

AC Motor Start Aluminum Electrolytic Capacitors



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Electronic Components
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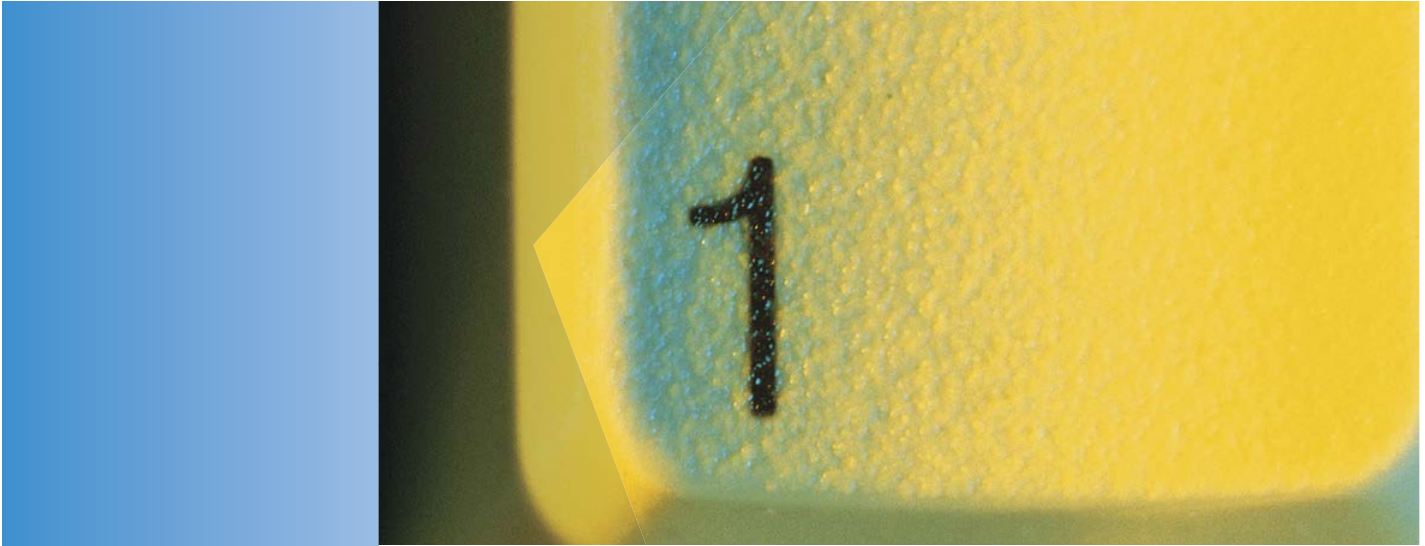
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One world. One source. One KEMET.

When you partner with KEMET, our entire global organization provides you with the coordinated service you need. No bouncing from supplier to supplier. No endless phone calls and web browsing. We're your single, integrated source for electronic component solutions worldwide.

Less hassles. More solutions.

Our commitment to product quality and on-time delivery has helped customers succeed for over 90 years. There's a reason KEMET components can be found in defense and aerospace equipment. Our reputation is built on a history of consistency, reliability and service.

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KEMET offers a level of responsiveness that far surpasses any other supplier. Our passion for customer service is evident throughout our global sales organization, which offers localized support bolstered by our worldwide logistics capabilities. Whether you need rush samples, technical assistance, in-person consultation, accelerated custom design, design collaboration or prototype services, we have a solution.



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When you need custom products delivered on a tight schedule, you can trust KEMET. Get direct design consultation from global experts, who help you get the job done on time and within budget.

Working for a better world.

KEMET is dedicated to economically, environmentally and socially sustainable development. We've adopted the Electronic Industry Code of Conduct (EICC) to address all aspects of corporate responsibility. Our manufacturing facilities have won numerous environmental excellence awards and recognitions, and our supply chain is certified. We believe doing the right thing is in everyone's interest.

About KEMET.

KEMET Corporation is a leading global supplier of electronic components. We offer our customers the broadest selection of capacitor technologies in the industry across multiple dielectrics, along with an expanding range of electromechanical devices, and electromagnetic compatibility solutions. Our vision is to be the preferred supplier of electronic component solutions for customers demanding the highest standards of quality, delivery and service.

Overview

KEMET's MS/MD Series of aluminum electrolytic capacitors are designed for intermittent duty only and capable of withstanding the AC voltage applied to the motor during starting. The capacitor construction is comprised of either double anode or O-style (double anode and floating cathode) windings, which are housed in a molded plastic case. KEMET's MD Series is VDE approved to IEC 60252-2 for the defined ratings.

Applications

KEMET's MS/MD Series is a range of aluminium electrolytic capacitors specifically designed for AC operation which helps to start the motor by providing a leading current to the auxiliary winding. The capacitor is not permanently connected to the winding of the motor and is usually switched off automatically after starting.

Benefits

- Intermittent AC motor starting
- 6.3 mm double amp tags (quick connect types)
- VDE approved to IEC 60252-2



Part Number System

080	MS	12	AA	M	A	1	STD
Capacitance Code (µF)	Rating	Voltage (VAC)	Size Code	Manufacturing Style	Capacitance Tolerance	Terminal Code	Version
Example: 080 = 80 µF 120 = 120 µF	MS = Motor start single rating MD = Motor start dual rating	12 = 120 22 = 220 26 = 260	See Dimension Table	M = Molded case	A = -0% +25% K = ±10%	1 = Double amp tag	STD = Standard

Performance Characteristics

Item	Performance Characteristics	
Series	MD (Dual voltage rating)	MS (Single voltage rating)
Capacitance Range	25 – 750 μ F	25 – 750 μ F
Rated Voltage	120 – 360 VAC 50 Hz	120 – 260 VAC 50 Hz
Temperature Range	-20°C to +70°C	-20°C to +60°C
Capacitance Tolerance	$\pm 10\%$, -0% +25%	$\pm 10\%$, -0% +25%
Operational Lifetime	500 hours at +70°C, 1.1 V_R (specified duty cycle)	500 hours at +60°C, 1.1 V_R (specified duty cycle)
Shelf Life	2 years	2 years
Standards	IEC 60252-2: AC Motor Capacitors - Part 2: Motor Start Capacitors	

VDE Approvals to IEC 60252-2

Rated Voltage	220 V	260 V
Capacitor Type	MD	MD
Capacitance (μ F)	(Note 1)	(Note 2)
30	AA	
40	AA AB	AB
50	AA AB	AB
60	AA AB	AB
70	AB	AB
80	AB AC	AB
90	AC	AC
100	AC	AC
120	AC	AC
125	AC	AC

Note 1: Duty cycles approved

220 V @ $SD = 3$ & $ED = 1.7\%$

300 V @ $SD = 1$ & $ED = 0.1\%$

Note 2: Duty cycles approved

260 V @ $SD = 3$ & $ED = 1.7\%$ (40 – 125 μ F)

330 V @ $SD = 1$ & $ED = 0.55\%$ (40 – 125 μ F)

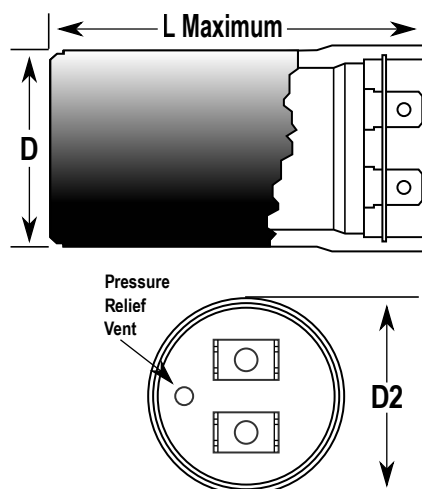
360 V @ $SD = 1$ & $ED = 0.33\%$ (90 – 125 μ F)

General approval notes:

• Valid for both $\pm 10\%$ and -0 +25% tolerance.

• Valid for intermediate capacitance. Values in increments of 1 μ F between 30 μ F and 100 μ F, and in increments of 5 μ F between 100 μ F and 125 μ F.

Dimensions – Millimeters



Size Code	Dimensions in mm		
	D	D2	L
	±0.5	±0.5	Maximum
AA	38	39	75
AB	38	39	90
AC	38	39	116

Power Factor

The tangent of the loss angle for motor start capacitors shall not exceed 0.1 and shall be calculated as follows:

$$\tan \delta = \frac{W}{V \times I} = \frac{\text{true watts}}{\text{apparent watts}}$$

Duty Cycle

The standard rating is 1.67% or 1/60th full time and corresponds to a maximum duty of 20 starts, each of three seconds duration per hour. It is expressed as 3/1.67 (a 3 minute cycle with 1.67% duration during which the capacitor may be energized). If the same capacitor is to be used for a duty cycle of 60 starts per hour the cycle duration will be 1 minute. The operation time per cycle will then have to be reduced to 1.67% of 1 minute (i.e. 1 second). Alternative duty cycles are available on request.

Presence of Run Capacitor

When the motor is fitted with both starting and run capacitors, consideration should be given to fitting of the appropriate discharge resistor to the starting capacitor. This is to protect the run capacitor from damage through discharge of the starting capacitor.

Container Form

Cylindrical mouldings, meeting creepage and clearance distances, according to IEC 60335–1 and flammability ratings according to UL94–V1.

Discharge Resistors

A discharge resistor may be fitted to a motor start capacitor to prevent electrical overstress of the capacitor and/or for safety reasons. In accordance with IEC 60252, the resistor value should be such that it reduces the voltage on the capacitor, from the line voltage to less than 50 V within 60 seconds. The resistor value may be approximated as follows: $R(\text{k}\Omega) = T/\text{Rated Capacitance } (\mu\text{F})$

DC Voltage	T
120	50000
220	32000
260	30000
280	28000
330	26000

Resistor Value (kOhms)	Wattage
5.6	2W
15	2W
33	0.5W
56	1W
82	2W
100	1W

Environmental Compliance

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

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

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



RoHS Compliant

Table 1A – Ratings & Part Number Reference

VAC	Rated Capacitance		Capacitance Tolerance	Case Size D x L (mm)	Duty Cycle		Part Number	Approval	
	Minimum (μF)	Maximum (μF)			120 V _{RMS}	150 V _{RMS}		VDE	CQC
120	25	325	-0/+25%	38 x 75	1.67%		(1)MS12AAMA1STD	-	-
120	25	360	±10%	38 x 75	1.67%		(1)MS12AAMK1STD	-	-
120	85	460	-0/+25%	38 x 90	1.67%		(1)MS12ABMA1STD	-	-
120	90	510	±10%	38 x 90	1.67%		(1)MS12ABMK1STD	-	-
120	120	670	-0/+25%	38 x 116	1.67%		(1)MS12ACMA1STD	-	-
120	130	750	±10%	38 x 116	1.67%		(1)MS12ACMK1STD	-	-
120	25	325	-0/+25%	38 x 75	1.67%	0.55%	(1)MD12AAMA1STD	-	x
120	25	360	±10%	38 x 75	1.67%	0.55%	(1)MD12AAMK1STD	-	x
120	85	460	-0/+25%	38 x 90	1.67%	0.55%	(1)MD12ABMA1STD	-	x
120	90	510	±10%	38 x 90	1.67%	0.55%	(1)MD12ABMK1STD	-	x
120	120	670	-0/+25%	38 x 116	1.67%	0.55%	(1)MD12ACMA1STD	-	x
120	130	750	±10%	38 x 116	1.67%	0.55%	(1)MD12ACMK1STD	-	x
VAC	Rated Capacitance		Capacitance Tolerance	Case Size	Duty Cycle		Part Number	VDE	CQC

(1) Insert capacitance code.

Table 1B – Ratings & Part Number Reference

VAC	Rated Capacitance		Capacitance Tolerance	Case Size D x L (mm)	Duty Cycle		Part Number	Approval	
	Minimum (μF)	Maximum (μF)			220 V _{RMS}	300 V _{RMS}		VDE	CQC
220	30	65	-0/+25%	38 x 75	1.67%		(1)MS22AAMA1STD	-	-
220	30	70	±10%	38 x 75	1.67%		(1)MS22AAMK1STD	-	-
220	40	90	-0/+25%	38 x 90	1.67%		(1)MS22ABMA1STD	-	-
220	40	100	±10%	38 x 90	1.67%		(1)MS22ABMK1STD	-	-
220	55	130	-0/+25%	38 x 116	1.67%		(1)MS22ACMA1STD	-	-
220	65	150	±10%	38 x 116	1.67%		(1)MS22ACMK1STD	-	-
220	30	60	-0/+25%	38 x 75	1.67%	0.10%	(1)MD22AAMA1STD	x	x
220	30	60	±10%	38 x 75	1.67%	0.10%	(1)MD22AAMK1STD	x	x
220	40	80	-0/+25%	38 x 90	1.67%	0.10%	(1)MD22ABMA1STD	x	x
220	40	80	±10%	38 x 90	1.67%	0.10%	(1)MD22ABMK1STD	x	x
220	80	125	-0/+25%	38 x 116	1.67%	0.10%	(1)MD22ACMA1STD	x	x
220	80	125	±10%	38 x 116	1.67%	0.10%	(1)MD22ACMK1STD	x	x
VAC	Rated Capacitance		Capacitance Tolerance	Case Size	Duty Cycle		Part Number	VDE	CQC

(1) Insert capacitance code.

Table 1C – Ratings & Part Number Reference

VAC	Rated Capacitance		Capacitance Tolerance	Case Size D x L (mm)	Duty Cycle			Part Number	Approval	
	Minimum (µF)	Maximum (µF)			260 V _{RMS}	330 V _{RMS}	360 V _{RMS}		VDE	CQC
260	25	55	-0/+25%	38 x 75	1.67%			(1)MS26AAMA1STD	-	-
260	25	60	±10%	38 x 75	1.67%			(1)MS26AAMK1STD	-	-
260	35	75	-0/+25%	38 x 90	1.67%			(1)MS26ABMA1STD	-	-
260	35	85	±10%	38 x 90	1.67%			(1)MS26ABMK1STD	-	-
260	50	110	-0/+25%	38 x 116	1.67%			(1)MS26ACMA1STD	-	-
260	55	125	±10%	38 x 116	1.67%			(1)MS26ACMK1STD	-	-
260	25	50	-0/+25%	38 x 75	1.67%	0.55%		(1)MD26AAMA1STD	x	x
260	25	55	±10%	38 x 75	1.67%	0.55%		(1)MD26AAMK1STD	x	x
260	40	80	-0/+25%	38 x 90	1.67%	0.55%		(1)MD26ABMA1STD	x	x
260	40	80	±10%	38 x 90	1.67%	0.55%		(1)MD26ABMK1STD	x	x
260	90	125	-0/+25%	38 x 116	1.67%	0.55%	0.33%	(1)MD26ACMA1STD	x	x
260	90	125	±10%	38 x 116	1.67%	0.55%	0.33%	(1)MD26ACMK1STD	x	x
VAC	Rated Capacitance		Capacitance Tolerance	Case Size	Duty Cycle			Part Number	VDE	CQC

(1) Insert capacitance code.

Print Detail

- KEMET Logo
- Rated capacitance
- Capacitance tolerance
- Rated voltage
- Climatic Category
- Article code
- Date of manufacture & Batch No.

Construction

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.

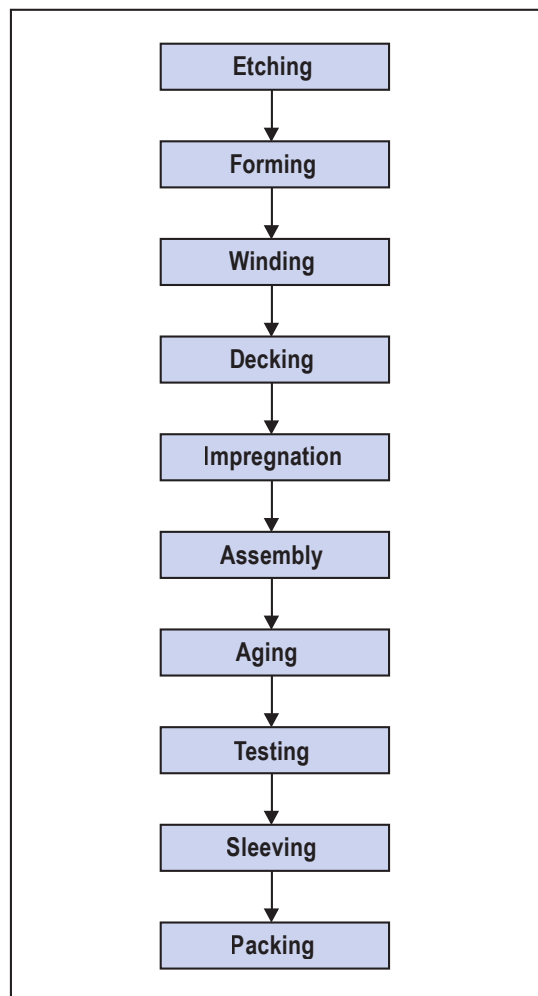
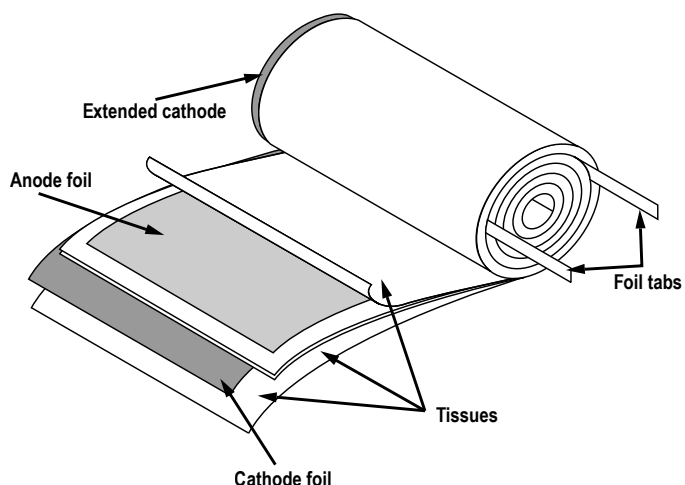
The following tests are applied and may be varied at the request of the customer. In this case the batch, or special procedure, will determine the course of action.

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



Product Safety

THESE NOTES SHOULD BE READ IN CONJUNCTION WITH THE PRODUCT DATA SHEET. FAILURE TO OBSERVE THE RATINGS AND THE INFORMATION ON THIS SHEET MAY RESULT IN A SAFETY HAZARD.

Warning

When potentially lethal voltages e.g. 30V a.c. (r.m.s) or 60V d.c. are applied to the terminals of this product, the use of a hazard warning label is recommended. In the case of motor start capacitors they meet the requirements of British Standard Specifications BS.5267: 1976 and reference should be made to Appendix C -Guide for installation and operation.

1. Electrolyte

Aluminum electrolytic capacitors contain liquids (electrolytes) which can be hazardous. The electrolytes are conducting solutions of organic and/or boric acid, neutralized with amines or ammonia, in a variety of solvents. The major solvents are butyrolactone and ethylene glycol. Co-solvents e.g. N-methyl pyrrolidone may be present. Inorganic or organo-phosphates are present in low concentration. The physical, chemical and toxicological properties of the electrolytes are largely determined by the solvents, as summarized below:

Physical Properties

1. Low viscosity—typically 5 – 50 cp at 25°C
2. Combustible—flash points 95 – 120°C
3. Low vapor pressure– < 20 mm Hg at 25°C

Chemical properties

1. Non-corrosive
2. Can be aggressive to many plastics, lacquers and resins
3. Totally soluble in hot water

Toxicology

The electrolytes are moderately toxic, with LD50 values in the range 1.5 – 2 g/Kg. Skin exposure can cause drying and defatting. Severe irritation may be caused to the mucous membranes, particularly the eyes, where conjunctivitis may result.

Safety Precautions

In the event of electrolyte escape, wash the affected area with hot water. Use rubber gloves to avoid skin contact. Any contact with the eyes should be liberally irrigated with water and medical advice sought.

Note: The electrolyte systems do not contain materials currently listed as carcinogenic, mutagenic or teratogenic, e.g., polychlorinated biphenyls (PCBs), dimethylformamide (DMF) or dimethylacetamide (DMA).

2. Intrinsic Properties

Operating

DC capacitors are polar devices and will operate safely only if correctly connected. Reversing the connections will result in high leakage currents which could subsequently cause short circuit failure, rupture of the safety vent, and possibly explosion and fire. Correctly polarized operation may result in the above failure modes if:

- The surge voltage is exceeded
- The ambient temperature is too high
- Excessive ripple currents are applied

AC types are non-polar. Catastrophic failure may be caused by:

- Abnormal duty cycles
- Voltage in excess of rated value
- Ambient temperature too high

Non-Operating

Aluminum electrolytic capacitors contain liquids which can leak out (see material content).

Damage to the encapsulation may cause leakage of the electrolyte. Excessive torque or soldering heat may affect the performance of the capacitor or damage the sealing. Electric shock may result if capacitors are not discharged.

3. Disposal

Aluminum electrolytic capacitors are consignable waste under the Special Waste Regulations 1996 (Statutory Instrument 1996 No 972), which complies with the EC Hazardous Waste Directive – Directive 91/689/EEC. The electrolyte should therefore be treated as a hazardous waste and advice should be sought from the local office of the Environmental Agency regarding its disposal.

Due to the construction of an aluminum electrolytic capacitor, high temperature incineration may cause the component to explode due to build-up of internal pressure. In addition, incineration may also cause the emission of noxious fumes. If it is decided that this is the best practicable option then it must be carried out under controlled conditions and at a minimum temperature of 1200°C. It should also be confirmed that the incinerator is authorized under parts A or B of the Environmental Protection Act.

The alternative is to dispose of them in an engineered lined landfill site that is licensed to take materials identified on the safety sheet. It should be stressed that these capacitors are not to be disposed of in a landfill site set aside for domestic waste.

KEMET strongly recommends that if there are any doubts regarding the disposal of aluminum electrolytic capacitors, that advice be sought from the local regulating authority.

In addition, KEMET would like to request that users of aluminum electrolytic capacitors respect the needs of the environment and, wherever possible, recover as much of the materials as possible, i.e. aluminum.

4. Unsafe Use

Most failures are of a passive nature and do not represent a safety hazard. A hazard may, however, arise if this failure causes a dangerous malfunction of the equipment in which the capacitor is employed. Circuits should be designed to fail safe under the normal modes of failure.

The usual failure mode is an increase in leakage current or short circuit. Other possible modes are decrease of capacitance, increase in dissipation factor (and impedance) or an open circuit.

Capacitors should be used in a well-ventilated enclosure or cabinet.

5. Mounting

Care should be taken when mounting by clamp, that any safety vent in the can is not covered.

6. Fumigation

In many countries throughout the world it is now common practice to fumigate shipments of products in order to control insect infestation, particularly when wooden packaging is used. Currently, methyl bromide is widely used as a fumigant, which can penetrate cardboard packing and polymer bags and, therefore, come into direct contact with equipment or components contained within.

If aluminum electrolytic capacitors become exposed to methyl bromide then corrosion may occur, depending upon the concentration and exposure time to the chemical.

This failure mode can affect all types of KEMET aluminum electrolytic capacitors. Methyl bromide can penetrate the seals of aluminum electrolytic capacitors and cause internal corrosion of the anode connection, resulting in the component becoming open circuit. The rate of corrosion will depend upon the level of exposure to methyl bromide as well as the subsequent operating conditions, such as voltage and temperature. It may take months or, in some cases, several years before the component becomes open circuit.

7. Dielectric Absorption

A phenomenon known as dielectric absorption can cause aluminum electrolytic capacitors to recharge themselves. The phenomenon is well known but impossible to predict with any great accuracy, so potentially any electrolytic product could be affected. Thus, a capacitor that has been charged and then completely discharged will appear to recharge itself if left open circuit; this will manifest itself as a small voltage across the terminals of the capacitor. Generally, the voltages seen are less than 20 VDC. However, higher voltages have on occasion been reported.

In order to avoid any problems caused by this voltage, KEMET recommends that capacitors be discharged before connecting to the terminals.

8. Flammability

Most plastics and elastomers are combustible (e.g., will ignite if an ignition source is applied under suitable conditions of temperature and oxygen level). For most published data, the UL 94 Horizontal or Vertical Burning System has been applied. Although useful for comparative values, this test is not practicable, as the ignition characteristics are strongly influenced by the material dimensions and other materials with which they may be in intimate contact. KEMET has completed a series of flammability tests based on a Needle Flame Test, as specified in IEC 60695–2–2. Details of the tests undertaken on both the external components and internal wind elements can be found in a full technical article, TD005, Flammability Characteristics contained within KEMET Aluminum Electrolytic Capacitors – Application Notes.

Fire Classification of Materials			
		Oxygen Index	Corresponding UL Standard
PEG124, PEG126, PEG127, PEG220-226	Tape (polyester)	20	UL 94 HB
PEH169 – PEH200 Series	Cover (phenolic - vyncolite)	35	UL 94 V-0
	Insulating cup (polypropylene)	17	UL 94 HB
	ALS Series Cover (phenolic - plenco)	30	UL 94 HB
ALS/C/P/T/N Series	Insulating sleeve (PVC)	35	UL 224 VW-1
	End disc (polypropylene)	17	UL 94 HB
	ALS (on request) Insulating sleeve (polyolefin)	34	UL94 V-2
PEH500 Series	Sleeve (PVC)	60	UL 94 V-0
ALC/P/T/N Series	Cover (phenolic - laminate)	51.3	NO DATA
MS/MD Series	Plastic case (noryl)	32	UL 94 V-1
Accessories	PYB mounting nut (polyamid)	26	UL 94 V-2

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Shanghai, China
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Taipei, Taiwan
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Southeast Asia
Singapore
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Penang, Malaysia
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Bangalore, India
Tel: 91-806-53-76817

Note: KEMET reserves the right to modify minor details of internal and external construction at any time in the interest of product improvement. KEMET does not assume any responsibility for infringement that might result from the use of KEMET Capacitors in potential circuit designs. KEMET is a registered trademark of KEMET Electronics Corporation.

Other KEMET Resources

Tools	
Resource	Location
Configure A Part: CapEdge	http://capacitoredge.kemet.com
SPICE & FIT Software	http://www.kemet.com/spice
Search Our FAQs: KnowledgeEdge	http://www.kemet.com/keask
Electrolytic LifeCalculator	http://www.kemet.com:8080/elc

Product Information	
Resource	Location
Products	http://www.kemet.com/products
Technical Resources (Including Soldering Techniques)	http://www.kemet.com/technicalpapers
RoHS Statement	http://www.kemet.com/rohs
Quality Documents	http://www.kemet.com/qualitydocuments

Product Request	
Resource	Location
Sample Request	http://www.kemet.com/sample
Engineering Kit Request	http://www.kemet.com/kits

Contact	
Resource	Location
Website	www.kemet.com
Contact Us	http://www.kemet.com/contact
Investor Relations	http://www.kemet.com/ir
Call Us	1-877-MyKEMET
Twitter	http://twitter.com/kemetcapacitors

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

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

Product & Process Design

Sales & Marketing

Supplier

Material Management

Quality

Manufacturing

Logistics & Distribution

People: Leadership
& Development

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