2(1)           50         63         1200         16 x 32         14         0.045         3150         0.045         750.0         EST128M050AM2(1)           50         63										
50         63         470         13 x 20         14         0.160         1660         0.16         235.0         EST477M050AL3(1)           50         63         560         13 x 25         14         0.120         1950         0.12         280.0         EST567M050AL4(1)           50         63         680         13 x 30         14         0.100         2310         0.1         340.0         EST687M050AL8(1)           50         63         820         13 x 35         14         0.083         2510         0.083         410.0         EST687M050AL8(1)           50         63         1000         16 x 25         14         0.073         2555         0.073         500.0         EST108M050AM7(1)           50         63         1200         16 x 32         14         0.054         3010         0.054         600.0         EST128M050AM7(1)           50         63         1800         18 x 32         14         0.045         3150         0.045         750.0         EST188M050AM1(1)           50         63         1800         18 x 32         14         0.047         3635         0.047         900.0         EST188M050AM3(1)           50         63<										
50         63         560         13 x 25         14         0.120         1950         0.12         280.0         EST567M050AL4(1)           50         63         680         13 x 30         14         0.100         2310         0.1         340.0         EST687M050AL8(1)           50         63         820         13 x 35         14         0.083         2510         0.083         410.0         EST827M050AL6(1)           50         63         1000         16 x 25         14         0.073         2555         0.073         500.0         EST108M050AM7(1)           50         63         1200         16 x 32         14         0.054         3010         0.054         600.0         EST128M050AM2(1)           50         63         1500         16 x 36         14         0.045         3150         0.045         750.0         EST158M050AM3(1)           50         63         1800         18 x 32         14         0.047         3635         0.047         900.0         EST188M050AM3(1)           50         63         2200         18 x 40         14         0.040         3680         0.04         1100.0         EST228M050AN2(1)           50         6						0.150				` ,
50         63         680         13 x 30         14         0.100         2310         0.1         340.0         EST687M050AL8(1)           50         63         820         13 x 35         14         0.083         2510         0.083         410.0         EST827M050AL6(1)           50         63         1000         16 x 25         14         0.073         2555         0.073         500.0         EST108M050AM7(1)           50         63         1200         16 x 32         14         0.054         3010         0.054         600.0         EST128M050AM2(1)           50         63         1500         16 x 36         14         0.045         3150         0.045         750.0         EST158M050AM3(1)           50         63         1800         18 x 32         14         0.047         3635         0.047         900.0         EST188M050AM1(1)           50         63         2200         18 x 36         14         0.040         3680         0.04         1100.0         EST228M050AN2(1)           50         63         2700         18 x 40         14         0.036         3800         0.036         1350.0         EST278M050AN3(1)           63 <t< td=""><td></td><td>1</td><td></td><td></td><td></td><td>1</td><td></td><td></td><td></td><td></td></t<>		1				1				
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50         63         1000         16 x 25         14         0.073         2555         0.073         500.0         EST108M050AM7(1)           50         63         1200         16 x 32         14         0.054         3010         0.054         600.0         EST128M050AM2(1)           50         63         1500         16 x 36         14         0.045         3150         0.045         750.0         EST128M050AM3(1)           50         63         1800         18 x 32         14         0.047         3635         0.047         900.0         EST188M050AN1(1)           50         63         2200         18 x 36         14         0.040         3680         0.04         110.0         EST228M050AN2(1)           50         63         2700         18 x 40         14         0.040         3680         0.04         110.0         EST278M050AN3(1)           63         79         10         5 x 11         14         2.300         55         2.3         6.3         EST796M050AN3(1)           63         79         33         6.3 x 11         14         1.200         115         1.2         20.8         EST336M063AE3(1)           63         79		1				1			1	` '
50         63         1200         16 x 32         14         0.054         3010         0.054         600.0         EST128M050AM2(1)           50         63         1500         16 x 36         14         0.045         3150         0.045         750.0         EST158M050AM3(1)           50         63         1800         18 x 32         14         0.047         3635         0.047         900.0         EST188M050AN1(1)           50         63         2200         18 x 36         14         0.040         3680         0.04         1100.0         EST228M050AN2(1)           50         63         2700         18 x 40         14         0.036         3800         0.036         1350.0         EST278M050AN3(1)           63         79         10         5 x 11         14         2.300         55         2.3         6.3         EST106M063AC3(1)           63         79         33         6.3 x 11         14         1.200         115         1.2         2.08         EST336M063AE3(1)           63         79         56         8 x 11         14         0.630         232         0.63         35.3         EST566M063AG3(1)           63         79										
50         63         1800         18 x 32         14         0.047         3635         0.047         900.0         EST188M050AN1(1)           50         63         2200         18 x 36         14         0.040         3680         0.04         1100.0         EST228M050AN2(1)           50         63         2700         18 x 40         14         0.036         3800         0.036         1350.0         EST278M050AN3(1)           63         79         10         5 x 11         14         2.300         55         2.3         6.3         EST106M063AC3(1)           63         79         33         6.3 x 11         14         1.200         115         1.2         20.8         EST336M063AE3(1)           63         79         56         8 x 11         14         0.630         232         0.63         35.3         EST566M063AG3(1)           63         79         120         10 x 15         14         0.310         357         0.31         75.6         EST127M063AH2(1)           63         79         120         10 x 16         14         0.310         357         0.31         75.6         EST127M063AH8(1)           63         79         18	50	63	1200	16 x 32	14	0.054	3010	0.054	600.0	EST128M050AM2(1)
50         63         2200         18 x 36         14         0.040         3680         0.04         1100.0         EST228M050AN2(1)           50         63         2700         18 x 40         14         0.036         3800         0.036         1350.0         EST278M050AN3(1)           63         79         10         5 x 11         14         2.300         55         2.3         6.3         EST106M063AC3(1)           63         79         33         6.3 x 11         14         1.200         115         1.2         20.8         EST336M063AE3(1)           63         79         56         8 x 11         14         0.630         232         0.63         35.3         EST566M063AG3(1)           63         79         120         10 x 15         14         0.310         357         0.31         75.6         EST127M063AH2(1)           63         79         120         10 x 16         14         0.310         357         0.31         75.6         EST127M063AH8(1)           63         79         180         10 x 20         14         0.210         466         0.21         113.4         EST187M063AH4(1)           63         79         220 </td <td></td> <td>1</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>` '</td>		1								` '
50         63         2700         18 x 40         14         0.036         3800         0.036         1350.0         EST278M050AN3(1)           63         79         10         5 x 11         14         2.300         55         2.3         6.3         EST106M063AC3(1)           63         79         33         6.3 x 11         14         1.200         115         1.2         20.8         EST336M063AE3(1)           63         79         56         8 x 11         14         0.630         232         0.63         35.3         EST566M063AG3(1)           63         79         120         10 x 15         14         0.310         357         0.31         75.6         EST127M063AH2(1)           63         79         120         10 x 16         14         0.310         357         0.31         75.6         EST127M063AH8(1)           63         79         180         10 x 20         14         0.210         466         0.21         113.4         EST187M063AH4(1)           63         79         220         10 x 25         14         0.200         531         0.2         138.6         EST227M063AH5(1)           63         79         270		1								
63         79         10         5 x 11         14         2.300         55         2.3         6.3         EST106M063AC3(1)           63         79         33         6.3 x 11         14         1.200         115         1.2         20.8         EST336M063AE3(1)           63         79         56         8 x 11         14         0.630         232         0.63         35.3         EST566M063AG3(1)           63         79         120         10 x 15         14         0.310         357         0.31         75.6         EST127M063AH2(1)           63         79         180         10 x 20         14         0.210         466         0.21         113.4         EST187M063AH4(1)           63         79         220         10 x 25         14         0.200         531         0.2         138.6         EST227M063AH5(1)           63         79         270         10 x 30         14         0.150         663         0.15         170.1         EST277M063AH6(1)           63         79         270         10 x 30         14         0.150         663         0.15         170.1         EST277M063AH6(1)           63         79         270										` '
63         79         33         6.3 x 11         14         1.200         115         1.2         20.8         EST336M063AE3(1)           63         79         56         8 x 11         14         0.630         232         0.63         35.3         EST566M063AG3(1)           63         79         120         10 x 15         14         0.310         357         0.31         75.6         EST127M063AH2(1)           63         79         180         10 x 20         14         0.210         466         0.21         113.4         EST187M063AH4(1)           63         79         220         10 x 25         14         0.200         531         0.2         138.6         EST227M063AH5(1)           63         79         270         10 x 30         14         0.150         663         0.15         170.1         EST277M063AH6(1)           63         79         270         13 x 20         14         0.160         690         0.16         170.1         EST277M063AL3(1)										` ,
63         79         120         10 x 15         14         0.310         357         0.31         75.6         EST127M063AH2(1)           63         79         120         10 x 16         14         0.310         357         0.31         75.6         EST127M063AH8(1)           63         79         180         10 x 20         14         0.210         466         0.21         113.4         EST187M063AH4(1)           63         79         220         10 x 25         14         0.200         531         0.2         138.6         EST227M063AH5(1)           63         79         270         10 x 30         14         0.150         663         0.15         170.1         EST277M063AH6(1)           63         79         270         13 x 20         14         0.160         690         0.16         170.1         EST277M063AL3(1)	•	79	33	6.3 x 11	14	1	115			EST336M063AE3(1)
63         79         120         10 x 16         14         0.310         357         0.31         75.6         EST127M063AH8(1)           63         79         180         10 x 20         14         0.210         466         0.21         113.4         EST187M063AH4(1)           63         79         220         10 x 25         14         0.200         531         0.2         138.6         EST227M063AH5(1)           63         79         270         10 x 30         14         0.150         663         0.15         170.1         EST277M063AH6(1)           63         79         270         13 x 20         14         0.160         690         0.16         170.1         EST277M063AL3(1)	•					1				` ′
63 79 180 10 x 20 14 0.210 466 0.21 113.4 EST187M063AH4(1) 63 79 220 10 x 25 14 0.200 531 0.2 138.6 EST227M063AH5(1) 63 79 270 10 x 30 14 0.150 663 0.15 170.1 EST277M063AH6(1) 63 79 270 13 x 20 14 0.160 690 0.16 170.1 EST277M063AL3(1)	•									` ′
63 79 220 10 x 25 14 0.200 531 0.2 138.6 EST227M063AH5(1) 63 79 270 10 x 30 14 0.150 663 0.15 170.1 EST277M063AH6(1) 63 79 270 13 x 20 14 0.160 690 0.16 170.1 EST277M063AL3(1)										
63 79 270 10 x 30 14 0.150 663 0.15 170.1 EST277M063AH6(1) 63 79 270 13 x 20 14 0.160 690 0.16 170.1 EST277M063AL3(1)										` '
		79								EST277M063AH6(1)
VDC VDC Surge Rated Capacitance Case Size DF Z RC ESR LC Part Number	63	79	270	13 x 20	14	0.160	690	0.16	170.1	EST277M063AL3(1)
	VDC	VDC Surge	Rated Capacitance	Case Size	DF	z	RC	ESR	LC	Part Number

 $<sup>(1) \</sup> Insert\ packaging\ code.\ See\ Ordering\ Options\ Table\ for\ available\ options.$ 

<sup>\*</sup> When capacitance exceeds 1,000  $\mu$ F, the DF value (%) is increased by 2% for every additional 1,000  $\mu$ F.



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 %)*	Z 100 kHz 20°C (Ω)	RC 100 kHz 105°C (mA)	ESR 100 kHz 25°C (Ω)	LC 20°C 2 Minutes (µA)	Part Number
63	79	330	13 x 25	14	0.120	784	0.12	207.9	EST337M063AL4(1)
63	79	470	13 x 30	14	0.100	905	0.1	296.1	EST477M063AL8(1)
63	79	560	13 x 35	14	0.083	1050	0.083	352.8	EST567M063AL6(1)
63	79	680	13 x 40	14	0.071	1180	0.071	428.4	EST687M063AL7(1)
63	79	820	16 x 32	14	0.054	1570	0.054	516.6	EST827M063AM2(1)
63	79	1000	16 x 36	14	0.045	1790	0.045	630.0	EST108M063AM3(1)
63	79	1200	16 x 40	14	0.040	2020	0.04	756.0	EST128M063AM4(1)
100	125	2.2	5 x 11	14	10.000	20	10	3.0	EST225M100AC3(1)
100	125	3.3	5 x 11	14	8.500	27	8.5	3.3	EST335M100AC3(1)
100	125	4.7	5 x 11	14	8.000	30	8	4.7	EST475M100AC3(1)
100	125	6.8	5 x 11	14	7.500	45	7.5	6.8	EST685M100AC3(1)
100	125	10	6.3 x 11	14	5.000	55	5	10.0	EST106M100AE3(1)
100	125	15	6.3 x 11	14	5.000	70	5	15.0	EST156M100AE3(1)
100	125	22	8 x 11	14	2.700	85	2.7	22.0	EST226M100AG3(1)
100	125	33	8 x 11	14	2.500	95	2.5	33.0	EST336M100AG3(1)
100	125	47	8 x 15	14	1.800	150	1.8	47.0	EST476M100AG4(1)
100	125	56	8 x 20	14	1.500	200	1.5	56.0	EST566M100AG6(1)
100	125	68	10 x 15	14	1.300	230	1.3	68.0	EST686M100AH2(1)
100	125	82	10 x 20	14	1.200	250	1.2	82.0	EST826M100AH4(1)
100	125	100	10 x 20	14	0.950	330	0.95	100.0	EST107M100AH4(1)
100	125	120	10 x 25	14	0.800	400	0.8	120.0	EST127M100AH5(1)
100	125	150	13 x 20	14	0.900	460	0.9	150.0	EST157M100AL3(1)
100	125	220	13 x 25	14	0.600	640	0.6	220.0	EST227M100AL4(1)
100	125	330	16 x 25	14	0.570	720	0.57	330.0	EST337M100AM7(1)
100	125	470	16 x 32	14	0.550	770	0.55	470.0	EST477M100AM2(1)
100	125	470	18 x 25	14	0.500	840	0.5	470.0	EST477M100AN5(1)
100	125	680	18 x 36	14	0.180	1400	0.18	680.0	EST687M100AN2(1)
100	125	820	18 x 40	14	0.130	1850	0.13	820.0	EST827M100AN3(1)
100	125	1000	18 x 40	14	0.130	1850	0.13	1000.0	EST108M100AN3(1)
VDC	VDC Surge	Rated Capacitance	Case Size	DF	Z	RC	ESR	LC	Part Number

<sup>(1)</sup> Insert packaging code. See Ordering Options Table for available options.

<sup>\*</sup> When capacitance exceeds 1,000  $\mu$ F, the DF value (%) is increased by 2% for every additional 1,000  $\mu$ F.



### **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 k $\Omega$  for capacitors with  $V_R \le 160$  V (5 W resistor) and 10 k $\Omega$  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.



### Electrical Ratings: Capacitance (ESC)



Simplified equivalent circuit diagram of an electrolytic capacitor

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

### **Temperature Dependence of the Capacitance**

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

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

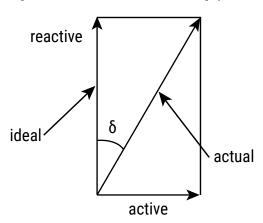
#### **Frequency Dependence of the Capacitance**

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

$$C = \frac{1}{2\pi \text{ fZ}} \frac{\text{C = capacitance (F)}}{\text{f = frequency (Hz)}}$$
$$Z = \text{impedance } (\Omega)$$

#### Dissipation Factor tan $\delta$ (DF)

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



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

Tan  $\delta = \omega \times ESC \times ESR$  where:

ESC = Equivalent series capacitance

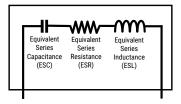
ESR = Equivalent series resistance



#### **Equivalent Series Inductance (ESL)**

Equivalent series inductance or self inductance results from the terminal configuration and internal design of the capacitor.

Capacitor Equivalent Internal Circuit



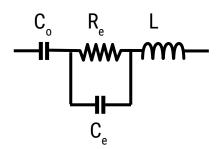
### **Equivalent Series Resistance (ESR)**

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:

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<sub>o</sub> = 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<sub>a</sub> = Electrolyte soaked paper capacitance.

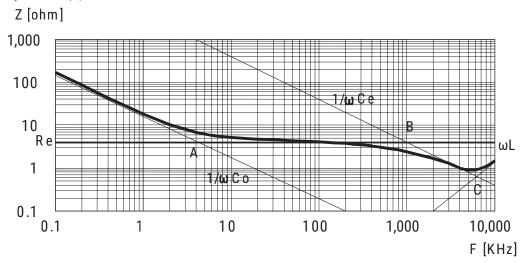
L = Inductive reactance of the capacitor winding and terminals.

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:



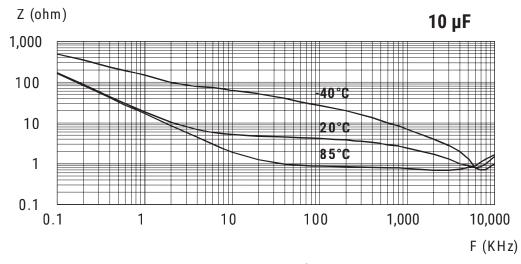
#### Impedance (Z) cont.



- · 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  $R_o(A)$
- At even higher frequencies, resistance of the electrolyte predominates: Z = R<sub>a</sub> (A B)
- When the capacitor's resonance frequency is reached ( $\omega_0$ ), capacitive and inductive reactance mutually cancel each other  $1/\omega C_p = \omega L$ ,  $\omega_0 = 1/SQR(LC_p)$
- 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  $C_a \approx 0.01 C_o$ .

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



 $R_{_{\rm e}}$  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)**

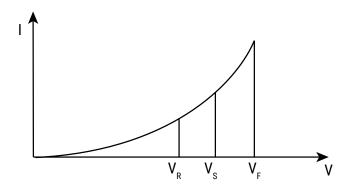
Due to the aluminum oxide layer that serves as a dielectric, a small current will continue to flow even after a DC voltage has been applied for long periods. This current is called leakage current.

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:

 $V_{\epsilon}$  = Forming voltage

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

V<sub>D</sub> = Rated voltage

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

V<sub>s</sub> = Surge voltage

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

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

#### Ripple Current (RC)

The maximum ripple current value depends on:

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

The capacitor's life depends on the thermal stress.



#### **Frequency Dependence of the Ripple Current**

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

### **Temperature Dependence of the Ripple Current**

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

#### **Expected Life Calculation**

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

L: Expected life

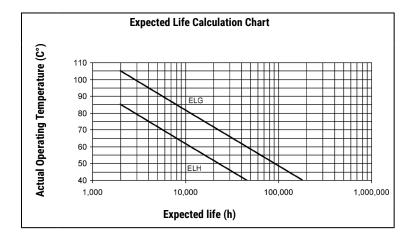
Lo: Load life at a maximum permissible operating

temperature

T: Actual operating temperature

To: Maximum permissible operating temperature

This formula is applicable between 40°C and To.



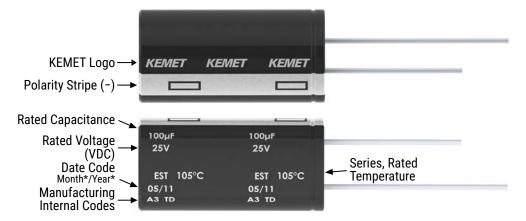


# **Packaging Quantities**

Size	Diameter	Length		
Code	(mm)	(mm)		
C3	5.0	11.0		
E3	6.3	11.0		
G3	8.0	11.0		
G4	8.0	15.0		
G6	8.0	20.0		
Н9	10.0	12.5		
H2	10.0	15.0		
Н8	10.0	16.0		
H4	10.0	20.0		
H5	10.0	25.0		
Н6	10.0	30.0		
L3	13.0	20.0		
L4	13.0	25.0		
L8	13.0	30.0		
L6	13.0	35.0		
L7	13.0	40.0		
М7	16.0	25.0		
M2	16.0	32.0		
М3	16.0	36.0		
M4	16.0	40.0		
N5	18.0	25.0		
N1	18.0	32.0		
N2	18.0	36.0		
N3	18.0	40.0		



## **Marking**



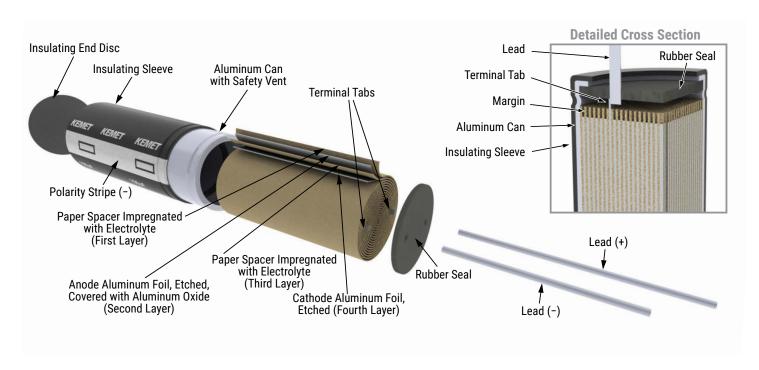
\*Y = Year

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

#### \*M = Month

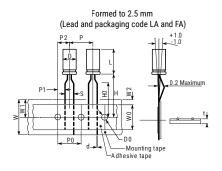
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Month	1	2	3	4	5	6	7	8	9	10	11	12

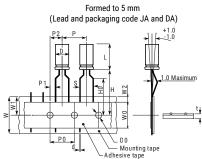
### Construction



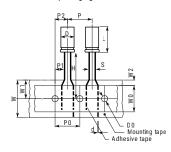


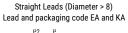
# **Taping for Automatic Insertion Machines**

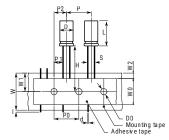




Straight Leads (Diameter: 4 – 8 mm) Lead and packaging code EA and KA





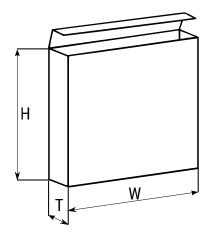


Dimensions (mm)	D	L	S	d	P	P0	P1	P2	W	W0	W1	W2	НО	H1	I	DO	t
Tolerance	+0.5		+0.8/-0.2	±0.05	±1.0	±0.3	±0.7	±1.3	+1/-0.5	±0.5	Maximum	Maximum	±0.75	±0.5	Maximum	±0.2	±0.2
	4	5 – 7	2.5	0.45	12.7	12.7	5.1	6.35	18	12	11	3	16.0	18.5		4	0.7
Formed to 2.5 mm	5	≤ 7	2.5	0.45	12.7	12.7	5.1	6.35	18	12	11	3	16.0	18.5		4	0.7
2.3 111111	Э	> 7	2.5	0.50	12.7	12.7	5.1	6.35	18	12	11	3	16.0	18.5		4	0.7
	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
Formed to 5 mm	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
3 111111		> 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
	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
Ctusionht lands	_	≤ 7	2.5	0.50	12.7	12.7	5.1	6.35	18	12	11	3	18.5			4	0.7
Straight leads	6	> 7	2.5	0.50	12.7	12.7	5.1	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
	8	> 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

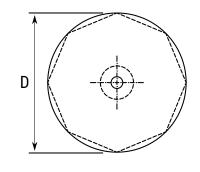


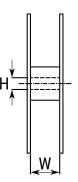
# **Lead Taping & Packaging**











			Ammo		Reel					
Diameter	Length	Н	W	Т	D	Н	<b>W</b> +1/-0.1			
			Maximum	Maximum	±2	±0.5				
4	All	230	340	42						
5	≤ 7	230	340	42						
5	11	275	340	42		30				
6.3	≤ 7	235	340	45						
6.3	11	230	340	48	350		50			
8	≤ 7	270	340	48	350		50			
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	NA	NA	NA			
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.

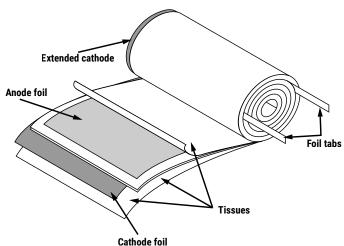
The following tests are applied and may be varied at the request of the customer. In this case the batch, or special procedure, will determine the course of action.

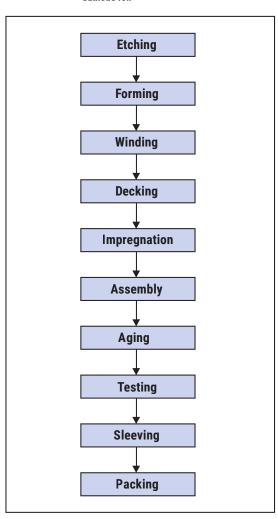
#### Electrical:

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

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