# ESC, +105°C



### **Overview**

The KEMET ESC radial aluminum electrolytic capacitors are designed for low impedance and high frequency applications.

## **Applications**

Typical applications include high frequency switch mode circuits.

### **Benefits**

- · Low impedance
- 1,000 3,000 hour operating life
- Operating temperature of up to 105°C
- Case with  $\emptyset$  D  $\geq$  5 mm
- · Safety vent on the capacitor base



# **Part Number System**

ESC	157	M	6	6R3		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	$H_0 = 16 \pm 0.75$	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	$H_0 = 16 \pm 0.75$	JA				
10	≤ 20	Tape & Reel	Straight	H <sub>0</sub> = 18.5 ±0.75	KA				
		Ar	nmo Pack						
4 - 8	All	Ammo	Formed to 5 mm	H <sub>0</sub> = 16 ±0.75	DA				
4 - 8	All	Ammo	Straight	H <sub>0</sub> = 18.5 ±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	$H_0 = 18.5 \pm 0.75$	EA				
		Contact KEMET for oth	er lead and packaging op	otions					

## **Environmental Compliance**

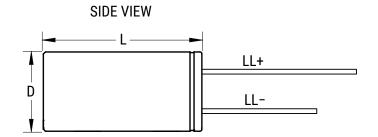
As an environmentally conscious company, KEMET is working continuously with improvements concerning the environmental effects of both our capacitors and their production. In Europe (RoHS Directive) and in some other geographical areas like China, legislation has been put in place to prevent the use of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

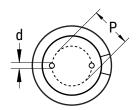
Due to customer requirements, there may appear additional markings such as lead free (LF) or lead-free wires (LFW) on the label.



## **Dimensions - Millimeters**



## TERMINAL END VIEW



Ci O-d-		D		L		P		d	LL+/LL-
Size Code	Nominal	Tolerance	Nominal	Tolerance	Nominal	Tolerance	Nominal	Tolerance	Mininimum
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
Н9	10.0	±0.5	12.5	+1.5/-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
Н5	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
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
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	4.7 – 15,000 μF
Capacitance Tolerance	±20% at 120 Hz/20°C
Rated Voltage	6.3 - 100 VDC
Life Test	2,000 – 3,000 hours (see conditions in Test Method & Performance)
Operating Temperature	-40°C to +105°C
	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	3	3	3	2	2	2
Z (-40°C)/Z (20°C)	8	6	4	4	4	4	4	4

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

Capacitance Range (μF)	50 Hz	120 Hz	300 Hz	1 kHz	10 kHz	100 kHz
4.7	0.30	0.40	0.50	0.70	0.80	1.00
5.6 - 33	0.40	0.50	0.60	0.80	0.90	1.00
34 - 330	0.60	0.70	0.80	0.90	0.95	1.00
331 - 1,000	0.65	0.90	0.90	0.98	1.00	1.00
1,200 - 15,000	0.85	0.90	0.95	0.98	1.00	1.00



### **Test Method & Performance**

Conditions	Load Li	fe Test	Shelf Life Test			
Temperature	105	5°C	105°C			
	Can $\emptyset \ge 5 \times 11, \le 10 \times 12.5 \text{ mm}$ 2,000 hours		1 000 haura			
Test Duration	Can Ø ≥ 10 x 15 mm	3,000 hours	1,000 hours			
	If dimension is down size, endurance will be 1,000 hours less than standard					
Ripple Current	Maximum ripple current s	No ripple current applied				
Voltage	The sum of DC voltage and the p the rated voltage		No voltage applied			
Performance	The following specification	ns will be satisfied when the	capacitor is restored to 20°C:			
Capacitance Change	Within ±20% of the initial value					
Dissipation Factor	Does not exceed 200% of the specified value					
Leakage Current	Does not exceed specified value					

### **Shelf Life**

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

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

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

## **Re-Age (Reforming) Procedure**

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



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

VDC VDC voltage         Capacitance (µF)         Case Size (µF)         120 Hz 20°C (µF)         100 kHz 20°C (µA)         100 kHz 20°C (µA)         100 kHz 20°C (µA)         100 kHz 20°C (µA)         400 kHz 20°C (µA) <t< th=""><th></th><th></th><th>Rated</th><th></th><th>DF</th><th></th><th></th><th></th><th></th></t<>			Rated		DF				
Voltage		VDC		Casa Siza		Z	RC	LC 20°C	
Voltage	VDC	Surge				100 kHz	100 kHz	2 Minutes	Part Number
6.3 8 220 6.3 x11 22 0.220 250 13.9 ESCISTMERBACE) 6.3 8 220 6.3 x11 22 0.220 250 17.0 ESCISTMERBACE) 6.3 8 330 6.3 x11 22 0.230 250 250 20.8 ESCISTMERBACE) 6.3 8 330 6.3 x11 22 0.180 400 20.8 ESCISTMERBACE) 6.3 8 330 6.3 x11 22 0.180 400 20.8 ESCISTMERBACE) 6.3 8 470 *6.3 x11 22 0.180 400 20.8 ESCISTMERBACE) 6.3 8 470 *6.3 x11 22 0.180 400 20.8 ESCISTMERBACE) 6.3 8 470 *8 x11 22 0.140 550 29.6 ESCISTMERBACE) 6.3 8 680 *8 x11 22 0.140 550 29.6 ESCISTMERBACE) 6.3 8 680 *8 x11 22 0.140 550 29.6 ESCISTMERBACE) 6.3 8 680 *8 x11 22 0.150 700 42.8 ESCISTMERBACE) 6.3 8 680 *8 x12 22 0.150 700 42.8 ESCISTMERBACE) 6.3 8 1.000 8 x15 22 0.150 580 63.0 ESCISTMERBACE) 6.3 8 1.000 8 x15 22 0.085 700 63.0 ESCISTMERBACE) 6.3 8 1.000 8 x15 22 0.085 690 63.0 ESCISTMERBACE) 6.3 8 1.000 10 x12.5 22 0.089 690 63.0 ESCISTMERBACE) 6.3 8 1.000 10 x12.5 22 0.089 690 63.0 ESCISTMERBACE) 6.3 8 1.000 10 x12.5 22 0.085 980 94.5 ESCISTMERBACE) 6.3 8 1.000 10 x12.5 22 0.085 980 94.5 ESCISTMERBACE) 6.3 8 1.000 10 x12.5 22 0.085 980 94.5 ESCISTMERBACE) 6.3 8 1.000 10 x12.5 22 0.085 980 94.5 ESCISTMERBACE) 6.3 8 1.000 10 x12.5 22 0.085 980 94.5 ESCISTMERBACE) 6.3 8 1.000 10 x12.5 22 0.085 980 94.5 ESCISTMERBACE) 6.3 8 1.000 10 x12.5 22 0.085 980 94.5 ESCISTMERBACE) 6.3 8 1.500 *8 x15 22 0.085 980 94.5 ESCISTMERBACE) 6.3 8 1.500 *10 x16 22 0.044 1.000 75.6 ESCISTMERBACE) 6.3 8 1.500 *10 x16 22 0.045 1.000 75.6 ESCISTMERBACE) 6.3 8 1.500 *10 x16 22 0.045 1.000 75.6 ESCISTMERBACE] 6.3 8 1.500 *10 x16 22 0.044 1.200 94.5 ESCISTMERBACE] 6.3 8 1.500 *10 x16 22 0.045 1.000 94.5 ESCISTMERBACE] 6.3 8 1.500 *10 x16 22 0.044 1.200 94.5 ESCISTMERBACE] 6.3 8 1.500 *10 x16 22 0.044 1.200 94.5 ESCISTMERBACE] 6.3 8 1.500 *10 x16 22 0.044 1.200 94.5 ESCISTMERBACE] 6.3 8 1.500 *10 x16 22 0.044 1.200 94.5 ESCISTMERBACE] 6.3 8 3.300 13 x25 22 0.035 1.000 94.5 ESCISTMERBACE] 6.3 8 3.300 13 x25 22 0.044 1.200 94.5 ESCISTMERBACE] 6.3 8 3.300 13 x25 22 0.044 1.200 94.5 ESCISTMERBACE] 6.3 8 3.300 13 x25 22 0.044 1.200 94.5 ESCISTMERBACE] 6.3 8 3.300 13 x25 22 0.045 1.0		Voltage		DXL(mm)		20°C (Ω)	105°C (mA)	(µA)	
6.3 8 220 6.3 x11 22 0.320 250 13.9 ESC227M6R3AES) 6.3 8 330 6.3 x11 22 0.220 250 17.0 ESC27M6R3AES) 6.3 8 330 6.3 x11 22 0.380 250 20.8 ESC337M6R3AES) 6.3 8 330 8 x11 22 0.180 440 29.6 ESC37M6R3AES) 6.3 8 470 8 x11 22 0.180 440 29.6 ESC37M6R3AES) 6.3 8 470 8 x11 22 0.140 550 29.6 ESC37M6R3AES) 6.3 8 680 78 x11 22 0.120 580 42.8 ESC567M6R3AES) 6.3 8 680 8 x15 22 0.120 580 42.8 ESC567M6R3AES) 6.3 8 680 8 x15 22 0.120 580 42.8 ESC567M6R3AES) 6.3 8 1.000 8 x15 22 0.010 70 70 42.3 ESC567M6R3AES) 6.3 8 1.000 8 x20 22 0.055 50 60 63.0 ESC16M6R3AES] 6.3 8 1.000 8 x20 22 0.056 800 63.0 ESC16M6R3AES] 6.3 8 1.000 10 x12.5 22 0.069 800 63.0 ESC16M6R3AES] 6.3 8 1.000 10 x12.5 22 0.056 800 63.0 ESC16M6R3AES] 6.3 8 1.000 10 x12.5 22 0.059 800 63.0 ESC16M6R3AES] 6.3 8 1.000 10 x12.5 22 0.059 800 63.0 ESC16M6R3AES] 6.3 8 1.000 10 x12.5 22 0.059 800 63.0 ESC16M6R3AES] 6.3 8 1.000 10 x12.5 22 0.059 800 63.0 ESC16M6R3AES] 6.3 8 1.000 10 x12.5 22 0.059 800 94.5 ESC15M6R3AES] 6.3 8 1.000 10 x12.5 22 0.059 800 94.5 ESC15M6R3AES] 6.3 8 1.000 10 x12.5 22 0.055 1.070 94.5 ESC15M6R3AES] 6.3 8 1.500 10 x12.5 22 0.055 1.070 94.5 ESC15M6R3AES] 6.3 8 1.500 10 x12.5 22 0.055 1.070 94.5 ESC15M6R3AES] 6.3 8 1.500 10 x12.5 22 0.055 1.070 94.5 ESC15M6R3AES] 6.3 8 1.500 10 x12.5 22 0.055 1.070 94.5 ESC15M6R3AES] 6.3 8 1.500 10 x12.5 22 0.055 1.070 94.5 ESC15M6R3AES] 6.3 8 2.200 10 x12.5 22 0.044 1.250 94.5 ESC15M6R3AES] 6.3 8 2.200 10 x12.5 22 0.044 1.250 94.5 ESC15M6R3AES] 6.3 8 2.200 10 x12.5 22 0.044 1.250 94.5 ESC15M6R3AES] 6.3 8 2.200 10 x12.5 22 0.044 1.250 94.5 ESC15M6R3AES] 6.3 8 2.200 10 x12.5 22 0.044 1.250 94.5 ESC15M6R3AES] 6.3 8 2.200 10 x12.5 22 0.044 1.250 94.5 ESC15M6R3AES] 6.3 8 2.200 10 x12.5 22 0.044 1.250 94.5 ESC15M6R3AES] 6.3 8 2.200 10 x12.5 22 0.044 1.250 94.5 ESC15M6R3AES] 6.3 8 2.200 10 x12.5 22 0.044 1.250 94.5 ESC15M6R3AES] 6.3 8 2.200 10 x12.5 22 0.044 1.250 94.5 ESC15M6R3AES] 6.3 8 2.200 10 x12.5 22 0.044 1.250 94.5 ESC15M6R3AES] 6.3 8 2.200 10 x12.5 22 0.044 1.250 94.5 ESC15M6R3AES] 6.3 8 2.200 10 x12.5 22 0.044 1.2	6.3	8		5 x 11	• •	0.420	200	9.5	FSC157M6R3AC3(1)
6.3 8 330 6.3 11 22 0.229 250 17.0 ESC2TMARSPASC) 6.3 8 330 6.3 11 22 0.380 400 20.8 ESC3TMARSPASC) 6.3 8 470 *6.3 11 22 0.180 400 20.8 ESC3TMARSPASC) 6.3 8 470 *6.3 11 22 0.180 400 20.8 ESC3TMARSPASC) 6.3 8 600 *8 11 22 0.140 550 29.6 ESC4TMARSPASC) 6.3 8 600 *8 11 22 0.120 580 42.8 ESC6TMARSPASC) 6.3 8 600 *8 11 22 0.120 580 42.8 ESC6TMARSPASC) 6.3 8 600 *8 11 22 0.000 700 42.8 ESC6TMARSPASC) 6.3 8 600 *8 11 22 0.000 700 42.8 ESC6TMARSPASC) 6.3 8 8 E20 8 x 20 22 0.005 700 42.8 ESC6TMARSPASC) 6.3 8 1,000 8 x 15 22 0.005 700 63.0 ESC10MARSPASC) 6.3 8 1,000 8 x 15 22 0.055 580 63.0 ESC10MARSPASC) 6.3 8 1,000 8 x 15 22 0.065 700 63.0 ESC10MARSPASC) 6.3 8 1,000 8 x 15 22 0.065 800 63.0 ESC10MARSPASC) 6.3 8 1,000 8 x 15 22 0.066 800 63.0 ESC10MARSPASC) 6.3 8 1,000 8 x 15 22 0.066 800 63.0 ESC10MARSPASC) 6.3 8 1,000 8 x 15 22 0.066 800 63.0 ESC10MARSPASC) 6.3 8 1,000 8 x 15 22 0.066 800 63.0 ESC10MARSPASC) 6.3 8 1,000 8 x 15 22 0.066 800 63.0 ESC10MARSPASC) 6.3 8 1,000 8 x 15 22 0.066 800 63.0 ESC10MARSPASC) 6.3 8 1,000 8 x 15 22 0.066 800 63.0 ESC10MARSPASC) 6.3 8 1,000 8 x 20 22 0.055 1.000 94.5 ESC15MARSPASC) 6.3 8 1,000 8 x 20 22 0.055 1.000 94.5 ESC15MARSPASC) 6.3 8 1,000 8 x 20 22 0.055 1.000 94.5 ESC15MARSPASC) 6.3 8 1,000 8 x 20 22 0.055 1.000 94.5 ESC15MARSPASC) 6.3 8 1,000 8 x 20 22 0.055 1.000 94.5 ESC15MARSPASC) 6.3 8 1,000 8 x 20 22 0.055 1.000 94.5 ESC15MARSPASC) 6.3 8 2,000 10 x 20 22 0.054 1.000 94.5 ESC15MARSPASC) 6.3 8 2,000 10 x 20 22 0.054 1.000 94.5 ESC15MARSPASC) 6.3 8 2,000 10 x 20 22 0.054 1.000 94.5 ESC15MARSPASC) 6.3 8 2,000 10 x 20 22 0.054 1.000 94.5 ESC15MARSPASC) 6.3 8 2,000 10 x 20 22 0.054 1.000 94.5 ESC15MARSPASC) 6.3 8 2,000 10 x 20 22 0.054 1.000 94.5 ESC15MARSPASC) 6.3 8 3,000 10 x 20 22 0.054 1.000 94.5 ESC15MARSPASC) 6.3 8 8 2,000 10 x 20 22 0.055 1.000 94.5 ESC15MARSPASC) 6.3 8 8 2,000 10 x 20 22 0.055 1.000 94.5 ESC15MARSPASC) 6.3 8 8 2,000 10 x 20 20 0.050 1.000 94.5 ESC15MARSPASC) 6.3 8 8 2,000 10 x 20 20 0.050 1.000 94.5 ESC15MARSPASC) 6.3 8 8 2,000 10 x 20 20 0.050 1.000 9									ESC227M6R3AE3(1)
6.3 8 470		8	270		22				ESC277M6R3AE3(1)
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6.3 8 660 *** *** *** *** *** *** *** *** ***		-							ESC337M6R3AG3(1)
6.3 8 680 8 x15 22 0.120 580 42.8 ESCRETMRRAGACII 6.3 8 680 8 x15 22 0.005 700 42.8 ESCRETMRRAGACII 6.3 8 8 620 8 x20 22 0.085 750 51.7 ESCRETMRRAGACII 6.3 8 1,000 8 x15 22 0.085 750 63.0 ESCRETMRRAGACII 6.3 8 1,000 8 x15 22 0.085 700 63.0 ESCRETMRRAGACII 6.3 8 1,000 8 x15 22 0.089 700 63.0 ESCRETMRRAGACII 6.3 8 1,000 8 x15 22 0.089 690 63.0 ESCRETMRRAGACII 6.3 8 1,000 10 x12.5 22 0.089 690 63.0 ESCRETMRRAGACII 6.3 8 1,000 10 x16 22 0.089 690 63.0 ESCRETMRRAGACII 6.3 8 1,500 10 x16 22 0.089 690 63.0 ESCRETMRRAGACII 6.3 8 1,500 8 x20 22 0.089 890 94.5 ESCRETMRRAGACII 6.3 8 1,500 8 x20 22 0.089 890 94.5 ESCRETMRRAGACII 6.3 8 1,500 10 x20 22 0.051 890 94.5 ESCRETMRRAGACII 6.3 8 1,500 10 x20 22 0.051 890 94.5 ESCRETMRRAGACII 6.3 8 2,200 10 x20 22 0.051 1,000 94.5 ESCRETMRRAGACII 6.3 8 2,200 10 x20 22 0.051 1,000 94.5 ESCRETMRRAGACII 6.3 8 2,200 10 x20 22 0.051 1,000 138.6 ESCRETMRRAGACII 6.3 8 2,200 10 x20 22 0.051 1,000 138.6 ESCRETMRRAGACII 6.3 8 2,200 10 x20 22 0.051 1,000 138.6 ESCRETMRRAGACII 6.3 8 2,200 10 x20 22 0.051 1,000 138.6 ESCRETMRRAGACII 6.3 8 3,300 13 x20 22 0.044 1,400 138.6 ESCRETMRRAGACII 6.3 8 3,300 13 x25 22 0.045 1,400 138.6 ESCRETMRRAGACII 6.3 8 3,300 13 x25 22 0.045 1,700 0.052 1,700 0.057 1,700 1									ESC477M6R3AE3(1)
6.3 8 8.00 8 x 15 22 0.100 700 42.8 ESC697M6R3A64[6] 6.3 8 8 1,000 8 x 11 22 0.150 580 63.0 ESC108M6R3A64[6] 6.3 8 1,000 8 x 15 22 0.085 700 63.0 ESC108M6R3A64[6] 6.3 8 1,000 10 x 12.5 22 0.085 700 63.0 ESC108M6R3A64[6] 6.3 8 1,000 10 x 12.5 22 0.080 690 63.0 ESC108M6R3A64[6] 6.3 8 1,000 10 x 12.5 22 0.080 690 63.0 ESC108M6R3A64[6] 6.3 8 1,500 8 x 20 22 0.081 800 94.5 ESC128M6R3A64[6] 6.3 8 1,500 8 x 20 22 0.085 980 94.5 ESC128M6R3A64[6] 6.3 8 1,500 8 x 20 22 0.085 800 94.5 ESC158M6R3A64[6] 6.3 8 1,500 10 x 1									` '
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6.3 8 1.500 *10 x 16 22 0.055 1.070 94.5 ESCISSM6R3AH61 6.3 8 2.200 *10 x 20 22 0.044 1.250 94.5 ESCISSM6R3AH61 6.3 8 2.200 *10 x 20 22 0.051 1.220 138.6 ESC22SM6R3AH61 6.3 8 2.200 *10 x 25 22 0.048 1.310 138.6 ESC22SM6R3AH61 6.3 8 2.200 13 x 20 22 0.043 1.450 138.6 ESC22SM6R3AH61 6.3 8 3.300 *10 x 25 22 0.043 1.400 207.9 ESC33SM6R3AH61 6.3 8 3.300 *10 x 25 22 0.043 1.400 207.9 ESC33SM6R3AH61 6.3 8 3.300 13 x 25 22 0.035 1.700 207.9 ESC33SM6R3AH61 6.3 8 3.300 13 x 25 22 0.035 1.700 207.9 ESC33SM6R3AH61 6.3 8 4.700 *13 x 25 22 0.032 1.750 245.7 ESC33SM6R3AH61 6.3 8 4.700 *13 x 25 22 0.032 1.750 245.7 ESC33SM6R3AH61 6.3 8 4.700 *13 x 25 22 0.032 1.550 296.1 ESC47SM6R3AH 6.3 8 4.700 *13 x 25 22 0.032 1.570 296.1 ESC47SM6R3AH 6.3 8 4.700 *13 x 25 22 0.033 1.570 296.1 ESC47SM6R3AH 6.3 8 4.700 *16 x 25 22 0.028 1.000 296.1 ESC47SM6R3AH 6.3 8 8.800 16 x 32 22 0.034 1.500 296.1 ESC47SM6R3AH 6.3 8 8.800 16 x 32 22 0.024 2.000 428.4 ESC6SSM6R3AM2 6.3 8 8.200 16 x 32 22 0.019 2.550 516.6 ESC32SM6R3AM2 6.3 8 8.200 16 x 32 22 0.019 2.550 516.6 ESC32SM6R3AM2 6.3 8 8.200 16 x 32 22 0.019 3.000 945.0 ESC10SM6R3AM3 (1.000 1.0000 1.000 1.0000 1.000 1.000 1.000 1.0	6.3	8	1,500	*8 x 15		0.085	980		ESC158M6R3AG4(1)
6.3 8 2,200 *10 x 20 22 0.044 1,250 94.5 ESCISBM6R3AH4[ 6.3 8 2,200 *10 x 20 22 0.051 1,310 138.6 ESC228M6R3AH5[ 6.3 8 2,200 13 x 20 22 0.043 1,450 138.6 ESC228M6R3AH5[ 6.3 8 3,300 *10 x 25 22 0.043 1,400 2079 ESC338M6R3AH5[ 6.3 8 3,300 13 x 25 22 0.043 1,400 2079 ESC338M6R3AH5[ 6.3 8 3,300 13 x 25 22 0.035 1,700 2079 ESC338M6R3AH5[ 6.3 8 4,700 *13 x 25 22 0.032 1,750 245.7 ESC398M6R3AH5[ 6.3 8 4,700 *13 x 25 22 0.032 1,520 296.1 ESC478M6R3AH5[ 6.3 8 4,700 16 x 25 22 0.032 1,570 296.1 ESC478M6R3AH5[ 6.3 8 4,700 16 x 25 22 0.032 1,570 296.1 ESC478M6R3AH5[ 6.3 8 6,800 16 x 32 22 0.028 1,800 296.1 ESC478M6R3AM7[ 6.3 8 6,800 16 x 32 22 0.028 1,800 296.1 ESC478M6R3AM7[ 6.3 8 8,200 16 x 32 22 0.019 2,550 516.6 ESC28M6R3AM7[ 6.3 8 8,200 16 x 32 22 0.019 2,550 516.6 ESC38M6R3AM7[ 6.3 8 10,000 16 x 36 22 0.019 2,550 630.0 ESC189M6R3AM7[ 10 13 100 5x 11 19 0.420 150 10.0 ESC107M10AC3[ 10 13 120 5x 11 19 0.370 200 12.0 ESC107M10AC3[ 10 13 120 5x 11 19 0.320 20 12.0 ESC107M10AC3[ 10 13 120 5x 11 19 0.320 250 15.0 ESC157M10AC3[ 10 13 470 8x 11 19 0.220 300 22.0 ESC237M10AC3[ 10 13 470 8x 11 19 0.120 550 47.0 ESC477M10AC3[ 10 13 470 8x 11 19 0.020 550 47.0 ESC477M10AC3[ 10 13 680 *8 x 11 19 0.040 550 33.0 ESC337M10AC3[ 10 13 680 *8 x 11 19 0.040 550 33.0 ESC337M10AC3[ 10 13 470 8x 11 19 0.040 550 47.0 ESC477M10AC3[ 10 13 680 *8 x 11 19 0.055 990 10.0 ESC107M10AC3[ 10 13 1,000 10 x 16 19 0.065 990 10.0 ESC107M10AC3[ 10 13 1,000 10 x 16 19 0.065 990 10.0 ESC108M10AG4[ 10 13 1,000 10 x 10 x 10 19 0.095 990 10.0 ESC108M10AG4[ 10 13 1,000 10 x 20 19 0.065 990 10.0 ESC108M10AG4[ 10 13 1,000 10 x 20 19 0.044 1,250 12.0 ESC238M10AG4[ 10 13 1,000 10 x 20 19 0.095 1,450 22.0 ESC238M10AG4[ 10 13 1,000 10 x 20 19 0.095 1,450 22.0 ESC238M10AG4[ 10 13 1,000 10 x 20 19 0.095 1,450 22.0 ESC238M10AG4[ 10 13 1,000 10 x 20 19 0.095 1,450 22.0 ESC238M10AG4[ 10 13 1,000 10 x 20 19 0.095 1,450 22.0 ESC238M10AG4[ 10 13 1,000 10 x 20 19 0.095 1,450 22.0 ESC238M10AG4[ 10 13 1,000 10 x 20 19 0.095 1,500 22.0 ESC238M10AG4[ 10 13 1,000 10 x 20 19 0.095									ESC158M6R3AG6(1)
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6.3 8 2,200									` '
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6.3 8 3,300 13 x 25 22 0.043 1,400 207.9 ESC338M6R3AL9(1 6.3 8 3,900 13 x 25 22 0.035 1,700 207.9 ESC338M6R3AL9(1 6.3 8 4,700 13 x 25 22 0.032 1,750 245.7 ESC398M6R3AL4(1 6.3 8 4,700 13 x 25 22 0.032 1,520 296.1 ESC478M6R3AL4(1 6.3 8 4,700 16 x 25 22 0.033 1,570 296.1 ESC478M6R3AL9(1 6.3 8 4,700 16 x 25 22 0.028 1,800 296.1 ESC478M6R3AL9(1 6.3 8 6,800 16 x 32 22 0.028 1,800 296.1 ESC478M6R3AL9(1 6.3 8 8,200 16 x 32 22 0.024 1,800 296.1 ESC478M6R3AL9(1 6.3 8 1,000 16 x 32 22 0.024 1,000 428.4 ESC68M6R3AM2(1 6.3 8 1,000 16 x 36 22 0.019 2,350 516.6 ESC828M6R3AM2(1 6.3 8 1,000 16 x 36 22 0.019 2,350 516.6 ESC828M6R3AM2(1 10 13 100 5 x 11 19 0.420 150 10.0 ESC109M6R3AM2(1 10 13 100 5 x 11 19 0.420 150 10.0 ESC109M6R3AM2(1 10 13 150 6.3 x 11 19 0.370 200 12.0 ESC127M10AC3(1 10 13 150 6.3 x 11 19 0.320 250 15.0 ESC157M010AC3(1 10 13 150 6.3 x 11 19 0.320 250 15.0 ESC157M010AC3(1 10 13 150 6.3 x 11 19 0.320 250 15.0 ESC157M010AC3(1 10 13 30 8 x 11 19 0.320 250 15.0 ESC157M010AC3(1 10 13 30 8 x 11 19 0.140 550 33.0 ESC37M010AC3(1 10 13 30 8 x 11 19 0.140 550 33.0 ESC37M010AC3(1 10 13 30 8 x 11 19 0.140 550 33.0 ESC37M010AC3(1 10 13 30 8 x 11 19 0.140 550 33.0 ESC37M010AC3(1 10 13 470 8 x 11 19 0.140 550 33.0 ESC37M010AC3(1 10 13 470 8 x 11 19 0.140 550 33.0 ESC37M010AC3(1 10 13 820 10 x 12.5 19 0.065 10 0.0 ESC16M010AC4(1 10 13 820 10 x 15 10 10 0.0 ESC16M010AC4(1 10 13 820 10 x 15 10 10 0.0 ESC16M010AC4(1 10 13 820 10 x 15 10 10 0.0 ESC16M010AC4(1 10 13 1,000 10 x 12.5 19 0.065 10 0.0 ESC16M010AC4(1 10 13 1,000 10 x 12.5 19 0.065 10 0.0 ESC16M010AC4(1 10 13 1,000 10 x 12.5 19 0.065 10 0.0 ESC16M010AC4(1 10 13 1,000 10 x 20 19 0.044 1,250 12.0 ESC27M010AC4(1 10 13 1,000 10 x 20 19 0.044 1,250 12.0 ESC27M010AC4(1 10 13 1,000 10 x 20 19 0.044 1,250 12.0 ESC27M010AC4(1 10 13 1,000 10 x 20 19 0.044 1,250 12.0 ESC27M010AC4(1 10 13 1,200 10 x 20 19 0.044 1,250 12.0 ESC27M010AC4(1 10 13 1,200 10 x 20 19 0.044 1,250 12.0 ESC27M010AC4(1 10 13 1,200 10 x 20 19 0.044 1,250 12.0 ESC27M010AC4(1 10 13 1,200 10 x 20 19 0.044 1,250 12									` '
6.3 8 3,900 13 x 25 22 0.035 1,700 207.9 ESC338M6R3AL4(1 6.3 8 3,900 13 x 25 22 0.032 1,550 245.7 ESC398M6R3AL4(1 6.3 8 4,700 +13 x 30 22 0.033 1,570 296.1 ESC478M6R3AL(1 6.3 8 4,700 +13 x 30 22 0.033 1,570 296.1 ESC478M6R3AL(1 6.3 8 4,700 16 x 25 22 0.028 1,800 296.1 ESC478M6R3AL(1 6.3 8 6,800 16 x 32 22 0.028 1,800 296.1 ESC478M6R3AL(1 6.3 8 6,800 16 x 32 22 0.019 2,350 516.6 ESC28M6R3AM2(1 6.3 8 8,200 16 x 32 22 0.019 2,350 516.6 ESC28M6R3AM2(1 6.3 8 15,000 18 x 36 22 0.019 2,350 516.6 ESC28M6R3AM2(1 6.3 8 15,000 18 x 36 22 0.019 3,000 945.0 ESC159M6R3AM3(1 10 13 120 5 x 11 19 0.420 150 10.0 ESC107M010AC3(1 10 13 120 5 x 11 19 0.370 200 12.0 ESC127M010AC3(1 10 13 120 5 x 11 19 0.370 200 12.0 ESC127M010AC3(1 10 13 220 6.3 x 11 19 0.320 250 15.0 ESC157M010AC3(1 10 13 3 330 8 x 11 19 0.140 550 33.0 22.0 ESC227M010AC3(1 10 13 3 330 8 x 11 19 0.140 550 33.0 ESC337M010AG3(1 10 13 3 330 8 x 11 19 0.140 550 33.0 ESC337M010AG3(1 10 13 3 340 8 x 11 19 0.140 550 33.0 ESC337M010AG3(1 10 13 470 8 x 11 19 0.120 550 47.0 ESC477M010AG3(1 10 13 470 8 x 11 19 0.100 750 47.0 ESC477M010AG3(1 10 13 470 8 x 11 19 0.010 750 47.0 ESC477M010AG3(1 10 13 480 8 x 10 10 10 13 680 18 x 20 19 0.085 800 68.0 ESC687M010AG3(1 10 13 500 8 x 20 19 0.085 800 68.0 ESC687M010AG3(1 10 13 500 8 x 20 19 0.085 990 100.0 ESC108M010AH0(1 10 13 1,000 10 x 16 19 0.066 1080 100.0 ESC108M010AH0(1 10 13 1,000 10 x 16 19 0.065 1080 100.0 ESC108M010AH0(1 10 13 1,000 10 x 20 19 0.075 930 100.0 ESC108M010AH0(1 10 13 1,000 10 x 20 19 0.075 930 100.0 ESC108M010AH0(1 10 13 1,000 10 x 20 19 0.075 930 100.0 ESC108M010AH0(1 10 13 1,000 10 x 20 19 0.075 930 100.0 ESC108M010AH0(1 10 13 1,000 10 x 20 19 0.075 930 100.0 ESC108M010AH0(1 10 13 1,000 10 x 20 19 0.075 930 100.0 ESC108M010AH0(1 10 13 1,000 10 x 20 19 0.075 930 100.0 ESC108M010AH0(1 10 13 1,000 10 x 20 19 0.075 930 100.0 ESC108M010AH0(1 10 13 1,000 10 x 20 19 0.075 930 100.0 ESC108M010AH0(1 10 13 1,000 10 x 20 19 0.075 930 100.0 ESC108M010AH0(1 10 13 1,000 10 x 20 19 0.075 930 100.0 ESC228M010AH0(1 10 13 1,000									` '
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6.3 8 4,700 *13 x 25 22 0.032 1,520 296.1 ESC478M683AL4(1 6.3 8 4,700 16 x 25 22 0.032 1,500 296.1 ESC478M683AL4(1 6.3 8 4,700 16 x 25 22 0.028 1,800 296.1 ESC478M683AL4(1 6.3 8 6,800 16 x 32 22 0.024 2,000 428.4 ESC688M683AM2(1 6.3 8 8,200 16 x 32 22 0.019 2,350 516.6 ESC328M683AM2(1 6.3 8 10,000 16 x 36 22 20 0.019 2,350 516.6 ESC328M683AM2(1 6.3 8 15,000 18 x 36 22 0.019 3,000 945.0 ESC159M683AM2(1 10 13 100 5 x 11 19 0.420 150 10.0 ESC179M10AC3(1 10 13 120 5 x 11 19 0.370 200 12.0 ESC179M10AC3(1 10 13 120 5 x 11 19 0.370 200 12.0 ESC179M10AC3(1 10 13 150 6.3 x 11 19 0.370 200 12.0 ESC179M10AC3(1 10 13 330 8 x 11 19 0.320 300 22.0 ESC277M10AC3(1 10 13 330 8 x 11 19 0.220 300 22.0 ESC277M10AC3(1 10 13 330 8 x 11 19 0.140 550 33.0 ESC379M10AC3(1 10 13 470 8 x 11 19 0.120 550 47.0 ESC477M10AC3(1 10 13 680 *8 x 11 19 0.120 550 47.0 ESC477M10AC3(1 10 13 680 *8 x 11 19 0.110 640 68.0 ESC677M10AC3(1 10 13 680 *8 x 11 19 0.110 640 68.0 ESC677M10AC3(1 10 13 680 *8 x 11 19 0.064 1050 82.0 ESC677M10AC3(1 10 13 680 *8 x 11 19 0.064 1050 82.0 ESC677M10AC3(1 10 13 680 *8 x 11 19 0.064 1050 82.0 ESC677M10AC3(1 10 13 680 *8 x 11 19 0.064 1050 82.0 ESC677M10AC3(1 10 13 680 *8 x 11 19 0.064 1050 82.0 ESC677M10AC3(1 10 13 680 *8 x 11 19 0.064 1050 82.0 ESC677M10AC3(1 10 13 680 *8 x 11 19 0.064 1050 82.0 ESC677M10AC3(1 10 13 680 *8 x 11 19 0.064 1050 82.0 ESC677M10AC3(1 10 13 680 *8 x 11 19 0.064 1050 82.0 ESC677M10AC3(1 10 13 680 *8 x 11 19 0.065 100 640 68.0 ESC677M10AC3(1 10 13 680 *8 x 11 19 0.065 100 640 68.0 ESC677M10AC3(1 10 13 680 *8 x 11 19 0.065 100 640 68.0 ESC677M10AC3(1 10 13 680 *8 x 11 19 0.065 100 640 68.0 ESC677M10AC3(1 10 13 680 *8 x 11 19 0.065 100 640 68.0 ESC677M10AC3(1 10 13 680 *8 x 11 19 0.065 100 640 68.0 ESC677M10AC3(1 10 13 680 *8 x 11 19 0.065 100 640 68.0 ESC677M10AC3(1 10 13 680 *8 x 11 19 0.065 100 640 68.0 ESC677M10AC3(1 10 13 680 *8 x 11 19 0.065 100 640 68.0 ESC677M10AC3(1 10 13 680 *8 x 11 19 0.065 100 640 68.0 ESC677M10AC3(1 10 13 680 *8 x 11 19 0.065 100 640 68.0 ESC677M10AC3(1 10 13 680 *8									` '
6.3 8 4,700 16x25 22 0.033 1,570 296.1 ESC47BMR83ALR/I 6.3 8 6,800 16x32 22 0.024 2,000 428.4 ESC68BMRS3AMZ/I 6.3 8 8,200 16x32 22 0.019 2,350 516.6 ESC82BMRS3AMZ/I 6.3 8 8,200 16x32 22 0.019 2,550 630.0 ESC19BMRS3AMZ/I 6.3 8 10,000 16x36 22 0.019 2,550 630.0 ESC19BMRS3AMZ/I 6.3 8 15,000 18x36 22 0.019 3,000 945.0 ESC19BMRS3AMZ/I 6.3 8 15,000 18x36 22 0.019 3,000 945.0 ESC19BMRS3AMZ/I 10 13 100 5x11 19 0.420 150 10.0 ESC17MIOACG/I 10 13 120 5x11 19 0.370 200 12.0 ESC17MIOACG/I 10 13 150 6.3x11 19 0.320 250 15.0 ESC15PMOIOACG/I 10 13 150 6.3x11 19 0.320 250 15.0 ESC15PMOIOACG/I 10 13 330 8x11 19 0.220 300 22.0 ESC37MIOACG/I 10 13 330 8x11 19 0.220 300 22.0 ESC37MIOACG/I 10 13 470 8x11 19 0.120 550 47.0 ESC47FMIOACG/I 10 13 470 8x11 19 0.120 550 47.0 ESC47FMIOACG/I 10 13 680 *8x11 19 0.110 640 68.0 ESC687MIOACG/I 10 13 680 10x12.5 19 0.085 800 68.0 ESC687MIOACH/I 10 13 820 10x16 19 0.085 800 68.0 ESC687MIOACH/I 10 13 1,000 *10x20 19 0.065 1080 100.0 ESC10BMIOACH/I 10 13 1,000 *10x20 19 0.065 1080 100.0 ESC10BMIOACH/I 10 13 1,000 *10x20 19 0.065 1080 100.0 ESC10BMIOACH/I 10 13 1,000 *10x20 19 0.065 1080 100.0 ESC10BMIOACH/I 10 13 1,000 *10x20 19 0.065 1080 100.0 ESC10BMIOACH/I 10 13 1,000 *10x20 19 0.065 1080 100.0 ESC10BMIOACH/I 10 13 1,000 *10x20 19 0.065 1080 100.0 ESC10BMIOACH/I 10 13 1,000 *10x20 19 0.050 1,100 100.0 ESC10BMIOACH/I 10 13 1,000 *10x20 19 0.050 1,100 100.0 ESC10BMIOACH/I 10 13 1,000 *10x20 19 0.039 1,450 20.0 ESC32BMIOACH/I 10 13 1,000 *10x20 19 0.039 1,450 20.0 ESC32BMIOACH/I 10 13 1,200 10x20 19 0.039 1,450 20.0 ESC32BMIOACH/I 10 13 2,200 *10x20 19 0.039 1,450 20.0 ESC32BMIOACH/I 10 13 2,200 *10x20 19 0.038 1,600 20.0 ESC32BMIOACH/I 10 13 3,300 *10x20 19 0.038 1,600 20.0 ESC32BMIOACH/I 10 13 3,300 *10x20 19 0.038 1,600 20.0 ESC32BMIOACH/I 10 13 3,300 *10x20 19 0.038 1,600 20.0 ESC32BMIOACH/I 10 13 3,300 *10x20 19 0.038 1,600 20.0 ESC32BMIOACH/I 10 13 3,300 *10x20 19 0.038 1,600 20.0 ESC32BMIOACH/I 10 13 4,700 16x25 19 0.028 2,000 330.0 ESC33BMIOACH/I 10 13 4,700 16x25 19 0.024 2,200 470.0 ESC		-							` '
6.3 8 4,700 16 x 25 22 0.028 1,800 296.1 ESC478MGR3AM/(1 6.3 8 6,800 16 x 32 22 0.019 2,350 516.6 ESC828MGR3AM/(1 6.3 8 10,000 16 x 36 22 0.019 2,350 630.0 ESC28MGR3AM/(1 6.3 8 15,000 18 x 36 22 0.019 3,000 945.0 ESC159MGR3AM/(1 10 13 100 5 x 11 19 0.420 150 10.0 ESC109MGR3AM/(1 10 13 120 5 x 11 19 0.370 200 12.0 ESC127M010AG/(1 10 13 150 6.3 x 11 19 0.320 250 15.0 ESC157M010AG/(1 10 13 220 6.3 x 11 19 0.220 300 22.0 ESC227M010AG/(1 10 13 330 8 x 11 19 0.220 300 22.0 ESC227M010AG/(1 10 13 330 8 x 11 19 0.220 300 22.0 ESC227M010AG/(1 10 13 330 8 x 11 19 0.140 550 33.0 ESC337M010AG/(1 10 13 3470 8 x 11 19 0.120 550 47.0 ESC477M010AG/(1 10 13 470 8 x 15 19 0.100 750 47.0 ESC477M010AG/(1 10 13 470 8 x 15 19 0.100 750 47.0 ESC477M010AG/(1 10 13 680 *8 x 11 19 0.110 640 68.0 ESC687M010AG/(1 10 13 680 10 x 12.5 19 0.085 800 68.0 ESC687M010AH/(1 10 13 820 10 x 15.5 19 0.085 800 68.0 ESC687M010AH/(1 10 13 820 10 x 15.5 19 0.065 1080 100.0 ESC108M010AH/(1 10 13 1,000 8 x 20 19 0.065 1080 100.0 ESC108M010AH/(1 10 13 1,000 8 x 20 19 0.065 1080 100.0 ESC108M010AH/(1 10 13 1,000 10 x 10 x 10 x 10 x 10 x 10 x 10			· ·						` '
6.3 8 6,800 16 x 32 22 0.024 2,000 428.4 ESC68BMGR3AM2(1 6.3 8 10,000 16 x 36 22 0.019 2,550 630.0 ESC19MGR3AM2(1 6.3 8 15,000 18 x 36 22 0.019 2,550 630.0 ESC19MGR3AM2(1 10 13 100 5 x 11 19 0.420 150 10.0 ESC17M010AC3(1 10 13 150 6.3 x 11 19 0.370 200 12.0 ESC17M010AC3(1 10 13 150 6.3 x 11 19 0.370 200 12.0 ESC17M010AC3(1 10 13 150 6.3 x 11 19 0.320 250 15.0 ESC17M010AC3(1 10 13 220 6.3 x 11 19 0.220 300 22.0 ESC27M010AC3(1 10 13 300 8 x 11 19 0.140 550 33.0 ESC37M010AC3(1 10 13 470 8 x 11 19 0.120 550 47.0 ESC477M010AC3(1 10 13 470 8 x 11 19 0.120 550 47.0 ESC477M010AC3(1 10 13 470 8 x 15 19 0.100 750 47.0 ESC477M010AC3(1 10 13 680 *8 x 11 19 0.110 640 68.0 ESC687M010AG3(1 10 13 680 *8 x 11 19 0.010 750 47.0 ESC477M010AC3(1 10 13 680 *8 x 11 19 0.010 750 47.0 ESC477M010AC3(1 10 13 680 *8 x 11 19 0.010 750 47.0 ESC477M010AC3(1 10 13 680 *8 x 11 19 0.010 750 47.0 ESC477M010AC3(1 10 13 680 *8 x 11 19 0.010 750 47.0 ESC477M010AC3(1 10 13 680 *8 x 11 19 0.010 750 47.0 ESC477M010AC3(1 10 13 680 *8 x 11 19 0.010 750 47.0 ESC477M010AC3(1 10 13 680 *8 x 11 19 0.010 750 47.0 ESC477M010AC3(1 10 13 680 *8 x 10 10 x 12.5 19 0.085 800 68.0 ESC687M010AC3(1 10 13 1,000 8 x 20 19 0.065 1080 100.0 ESC108M010AC3(1 10 13 1,000 *10 x 12.5 19 0.055 930 100.0 ESC108M010AC3(1 10 13 1,000 *10 x 12.5 19 0.055 930 100.0 ESC108M010AC3(1 10 13 1,000 10 x 20 19 0.055 990 100.0 ESC108M010AC3(1 10 13 1,200 10 x 20 19 0.044 1,250 120.0 ESC128M010AC3(1 10 13 2,200 *10 x 20 19 0.044 1,250 120.0 ESC128M010AC3(1 10 13 3,300 *10 x 20 19 0.039 1,450 220.0 ESC228M010AC3(1 10 13 3,300 *10 x 20 19 0.039 1,450 220.0 ESC228M010AC3(1 10 13 3,300 *10 x 20 19 0.039 1,450 220.0 ESC228M010AC3(1 10 13 3,300 *10 x 20 19 0.039 1,450 220.0 ESC228M010AC3(1 10 13 3,300 *10 x 20 19 0.039 1,450 220.0 ESC228M010AC3(1 10 13 3,300 *10 x 20 19 0.039 1,450 220.0 ESC228M010AC3(1 10 13 3,300 *10 x 20 19 0.039 1,450 220.0 ESC228M010AC3(1 10 13 3,300 *10 x 20 19 0.039 1,450 220.0 ESC228M010AC3(1 10 13 3,300 *10 x 20 19 0.038 1,600 470.0 ESC478M010AC3(1 10 13 4,700 *13 x 25			· ·						ESC478M6R3AM7(1)
6.3 8 8,200 16 x 32 22 0.019 2,350 516.6 ESC828M6R3AM2(1 6.3 8 10,000 16 x 36 22 0.019 2,550 630.0 ESC109M6R3AM3(1 6.3 8 15,000 18 x 36 22 0.019 3,000 945.0 ESC159M6R3AM2(1 10 13 100 5x 11 19 0.420 150 10.0 ESC107M010AC3(1 10 13 120 5x 11 19 0.370 200 12.0 ESC127M010AC3(1 10 13 150 6.3 x 11 19 0.320 250 15.0 ESC157M010AC3(1 10 13 220 6.3 x 11 19 0.220 300 22.0 ESC227M010AC3(1 10 13 330 8x 11 19 0.140 550 33.0 ESC337M010AC3(1 10 13 470 8x 11 19 0.120 550 47.0 ESC477M010AC3(1 10 13 470 8x 15 19 0.100 750 47.0 ESC477M010AC3(1 10 13 470 8x 15 19 0.100 750 47.0 ESC477M010AC3(1 10 13 8820 10 x 16 19 0.085 800 68.0 ESC687M010AC3(1 10 13 820 10 x 16 19 0.085 800 68.0 ESC687M010AC3(1 10 13 13 680 8x 20 19 0.085 800 68.0 ESC687M010AC3(1 10 13 13 1,000 8x 20 19 0.065 1080 100.0 ESC108M010AC3(1 10 13 13 1,000 10 x 16 19 0.065 1080 100.0 ESC108M010AC3(1 10 13 1,000 10 x 10 x 12.5 19 0.085 990 100.0 ESC108M010AC3(1 10 13 1,000 10 x 20 19 0.085 990 100.0 ESC108M010AC3(1 10 13 1,000 10 x 20 19 0.085 990 100.0 ESC108M010AC3(1 10 13 1,000 10 x 20 19 0.085 990 100.0 ESC108M010AC3(1 10 13 1,000 10 x 20 19 0.085 990 100.0 ESC108M010AC3(1 10 13 1,000 10 x 20 19 0.085 990 100.0 ESC108M010AC3(1 10 13 1,000 10 x 20 19 0.039 1,450 220.0 ESC228M010AH3(1 10 13 1,500 10 x 20 19 0.039 1,450 220.0 ESC228M010AH3(1 10 13 1,500 10 x 20 19 0.039 1,450 220.0 ESC228M010AH3(1 10 13 1,500 10 x 20 19 0.039 1,450 220.0 ESC228M010AH3(1 10 13 1,500 10 x 20 19 0.039 1,450 220.0 ESC228M010AH3(1 10 13 1,500 10 x 20 19 0.039 1,450 220.0 ESC228M010AH3(1 10 13 1,500 10 x 20 19 0.039 1,450 220.0 ESC228M010AH3(1 10 13 1,500 10 x 20 19 0.039 1,450 220.0 ESC228M010AH3(1 10 13 1,500 10 x 20 19 0.039 1,450 220.0 ESC228M010AH3(1 10 13 1,500 10 x 20 19 0.039 1,450 220.0 ESC228M010AH3(1 10 13 1,500 10 x 20 19 0.039 1,450 220.0 ESC228M010AH3(1 10 13 1,500 10 x 20 19 0.039 1,450 220.0 ESC228M010AH3(1 10 13 1,500 10 x 20 19 0.039 1,450 220.0 ESC228M010AH3(1 10 13 1,500 10 x 20 19 0.039 1,450 220.0 ESC228M010AH3(1 10 13 1,500 10 x 20 19 0.039 1,450 220.0 ESC228M010AH3(1 1		8							ESC688M6R3AM2(1)
6.3 8 15,000 18 x 36 22 0.019 3,000 945.0 ESC159M6R3ANZ(10 13 100 5x 11 19 0.420 150 10.0 ESC107M010AC3(1 10 13 120 5x 11 19 0.370 200 12.0 ESC157M010AC3(1 10 13 150 6.3 x 11 19 0.320 250 15.0 ESC157M010AC3(1 10 13 220 6.3 x 11 19 0.320 250 15.0 ESC157M010AC3(1 10 13 3030 8x 11 19 0.220 300 22.0 ESC227M010AC3(1 10 13 330 8x 11 19 0.140 550 33.0 ESC37M010AC3(1 10 13 470 8x 11 19 0.140 550 47.0 ESC477M010AC3(1 10 13 470 8x 11 19 0.120 550 47.0 ESC477M010AC3(1 10 13 470 8x 11 19 0.110 550 47.0 ESC477M010AC3(1 10 13 470 8x 11 19 0.110 540 68.0 ESC67M010AC3(1 10 13 680 *8 x 11 19 0.110 640 68.0 ESC67M010AC3(1 10 13 680 *8 x 11 19 0.110 640 68.0 ESC67M010AC3(1 10 13 680 10 x 12.5 19 0.085 800 68.0 ESC67M010AC3(1 10 13 680 10 x 12.5 19 0.085 800 68.0 ESC67M010AC3(1 10 13 820 10 x 16 19 0.064 1050 82.0 ESC827M010AC3(1 10 13 1,000 8x 20 19 0.065 1080 100.0 ESC108M010AC3(1 10 13 1,000 *10 x 15 19 0.075 930 100.0 ESC108M010AC3(1 10 13 1,000 *10 x 15 19 0.075 930 100.0 ESC108M010AC3(1 10 13 1,000 *10 x 10 10 x	6.3	8	8,200	16 x 32	22	0.019		516.6	ESC828M6R3AM2(1)
10									ESC109M6R3AM3(1)
10									ESC159M6R3AN2(1)
10									` '
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10         13         680         10 x 12.5         19         0.085         800         68.0         ESC687M010AH9(1)           10         13         820         10 x 16         19         0.064         1050         82.0         ESC827M010AH8(1)           10         13         1,000         8 x 20         19         0.065         1080         100.0         ESC108M010A66(1)           10         13         1,000         *10 x 12.5         19         0.075         930         100.0         ESC108M010AH9(1)           10         13         1,000         10 x 16         19         0.085         990         100.0         ESC108M010AH4(1)           10         13         1,000         10 x 20         19         0.050         1,100         100.0         ESC108M010AH4(1)           10         13         1,200         10 x 20         19         0.044         1,250         120.0         ESC128M010AH4(1)           10         13         1,500         10 x 20         19         0.039         1,450         150.0         ESC228M010AH4(1)           10         13         2,200         *10 x 20         19         0.047         1,330         220.0         ESC228M010AH4(1									ESC687M010AG3(1)
10         13         820         10 x 16         19         0.064         1050         82.0         ESC827M010AH8(1           10         13         1,000         8 x 20         19         0.065         1080         100.0         ESC108M010AG6(1)           10         13         1,000         *10 x 12.5         19         0.075         930         100.0         ESC108M010AH9(1)           10         13         1,000         10 x 16         19         0.085         990         100.0         ESC108M010AH4(1)           10         13         1,000         10 x 20         19         0.050         1,100         100.0         ESC128M010AH4(1)           10         13         1,200         10 x 20         19         0.044         1,250         120.0         ESC128M010AH4(1)           10         13         1,500         10 x 20         19         0.039         1,450         150.0         ESC128M010AH4(1)           10         13         2,200         *10 x 20         19         0.047         1,330         220.0         ESC228M010AH4(1)           10         13         2,200         *10 x 25         19         0.039         1,450         220.0         ESC228M010AH									ESC687M010AH9(1)
10         13         1,000         *10 x 12.5         19         0.075         930         100.0         ESC108M010AH9(1)           10         13         1,000         10 x 16         19         0.085         990         100.0         ESC108M010AH8(1)           10         13         1,000         10 x 20         19         0.050         1,100         100.0         ESC108M010AH4(1)           10         13         1,200         10 x 20         19         0.044         1,250         120.0         ESC128M010AH4(1)           10         13         1,500         10 x 20         19         0.039         1,450         150.0         ESC128M010AH4(1)           10         13         2,200         *10 x 20         19         0.047         1,330         220.0         ESC228M010AH4(1)           10         13         2,200         *10 x 25         19         0.039         1,450         220.0         ESC228M010AH5(1)           10         13         2,200         13 x 20         19         0.038         1,600         220.0         ESC228M010AH3(1)           10         13         3,300         *10 x 30         19         0.038         1,600         220.0         ESC3	10								ESC827M010AH8(1)
10         13         1,000         10 x 16         19         0.085         990         100.0         ESC108M010AH8(1)           10         13         1,000         10 x 20         19         0.050         1,100         100.0         ESC108M010AH4(1)           10         13         1,200         10 x 20         19         0.044         1,250         120.0         ESC128M010AH4(1)           10         13         1,500         10 x 20         19         0.039         1,450         150.0         ESC158M010AH4(1)           10         13         2,200         *10 x 20         19         0.047         1,330         220.0         ESC228M010AH4(1)           10         13         2,200         *10 x 25         19         0.039         1,450         220.0         ESC228M010AH5(1)           10         13         2,200         13 x 20         19         0.039         1,450         220.0         ESC228M010AH5(1)           10         13         3,300         *10 x 30         19         0.038         1,600         220.0         ESC228M010AH6(1)           10         13         3,300         *10 x 30         19         0.032         2,000         330.0         ESC3			· ·						ESC108M010AG6(1)
10         13         1,000         10 x 20         19         0.050         1,100         100.0         ESC108M010AH4[1]           10         13         1,200         10 x 20         19         0.044         1,250         120.0         ESC128M010AH4[1]           10         13         1,500         10 x 20         19         0.039         1,450         150.0         ESC158M010AH4[1]           10         13         2,200         *10 x 25         19         0.047         1,330         220.0         ESC228M010AH5[1]           10         13         2,200         *10 x 25         19         0.039         1,450         220.0         ESC228M010AH5[1]           10         13         2,200         13 x 20         19         0.038         1,600         220.0         ESC228M010AH5[1]           10         13         3,300         *10 x 30         19         0.038         1,600         220.0         ESC38M010AH6[1]           10         13         3,300         *10 x 30         19         0.032         2,000         330.0         ESC38M010AH6[1]           10         13         4,700         *13 x 25         19         0.028         2,000         330.0         ESC									ESC108M010AH9(1)
10         13         1,200         10 x 20         19         0.044         1,250         120.0         ESC128M010AH4(1)           10         13         1,500         10 x 20         19         0.039         1,450         150.0         ESC158M010AH4(1)           10         13         2,200         *10 x 20         19         0.047         1,330         220.0         ESC228M010AH4(1)           10         13         2,200         *10 x 25         19         0.039         1,450         220.0         ESC228M010AH5(1)           10         13         2,200         13 x 20         19         0.038         1,600         220.0         ESC228M010AH3(1)           10         13         3,300         *10 x 30         19         0.032         2,000         330.0         ESC338M010AH4(1)           10         13         3,300         13 x 25         19         0.028         2,000         330.0         ESC338M010AH4(1)           10         13         4,700         *13 x 25         19         0.028         1,860         470.0         ESC478M010AH4(1)           10         13         4,700         16 x 25         19         0.024         2,200         470.0         ES			·						ESC108M010AH8(1)
10         13         1,500         10 x 20         19         0.039         1,450         150.0         ESC158M010AH4(1)           10         13         2,200         *10 x 20         19         0.047         1,330         220.0         ESC228M010AH4(1)           10         13         2,200         *10 x 25         19         0.039         1,450         220.0         ESC228M010AH5(1)           10         13         2,200         13 x 20         19         0.038         1,600         220.0         ESC228M010AH3(1)           10         13         3,300         *10 x 30         19         0.032         2,000         330.0         ESC338M010AH4(1)           10         13         3,300         13 x 25         19         0.028         2,000         330.0         ESC338M010AH4(1)           10         13         4,700         *13 x 25         19         0.028         1,860         470.0         ESC478M010AH4(1)           10         13         4,700         16 x 25         19         0.024         2,200         470.0         ESC478M010AM7(1)           10         13         6,800         16 x 36         19         0.019         2,550         680.0         ES			· ·				· ·		` '
10         13         2,200         *10 x 20         19         0.047         1,330         220.0         ESC228M010AH4(1           10         13         2,200         *10 x 25         19         0.039         1,450         220.0         ESC228M010AH5(1           10         13         2,200         13 x 20         19         0.038         1,600         220.0         ESC228M010AL3(1)           10         13         3,300         *10 x 30         19         0.032         2,000         330.0         ESC338M010AH6(1           10         13         3,300         13 x 25         19         0.028         2,000         330.0         ESC338M010AL4(1)           10         13         4,700         *13 x 25         19         0.028         1,860         470.0         ESC478M010AL4(1)           10         13         4,700         16 x 25         19         0.024         2,200         470.0         ESC478M010AM7(1)           10         13         6,800         16 x 36         19         0.019         2,550         680.0         ESC688M010AM3(1)									
10         13         2,200         *10 x 25         19         0.039         1,450         220.0         ESC228M010AH5(1           10         13         2,200         13 x 20         19         0.038         1,600         220.0         ESC228M010AL3(1)           10         13         3,300         *10 x 30         19         0.032         2,000         330.0         ESC338M010AH6(1)           10         13         3,300         13 x 25         19         0.028         2,000         330.0         ESC338M010AL4(1)           10         13         4,700         *13 x 25         19         0.028         1,860         470.0         ESC478M010AH4(1)           10         13         4,700         16 x 25         19         0.024         2,200         470.0         ESC478M010AM7(1)           10         13         6,800         16 x 36         19         0.019         2,550         680.0         ESC688M010AM3(1)									` '
10         13         2,200         13 x 20         19         0.038         1,600         220.0         ESC228M010AL3(1)           10         13         3,300         *10 x 30         19         0.032         2,000         330.0         ESC338M010AH6(1)           10         13         3,300         13 x 25         19         0.028         2,000         330.0         ESC338M010AL4(1)           10         13         4,700         *13 x 25         19         0.028         1,860         470.0         ESC478M010AL4(1)           10         13         4,700         16 x 25         19         0.024         2,200         470.0         ESC478M010AM7(1)           10         13         6,800         16 x 36         19         0.019         2,550         680.0         ESC688M010AM3(1)									` '
10         13         3,300         *10 x 30         19         0.032         2,000         330.0         ESC338M010AH6(1           10         13         3,300         13 x 25         19         0.028         2,000         330.0         ESC338M010AL4(1)           10         13         4,700         *13 x 25         19         0.028         1,860         470.0         ESC478M010AL4(1)           10         13         4,700         16 x 25         19         0.024         2,200         470.0         ESC478M010AM7(1)           10         13         6,800         16 x 36         19         0.019         2,550         680.0         ESC688M010AM3(1)							·		, ,
10     13     3,300     13 x 25     19     0.028     2,000     330.0     ESC338M010AL4(1)       10     13     4,700     *13 x 25     19     0.028     1,860     470.0     ESC478M010AL4(1)       10     13     4,700     16 x 25     19     0.024     2,200     470.0     ESC478M010AM7(1)       10     13     6,800     16 x 36     19     0.019     2,550     680.0     ESC688M010AM3(1)									` '
10     13     4,700     *13 x 25     19     0.028     1,860     470.0     ESC478M010AL4(1)       10     13     4,700     16 x 25     19     0.024     2,200     470.0     ESC478M010AM7(1)       10     13     6,800     16 x 36     19     0.019     2,550     680.0     ESC688M010AM3(1)									ESC338M010AL4(1)
10         13         4,700         16 x 25         19         0.024         2,200         470.0         ESC478M010AM7(1           10         13         6,800         16 x 36         19         0.019         2,550         680.0         ESC688M010AM3(1									ESC478M010AL4(1)
10 13 6,800 16 x 36 19 0.019 2,550 680.0 ESC688M010AM3(1		13							ESC478M010AM7(1)
VDC         VDC Surge         Rated Capacitance         Case Size         DF         Z         RC         LC         Part Number	10		6,800	16 x 36	19	0.019	2,550	680.0	ESC688M010AM3(1)
	VDC	VDC Surge	Rated Capacitance	Case Size	DF	Z	RC	LC	Part Number

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

 $<sup>^{1}</sup>$  When capacitance exceeds 1,000 μF, the DF value (%) is increased by 2% for every additional 1,000 μF.

<sup>\*</sup> Dimension is down size, Endurance will be less 1,000 hours than standard.



Table 1 - Ratings & Part Number Reference cont.

		Rated		DF				
	VDC	Capacitance	Case Size	120 Hz	Z	RC	LC 20°C	
VDC	Surge				100 kHz	100 kHz	2 Minutes	Part Number
	Voltage	120 Hz 20°C	D x L (mm)	20°C	20°C (Ω)	105°C (mA)	(μ <b>A</b> )	
		(µF)		(tan δ %) <sup>1</sup>		700 0 (1111.4)	(F7	
10	13	8,200	18 x 36	19	0.019	2,800	820.0	ESC828M010AN2(1)
16 16	20 20	56 68	5 x 11 5 x 11	16 16	0.630 0.420	100 150	9.0 10.9	ESC566M016AC3(1) ESC686M016AC3(1)
16	20	100	5 x 11	16	0.370	200	16.0	ESC107M016AC3(1)
16	20	120	6.3 x 11	16	0.320	250	19.2	ESC127M016AE3(1)
16	20	150	6.3 x 11	16	0.220	300	24.0	ESC157M016AE3(1)
16	20	220	8 x 11	16	0.140	550	35.2	ESC227M016AG3(1)
16	20	330	8 x 11	16	0.120	550	52.8	ESC337M016AG3(1)
16	20	330	8 x 15	16	0.100	750	52.8	ESC337M016AG4(1)
16	20	330	10 x 12.5	16	0.080	688	52.8	ESC337M016AH9(1)
16 16	20 20	470 470	8 x 15 10 x 12.5	16 16	0.093 0.085	730 800	75.2 75.2	ESC477M016AG4(1) ESC477M016AH9(1)
16	20	680	10 x 12.3	16	0.064	1,050	108.8	ESC687M016AH8(1)
16	20	820	10 x 10	16	0.044	1,100	131.2	ESC827M016AH4(1)
16	20	1,000	*10 x 16	16	0.043	1,140	160.0	ESC108M016AH8(1)
16	20	1,000	10 x 20	16	0.039	1,250	160.0	ESC108M016AH4(1)
16	20	1,200	*10 x 25	16	0.042	1,310	192.0	ESC128M016AH5(1)
16	20	1,200	13 x 20	16	0.038	1,450	192.0	ESC128M016AL3(1)
16	20	1,500	*10 x 20	16	0.045	1,200	240.0	ESC158M016AH4(1)
16	20 20	1,500	13 x 20	16 16	0.034	1,600	240.0 352.0	ESC158M016AL3(1)
16 16	20 20	2,200 2,200	*10 x 30 *13 x 20	16	0.032 0.033	1,780 1,720	352.0 352.0	ESC228M016AH6(1) ESC228M016AL3(1)
16	20	2,200	13 x 25	16	0.033	2,000	352.0	ESC228M016AL4(1)
16	20	3,300	*13 x 40	16	0.026	2,200	528.0	ESC338M016AL7(1)
16	20	3,300	16 x 25	16	0.024	2,200	528.0	ESC338M016AM7(1)
16	20	4,700	16 x 36	16	0.019	2,550	752.0	ESC478M016AM3(1)
16	20	6,800	18 x 36	16	0.019	2,800	1088.0	ESC688M016AN2(1)
25	32	10	5 x 11	14	0.550	50	3.0	ESC106M025AC3(1)
25	32 32	47	5 x 11 5 x 11	14 14	0.450	150 150	11.8 14.0	ESC476M025AC3(1)
25 25	32	56 68	6.3 x 11	14	0.420 0.370	200	17.0	ESC566M025AC3(1) ESC686M025AE3(1)
25	32	100	6.3 x 11	14	0.220	250	25.0	ESC107M025AE3(1)
25	32	120	8 x 11	14	0.200	300	30.0	ESC127M025AG3(1)
25	32	150	8 x 11	14	0.140	550	37.5	ESC157M025AG3(1)
25	32	220	8 x 11	14	0.120	550	55.0	ESC227M025AG3(1)
25	32	220	8 x 15	14	0.100	750	55.0	ESC227M025AG4(1)
25	32	330	*8 x 15	14	0.100	660	82.5	ESC337M025AG4(1)
25	32 32	330 330	8 x 20	14 14	0.069	800 900	82.5 82.5	ESC337M025AG6(1)
25 25	32	470	10 x 16 8 x 20	14	0.086 0.067	800	82.5 117.5	ESC337M025AH8(1) ESC477M025AG6(1)
25	32	470	10 x 16	14	0.064	1050	117.5	ESC477M025AH8(1)
25	32	470	10 x 12.5	14	0.086	760	117.5	ESC477M025AH9(1)
25	32	680	10 x 20	14	0.039	1,100	170.0	ESC687M025AH4(1)
25	32	820	10 x 20	14	0.039	1,250	205.0	ESC827M025AH4(1)
25	32	1,000	*10 x 20	14	0.047	1,160	250.0	ESC108M025AH4(1)
25	32	1,000	*10 x 25	14	0.042	1,310	250.0	ESC108M025AH5(1)
25 25	32 32	1,000 1,200	13 x 20 13 x 25	14 14	0.038 0.035	1,450 1,600	250.0 300.0	ESC108M025AL3(1) ESC128M025AL4(1)
25	32	1,500	*13 x 30	14	0.032	1,750	375.0	ESC128M025AL4(1) ESC158M025AL8(1)
25	32	1,500	16 x 25	14	0.028	2,000	375.0	ESC158M025AM7(1)
25	32	2,200	*13 x 30	14	0.029	1,810	550.0	ESC228M025AL8(1)
25	32	2,200	*16 x 25	14	0.032	1,660	550.0	ESC228M025AM7(1)
25	32	2,200	16 x 32	14	0.024	2,200	550.0	ESC228M025AM2(1)
25	32	3,300	*16 x 36	14	0.019	2,540	825.0	ESC338M025AM3(1)
25 25	32 32	3,300 4,700	18 x 36 18 x 36	14 14	0.019 0.019	2,550 2,800	825.0 1175.0	ESC338M025AN2(1) ESC478M025AN2(1)
VDC	VDC Surge	Rated Capacitance	Case Size	DF	Z	RC	LC	Part Number

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

 $<sup>^{1}</sup>$  When capacitance exceeds 1,000 μF, the DF value (%) is increased by 2% for every additional 1,000 μF.

<sup>\*</sup> Dimension is down size, Endurance will be less 1,000 hours than standard.



Table 1 - Ratings & Part Number Reference cont.

	VDC	Rated Capacitance	Case Size	DF 120 Hz	Z	RC	LC 20°C	
VDC	Surge	120 Hz 20°C	D x L (mm)	20°C	100 kHz	100 kHz	2 Minutes	Part Number
	Voltage	(μF)	D X L (IIIIII)	(tan δ %) <sup>1</sup>	20°C (Ω)	105°C (mA)	(μ <b>A</b> )	
25	32	6,800	18 x 36	14	0.010	0.000	1700.0	F00(00M00FAN0/1)
35	32 44	4.7	5 x 11	12	0.019 1.200	2,800 115	3.0	ESC688M025AN2(1) ESC475M035AC3(1)
35	44	6.8	5 x 11	12	1.000	120	3.0	ESC685M035AC3(1)
35	44	10	5 x 11	12	0.900	140	3.5	ESC106M035AC3(1)
35	44	15	5 x 11	12	0.690	170	5.3	ESC156M035AC3(1)
35	44	22	5 x 11	12	0.600	190	7.7	ESC226M035AC3(1)
35 35	44 44	33 47	5 x 11 6.3 x 11	12 12	0.580 0.039	200 250	11.6 16.5	ESC336M035AC3(1) ESC476M035AE3(1)
35	44	68	6.3 x 11	12	0.039	300	23.8	ESC686M035AE3(1)
35	44	100	6.3 x 11	12	0.180	300	35.0	ESC107M035AE3(1)
35	44	100	8 x 11	12	0.140	450	35.0	ESC107M035AG3(1)
35	44	120	8 x 11	12	0.130	550	42.0	ESC127M035AG3(1)
35	44	150	8 x 15	12	0.100	650	52.5	ESC157M035AG4(1)
35 35	44 44	220 220	8 x 15 10 x 12.5	12 12	0.100 0.069	650 800	77.0 77.0	ESC227M035AG4(1) ESC227M035AH9(1)
35	44	330	*10 x 12.3	12	0.052	900	115.5	ESC337M035AH8(1)
35	44	330	10 x 20	12	0.044	1,050	115.5	ESC337M035AH4(1)
35	44	470	10 x 20	12	0.039	1,300	164.5	ESC477M035AH4(1)
35	44	680	13 x 20	12	0.038	1,400	238.0	ESC687M035AL3(1)
35	44	820	13 x 20	12	0.034	1,550	287.0	ESC827M035AL3(1)
35 35	44 44	1,000 1,200	13 x 25 16 x 25	12 12	0.029 0.028	1,700 1,900	350.0 420.0	ESC108M035AL4(1) ESC128M035AM7(1)
35	44	1,500	16 x 25	12	0.024	2,100	525.0	ESC158M035AM7(1)
35	44	2,200	*16 x 32	12	0.021	2,300	770.0	ESC228M035AM2(1)
35	44	2,200	16 x 36	12	0.019	2,550	770.0	ESC228M035AM3(1)
35	44	3,300	18 x 36	12	0.019	2,800	1155.0	ESC338M035AN2(1)
50	63	4.7	5 x 11	10	2.000	115	3.0	ESC475M050AC3(1)
50 50	63 63	6.8 10	5 x 11 5 x 11	10 10	1.850 1.700	120 140	3.4 5.0	ESC685M050AC3(1) ESC106M050AC3(1)
50	63	15	5 x 11	10	1.200	180	7.5	ESC156M050AC3(1)
50	63	22	5 x 11	10	0.700	200	11.0	ESC226M050AC3(1)
50	63	33	6.3 x 11	10	0.600	250	16.5	ESC336M050AE3(1)
50	63	47	6.3 x 11	10	0.520	300	23.5	ESC476M050AE3(1)
50 50	63 63	68 100	8 x 11 8 x 11	10 10	0.350 0.290	450 450	34.0 50.0	ESC686M050AG3(1) ESC107M050AG3(1)
50	63	100	8 x 15	10	0.250	550	50.0	ESC107M050AG3(1) ESC107M050AG4(1)
50	63	120	8 x 20	10	0.210	650	60.0	ESC127M050AG6(1)
50	63	150	10 x 12.5	10	0.160	800	75.0	ESC157M050AH9(1)
50	63	220	*10 x 16	10	0.100	1,050	110.0	ESC227M050AH8(1)
50	63	220	10 x 25	10	0.068	1,050	110.0	ESC227M050AH5(1)
50 50	63 63	330 470	10 x 20 *10 x 20	10 10	0.072 0.075	1,300 1,390	165.0 235.0	ESC337M050AH4(1) ESC477M050AH4(1)
50	63	470	13 x 20	10	0.073	1,400	235.0	ESC477M050AH4(1)
50	63	680	13 x 25	10	0.050	1,550	340.0	ESC687M050AL4(1)
50	63	820	16 x 25	10	0.040	1,700	410.0	ESC827M050AM7(1)
50	63	1,000	16 x 25	10	0.039	1,900	500.0	ESC108M050AM7(1)
50 50	63 62	1,200	16 x 32	10 10	0.025	2,100	600.0 750.0	ESC128M050AM2(1)
50 50	63 63	1,500 2,200	16 x 36 18 x 40	10 10	0.025 0.025	2,550 2,800	1100.0	ESC158M050AM3(1) ESC228M050AN3(1)
63	79	4.7	5 x 11	9	2.200	115	3.0	ESC475M063AC3(1)
63	79	6.8	5 x 11	9	2.000	120	4.3	ESC685M063AC3(1)
63	79	10	5 x 11	9	1.850	140	6.3	ESC106M063AC3(1)
63	79	15	5 x 11	9	1.700	200	9.5	ESC156M063AC3(1)
63	79 70	22	6.3 x 11	9	1.200	250	13.9	ESC226M063AE3(1)
63 63	79 79	33 47	6.3 x 11 8 x 11	9 9	0.900 0.700	300 450	20.8 29.6	ESC336M063AE3(1) ESC476M063AG3(1)
VDC	VDC Surge	Rated Capacitance	Case Size	DF	Z	RC	LC	Part Number

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

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

<sup>\*</sup> Dimension is down size, Endurance will be less 1,000 hours than standard.



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 %) <sup>1</sup>	Z 100 kHz 20°C (Ω)	RC 100 kHz 105°C (mA)	LC 20°C 2 Minutes (µA)	Part Number
63	79	68	8 x 11	9	0.520	550	42.8	ESC686M063AG3(1)
63	79	100	8 x 20	9	0.350	650	63.0	ESC107M063AG6(1)
63	79	120	10 x 16	9	0.300	800	75.6	ESC127M063AH8(1)
63	79	150	10 x 16	9	0.200	1,050	94.5	ESC157M063AH8(1)
63	79	220	10 x 20	9	0.150	1,300	138.6	ESC227M063AH4(1)
63	79	330	13 x 20	9	0.100	1,400	207.9	ESC337M063AL3(1)
63	79	470	13 x 25	9	0.064	1,550	296.1	ESC477M063AL4(1)
63	79	680	16 x 25	9	0.052	1,700	428.4	ESC687M063AM7(1)
63	79	820	16 x 32	9	0.048	1,900	516.6	ESC827M063AM2(1)
63	79	1,000	16 x 32	9	0.042	2,100	630.0	ESC108M063AM2(1)
63	79	1,200	16 x 36	9	0.036	2,550	756.0	ESC128M063AM3(1)
63	79	1,500	18 x 36	9	0.033	2,800	945.0	ESC158M063AN2(1)
100	125	4.7	5 x 11	8	2.000	120	4.7	ESC475M100AC3(1)
100	125	6.8	5 x 11	8	1.850	140	6.8	ESC685M100AC3(1)
100	125	10	6.3 x 11	8	1.500	200	10.0	ESC106M100AE3(1)
100	125	15	6.3 x 11	8	1.200	250	15.0	ESC156M100AE3(1)
100	125	22	8 x 11	8	0.790	300	22.0	ESC226M100AG3(1)
100	125	33	8 x 15	8	0.590	450	33.0	ESC336M100AG4(1)
100	125	47	10 x 16	8	0.350	550	47.0	ESC476M100AH8(1)
100	125	68	10 x 20	8	0.240	650	68.0	ESC686M100AH4(1)
100	125	100	13 x 20	8	0.180	800	100.0	ESC107M100AL3(1)
100	125	120	13 x 25	8	0.150	1,050	120.0	ESC127M100AL4(1)
100	125	150	13 x 25	8	0.110	1,300	150.0	ESC157M100AL4(1)
100	125	220	16 x 25	8	0.071	1,400	220.0	ESC227M100AM7(1)
100	125	330	16 x 32	8	0.049	1,550	330.0	ESC337M100AM2(1)
100	125	470	18 x 36	8	0.038	1,700	470.0	ESC477M100AN2(1)
VDC	VDC Surge	Rated Capacitance	Case Size	DF	Z	RC	LC	Part Number

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

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

<sup>\*</sup> Dimension is down size, Endurance will be less 1,000 hours than standard.



## **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)

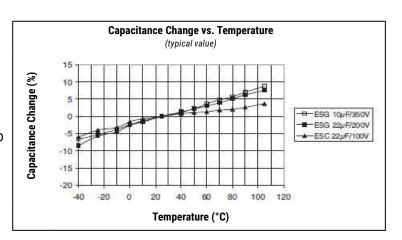


Simplified equivalent circuit diagram of an electrolytic capacitor

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**

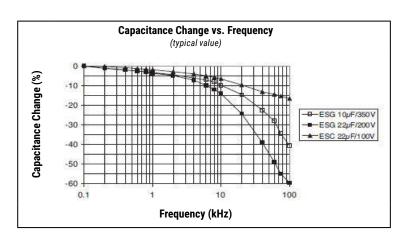
Capacitance of an electrolytic capacitor depends upon temperature: with decreasing temperature the viscosity of the electrolyte increases, thereby reducing its conductivity. Capacitance will decrease if temperature decreases. Furthermore, temperature drifts cause armature dilatation and, therefore, capacitance 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.

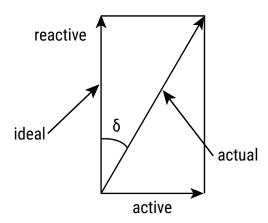
$$C = \frac{1}{2\pi \text{ fZ}} \frac{\text{C = capacitance (F)}}{\text{f = frequency (Hz)}}$$
$$Z = impedance (\Omega)$$





#### 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.

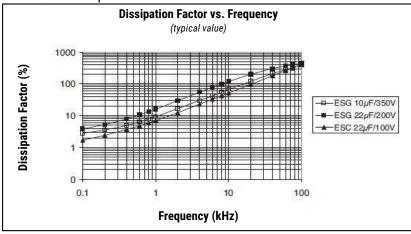


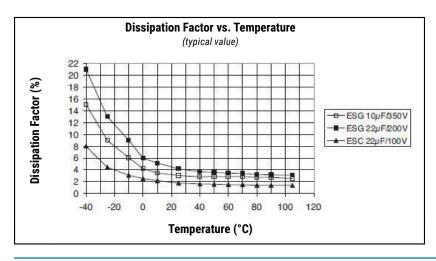
Tan  $\delta$  is measured with the same set-up used for the series capacitance ESC.

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

ESC = Equivalent series capacitance

ESR = Equivalent series resistance



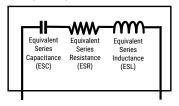




#### **Equivalent Series Inductance (ESL)**

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

Capacitor Equivalent Internal Circuit

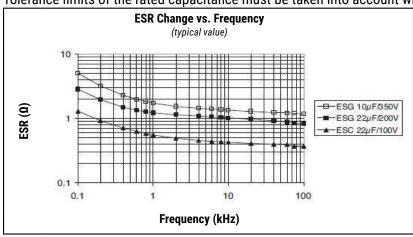


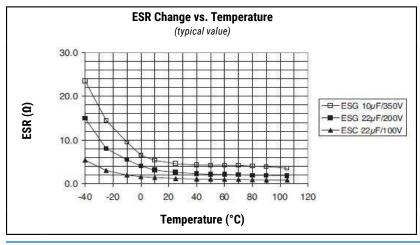
#### **Equivalent Series Resistance (ESR)**

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:

$$ESR = \frac{\tan \delta}{2\pi f \ ESC} = \frac{\tan \delta}{2\pi f \ ESC} = \frac{\tan \delta}{\sin \delta} = Dissipation \ factor \\ ESC = Equivalent \ series \ capacitance \ (F) \\ f = Frequency \ (Hz)$$

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

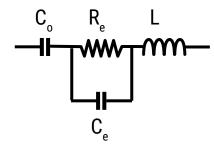






#### Impedance (Z)

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



C<sub>o</sub> = Aluminum oxide capacitance (surface and thickness of the dielectric.)

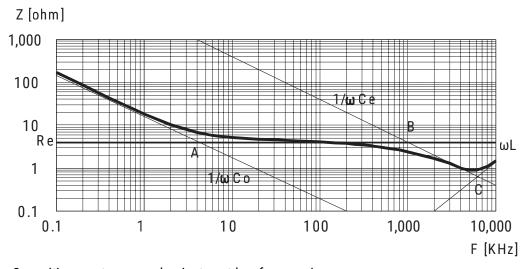
 $R_e^-$  = Resistance of electrolyte and paper mixture (other resistances not depending on the frequency are not considered: tabs, plates, etc.)

C<sub>e</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:



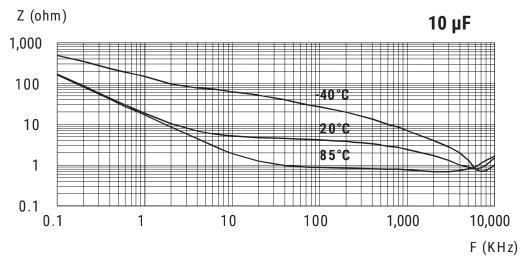
- Capacitive reactance predominates at low frequencies.
- With increasing frequency, capacitive reactance  $Xc = 1/\omega C_o$  decreases until it reaches the order of magnitude of electrolyte resistance  $R_o(A)$
- At even higher frequencies, resistance of the electrolyte predominates: Z = R<sub>a</sub> (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  $C_a \approx 0.01 C_a$ .



#### Impedance (Z) cont.

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<sub>e</sub> must be as little as possible. However, R<sub>e</sub> 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.



#### Leakage Current (LC) cont.

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:



V<sub>F</sub> = Forming voltage

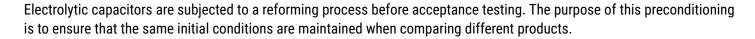
If this level is exceeded, a large quantity of heat and gas will be generated and the capacitor could be damaged.

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.





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 x  $2^{(To-T)/10}$ 

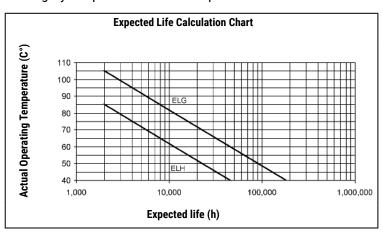
Where:

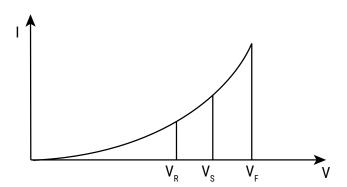
L: Expected life

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.





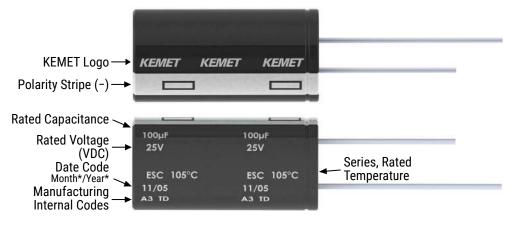


# **Packaging Quantities**

			Вι	ılk	Auto-ir	sertion		
Size Code	Diameter (mm)	Length (mm)	Standard Leads	Cut Leads	Ammo	Tape & Reel		
C3	5.0	11.0	10,000	15,000	2,000	2,600		
E3	6.3	11.0	10,000	15,000	2,000	2,200		
G3	8.0	11.0	6,000	8,000	1,000	1,500		
G4	8.0	15.0	5,000	5,000	1,000	1,500		
G6	8.0	20.0	4,000	4,000	1,000	1,500		
Н9	10.0	12.5	4,000	4,000	700	1,200		
Н8	10.0	16.0	3,000	4,000	700	1,200		
H4	10.0	20.0	2,400	3,000	700	1,200		
H5	10.0	25.0	2,400	2,400	500			
Н6	10.0	30.0	2,000	2,000	500			
L3	13.0	20.0	2,000	2,000	500			
L4	13.0	25.0	1,600	1,600	500			
L8	13.0	30.0	1,200	1,200	500			
L7	13.0	40.0	1,000	500	500			
М7	16.0	25.0	1,000	500	300			
M2	16.0	32.0	800	500	300			
М3	16.0	36.0	600	500	300			
N2	18.0	36.0	500	500				
N3	18.0	40.0	500	500				



## **Marking**



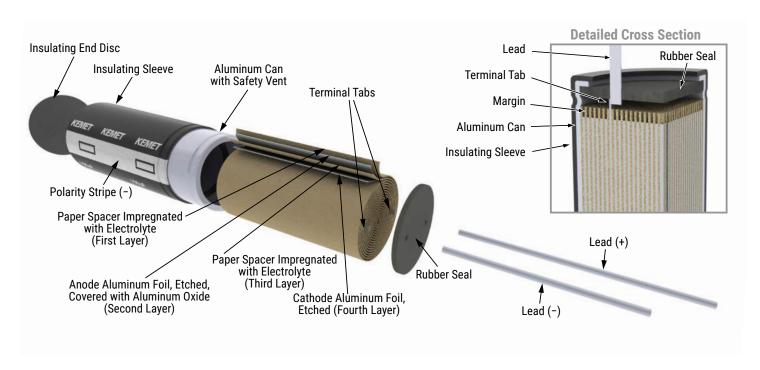
\*Y = Year

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

#### \*M = Month

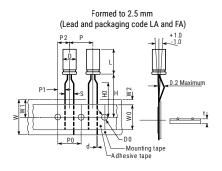
Code	01	02	03	04	05	06	07	08	09	10	11	12
Month	1	2	3	4	5	6	7	8	9	10	11	12

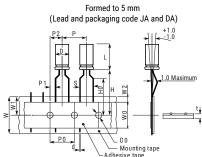
### Construction



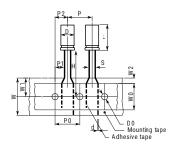


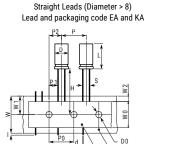
# **Taping for Automatic Insertion Machines**





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



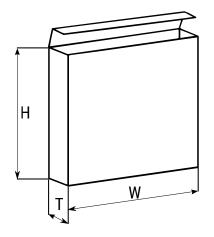


Dimensions (mm)	D	L	S	d	P	P0	P1	P2	W	W0	W1	W2	НО	H1	I	DO	t
Tolerance	+0.5		+0.8/-0.2	±0.05	±1.0	±0.3	±0.7	±1.3	+1/-0.5	±0.5	Maximum	Maximum	±0.75	±0.5	Maximum	±0.2	±0.2
	4	5 - 7	2.5	0.45	12.7	12.7	5.1	6.35	18	12	11	3	16.0	18.5		4	0.7
Formed to 2.5 mm	5	≤ 7	2.5	0.45	12.7	12.7	5.1	6.35	18	12	11	3	16.0	18.5		4	0.7
2.5 111111	3	> 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
F	3	>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
	U	> 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
	0	> 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
	3	> 7	2.0	0.50	12.7	12.7	5.35	6.35	18	12	11	3	18.5			4	0.7
Ctraight loads	6	≤ 7	2.5	0.50	12.7	12.7	5.1	6.35	18	12	11	3	18.5			4	0.7
Straight leads	U	> 7	2.5	0.50	12.7	12.7	5.1	6.35	18	12	11	3	18.5			4	0.7
	8	≤ 7	3.5	0.50	12.7	12.7	4.6	6.35	18	12	11	3	18.5			4	0.7
	0	> 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

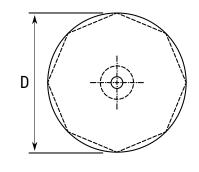


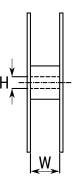
# **Lead Taping & Packaging**











			Ammo		Reel					
Diameter	Length	Н	W	T	D	Н	W			
			Maximum	Maximum	±2	±0.5	+1/-0.1			
4	All	230	340	42						
5	≤ 7	230	340	42		30				
5	11	275	340	42						
6.3	≤ 7	235	340	45						
6.3	11	230	340	48	350		EO			
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.

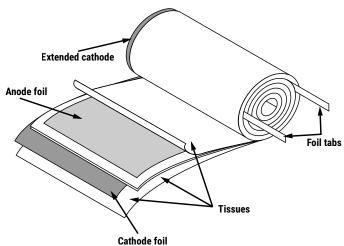
The following tests are applied and may be varied at the request of the customer. In this case the batch, or special procedure, will determine the course of action.

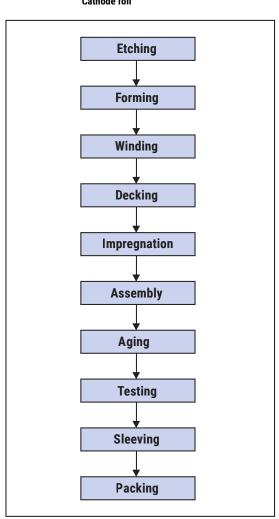
#### Electrical:

- · 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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