

HYBRID POLYMER ELECTROLYTIC CAPACITORS  
**HYBRID POLYMER RADIAL**

PH LC LC

**4 000h  
at 125°C**

- Low ESR
- Hybrid Polymeric Electrolyte


**ITEM CHARACTERISTICS**

Operating Temperature Range (°C)	-55 ~ +125
Voltage Range (V)	25 ~ 35
Capacitance Range (µF)	180 ~ 470
Capacitance Tolerance (20°C, 120Hz)	± 20%
Surge Voltage (V)	$U_R * 1,15$
Dissipation Factor	at 20°C, 120Hz, see table
Leakage Current (µA)	at 20°C after 2 minutes
Temperature Stability	$Z_{-55°C} / Z_{+20°C} \leq 2,0$ $Z_{-25°C} / Z_{+20°C} \leq 1,5$

**!** The usage at lower temperatures than indicated may be possible. Please contact the Jianghai Europe sales office for approval.

ITEM	LOAD LIFETIME L	DAMP HEAT (Steady State)	RESISTANCE TO SOLDERING HEAT RADIAL
Lifetime	4 000h	2 000h	5sec, Wave
Leakage Current	≤ the specified value	≤ the specified value (after voltage processing)	≤ the specified value (after voltage processing)
Capacitance Change	Within ± 30% of initial value	Within ± 30% of initial value	Within ± 10% of initial value
Dissipation Factor	≤ 200% of specified value	≤ 200% of specified value	≤ specified value
ESR Change	≤ 200% of specified value	≤ 200% of specified value	≤ specified value
Condition	125°C $U_R$ $I_R$ $U_{MAX} = U_R$	85°C (85-90% relative humidity) $U_R$ $I_R = 0$	260°C±5°C
dTo	13K		

**MULTIPLIER FOR RIPPLE CURRENT (FREQUENCY COEFFICIENT)**

Frequency µF	120Hz	1kHz	5kHz	10kHz	20kHz	30kHz	100-500kHz
180-470	0,15	0,50	0,70	0,75	0,85	0,85	1,00

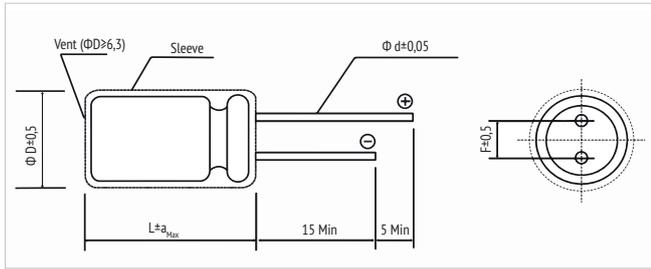
Multipliers for typical operating conditions.

**ENVIRONMENTAL**

 The products are RoHS, WEEE and REAcH compliant. The detailed version please see separate "Environmental Certificates" document or [www.jianghai-europe.com](http://www.jianghai-europe.com)

**DIMENSIONS FOR LOOSE, LONG-LEAD TYPE (BULK)**

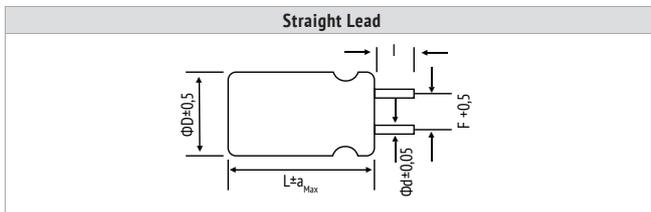
ORDER CODE: LL



$\Phi D$	8	10
F	3,5	5,0
$\Phi d$	0,6	
aMax	1,5	

in mm

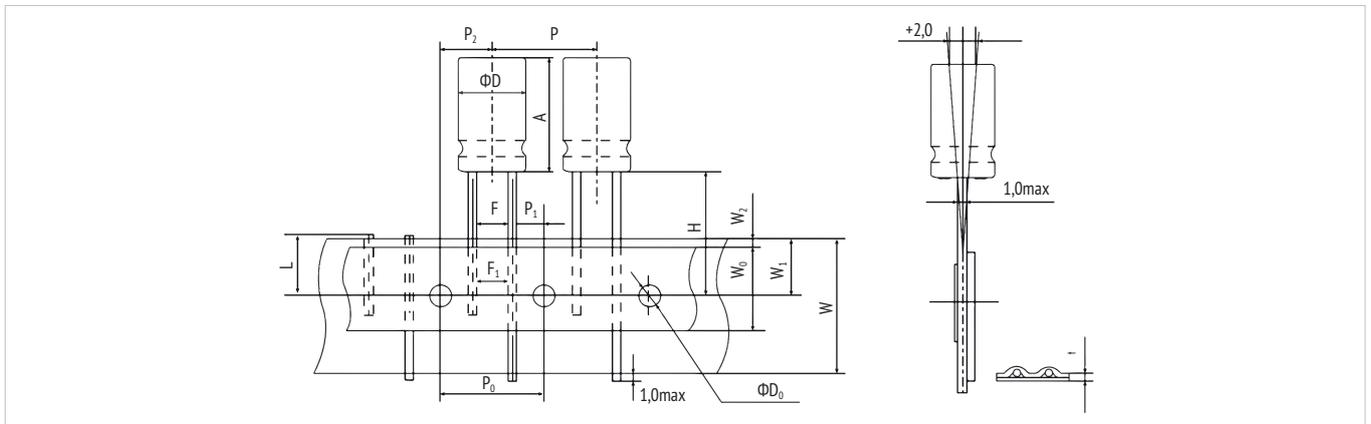
**DIMENSIONS FOR LOOSE, CUT LEADS (BULK)**



Code	CB	CC	CD	CE	CF
I	5,0 ± 0,5	4,5 ± 0,5	4,0 ± 0,5	<b>3,5 ± 0,5</b>	3,0 ± 0,5

preferred in mm

**DIMENSIONS AMMOPACK TAPING**



$\Phi D$	P	$P_0$	$P_1$	$P_2$	F	$F_1$	W	$W_0$	$W_1$	$W_2$	H	L	$\Phi D_0$	t
± 0,5	± 1,0	± 0,2	± 0,5	± 1,0	0,8/ -0,2	± 1,0	± 0,5	min	± 0,5	max	0,75/ -0,5	max	± 0,5	± 0,3
8	12,7	12,7	4,6	6,35	3,5	3,5	18,0	12,0	9,0	1,5	18,5	11,0	4,0	0,7
10	12,7	12,7	3,85	6,35	5,0	5,0	18,0	12,0	9,0	1,5	18,5	11,0	4,0	0,7

$U_{RDC}$ Rated Voltage Code	$C_R$ Rated Capacitance	$ESR_{max}$ Equivalent Series Resistance	$\tan\delta$ Dissipation Factor	$I_{leak}$ Leakage Current	$I_{max, 125^\circ C}$ Max. Allowed Ripple Current	Size $\varnothing D \times L$	Ordercode  ◇◇ = pin style & length  Details: Page 5
(V)	$(\mu F)$	$(m\Omega)$		$(\mu A)$	(mArms)	(mm)	
25 1E	270	27	0,14	68	2000	8 x 11,5	PHR1ELC271MBAB◇◇35WPE3
	390	20	0,14	98	2800	10 x 10	PHR1ELC391MC10◇◇50WPE3
	470	20	0,14	118	2800	10 x 10	PHR1ELC471MC10◇◇50WPE3
35 1V	180	27	0,12	63	2000	8 x 11,5	PHR1VLC181MBAB◇◇35WPE3
	330	20	0,12	116	2800	10 x 10	PHR1VLC331MC10◇◇50WPE3

## ORDER CODE HYBRID POLYMER RADIAL TYPE



PH	R	1V	LC	101	M	C10	LL	50	W	P	E3	JExxxx
Techno-logy	Terminal Type	Rated Voltage Code	Series Code	Capa-citance Code (µF)	Capacitance Tolerance	Size Code (ΦDxL)	Lead Form	Pitch	Material Code	Rubber Code	for internal use	for Specials only
PH = Hybrid Capacitor	Radial R	25V 1E	PH LC LC	47 470	±20% M	BAB 8,0 x 11,5	Taped FF	3,5 mm 35	Laminated W	Standard -		
		35V 1V		100 101	±10% K	C10 10 x 10,0	Long Lead LL	5,0 mm 50		Flat Rubber P		
				1000 102	+30/-10% Q		Cut 5,0 mm CB			Stand-Off T		
							Cut 4,5 mm CC					
							Cut 4,0 mm CD					
							Cut 3,5 mm CE					
							Cut 3,0 mm CF					

■ preferred

## INTRODUCTION SOLID POLYMER CAPACITORS

Aluminum solid electrolyte capacitors with conductive polymer are wound aluminum electrolytic capacitors that use a polythiophene electrolytic system. The conductive polymer yields extremely low ESR-values that allow for very high ripple currents at high frequencies. Typically, these types of capacitors are used in smoothing circuits of DC-DC converters and in high-frequency applications. Polymer Capacitors from Jianghai has been enlarged to voltages up to 200V, which allows the usage in many power supply applications too.

## COMPARISON OF SOLID POLYMER CAPACITORS AND LIQUID ELECTROLYTIC CAPACITORS

Besides the excellent lifetime performance, the temperature characteristics of polymer capacitors allow for a usage in a wide range of ambient temperatures. Temperatures in the range from -55°C to 105°C lead merely to capacitance changes from 10...15%, while the ESR remains almost constant. Especially the stability of its low ESR-values makes the polymer capacitor attractive for smoothing circuits or for decoupling functions. Compared to tantalum electrolytic capacitors, polymer capacitors offer a more reliable solution with a similar functionality.

## HYBRID POLYMER CAPACITORS

Hybrid Polymer Capacitors combine the technology of Solid Polymer Capacitors and Liquid Electrolytic Capacitors. As a result Hybrid Capacitors follow the rules of both technologies. Please consider carefully the Handling Precautions for Liquid Aluminum Electrolytic Capacitors and Solid Polymer Capacitors together. The lifetime of Hybrid Polymer Capacitors follows roughly the rules of Arrhenius like for Liquid Aluminum Electrolytic Capacitors, while the limitations of voltages and currents of the Polymer technology need to be applied. For details please contact Jianghai Europe.

## LIFETIME ESTIMATION **HYBRID** POLYMER CAPACITORS

In analogy to liquid electrolytic capacitors also hybrid polymer capacitors do have a lifetime. The characteristics differs from solid polymer and liquid capacitors in some ways. In the datasheets there are ripple currents defined. Anyway, most lifetime models do not include the currents for estimating the lifetime. The established lifetime models typically are based on voltage-temperature tests without any additional currents applied. As the capacitors are used in many cases under load conditions, where ripple currents are found, the many lifetime models do not meet well the real usage condition.

**Load Life L** defines the acceptable drift criteria of the capacitor parameters, where the max. allowed ripple current is applied at the upper category temperature together with a DC voltage. The sum of this DC voltage and peak of the applied ripple voltage must not exceed the rated voltage.

$$L = L_0 \cdot 2^{\frac{T_0 - T_A + dT_0 \cdot \left[ 1 - \left( \frac{I_A}{I_{max}} \right)^2 \right]}{10K}}$$

Where

L Lifetime

$L_0$  Load Lifetime

$T_0$  Rated Temperature, Upper Category Temperature

$T_A$  Ambient Temperature

$I_A$  Actual Rated Ripple Current (at 100kHz)

$I_{max}$  Max. Allowed Ripple Current (databook value)

$I_A \leq I_{max}$

## HANDLING PRECAUTIONS HYBRID POLYMER

Please see “General Handling Precautions” for Aluminum Electrolytic Capacitors on page 8 ff..

Additional requirements for aluminum solid electrolyte capacitors with conductive polymer:

- 1) Solid polymer capacitors do have a polarity. Never allow a reverse or negative voltage.
- 2) Over-voltages higher than the rated voltage will destroy the capacitors and must be avoided. The sum of DC voltage and the ripple voltage peak must not exceed the rated voltage.
- 3) If the rated voltage is low, take care that any negative ripple voltage peak does not become a reverse voltage. The minimum peak ripple voltage should be larger than  $0,1 \cdot U_r$ .
- 4) Leakage Currents might increase as consequence of longer storage, critical soldering processes, overload conditions, heavy charging/discharging, mechanical stress. Please note that solid polymer capacitors need a longer time for an internal repair than liquid capacitors. An increase of the leakage current shall be taken as an indication of a possible damage and should be avoided generally. It is essential to ensure a correct soldering profile. Please follow the recommendation of Jianghai page 169. In case of any questions please contact Jianghai Europe.
- 5) Polymer Capacitors cannot be used:
  - in circuits with frequent and/or rapid charging and discharging function,
  - in time-constant or coupling circuits,
  - in high impedance circuits or applications, where the leakage current affects the circuit operation,
  - after heavy thermal stress during soldering as the capacitance and leakage current may change,
  - under mechanical stress. Avoid mechanical vibration and shock.
  - in applications with heavy discharges / negative transients higher than 20% of  $U_r$ .
- 6) Ripple currents above the specified rating must be avoided as they may damage the capacitor.
- 7) Serial connections shall be avoided to prevent possible overvoltage conditions.
- 8) When parallel connections between polymer capacitors are planned, please take proper current balancing into account.
- 9) Use a protection circuit when the inrush current exceeds 10A. Especially higher voltage capacitor might need an individual protection against high inrush currents.
- 10) Always consider the safety when designing circuits. Plan for worst case failures such as short circuits and open circuits.
- 11) Protect Polymer capacitors from short-circuiting. Such high currents might destroy the capacitor and in rare case ignite the rubber inside the capacitor.
- 12) Laminated capacitors need to be handled like non-isolated components. Please take care of a completely separation of the lead wires and the case of the capacitor.
- 13) Without written consent by Jianghai, Polymer capacitors should not be used in highly reliable or life sustaining applications such as: medical equipment, aviation/aerospace equipment, automotive and nuclear applications and others, where a capacitor failure may have a major impact.
- 14) Environmental restrictions: please follow carefully all restrictions valid for liquid electrolytic capacitors, described in the “General Handling Precautions” at page 8 ff.. In addition any contact with water, especially salt water and/or oil must be avoided. In the same way the usage of polymer capacitors in places with higher concentration of noxious gases like hydrogen sulfide, sulfide acid, chlorine, ammonia and other is not allowed. Protect the capacitors against radiation, especially ultraviolet rays. If a circuit board cleaning is planned, please contact Jianghai Europe for approval of the cleaning process to avoid damages of the capacitors.
- 15) Never reuse capacitors if they have been assembled and energized already.
- 16) Do not drop capacitors or apply any mechanical shock. If this has happened, please do not use them anymore.
- 17) Storage: Do not store the capacitors at high temperature or high humidity, without any direct sunlight. Please keep the temperature in a range of 5°C to 35°C and a relative humidity less than 75%. In order to keep a good solder ability, store the capacitors in its plastic bags. The maximum storage time shall be limited to one year.
- 18) For Polymer Capacitors of 125°C temperature class current deratings for temperatures > 105°C might be necessary. Please check carefully the individual datasheet.

## HANDLING PRECAUTIONS FOR ALUMINUM ELECTROLYTIC CAPACITORS FROM JIANGHAI

### WARNING

JIANGHAI is not liable for any extent of possible injuries or damages to persons or things, of any kind, caused by the improper application of and/or operating conditions harmful to electrolytic capacitors. Misapplications which may cause failures include, but are not limited to: ripple current or peak current or voltage above specification, operating voltage above surge voltage specified, temperature exposure outside the specified operating temperature range. Examples of harmful operating conditions comprise, but are not limited to: unusual storage or transport temperatures, excessive and/or rapid changes of ambient temperature or humidity, heavy mechanical shock or vibration, corrosive and abrasive particles in the ambient (cooling) air, conducting dust in the ambient (cooling) air, oil or water vapor or corrosive substances, explosive gas or dust, operation under extremely high or low ambient pressure conditions (below or above sea level), superimposed radio frequency voltages, radioactivity. In case of doubt about the impact of operating conditions on capacitor performance, please contact JIANGHAI.

### PERSONAL SAFETY

Electrical or mechanical misapplication of electrolytic capacitors may be hazardous. Personal injury or property damage may result from explosion of a capacitor or from the expulsion of electrolyte due to mechanical disruption or the release of a safety vent of a capacitor. In case of injury or skin or eye exposure to electrolyte, immediately seek professional medical advice. Before using electrolytic capacitors in any application, please read these Handling Precautions, familiarizing thoroughly with the information contained herein. Please check before using any of our electrolytic capacitors if these components fulfill the requirements of your application and that warnings and instructions for use are followed.

### WARRANTY

The information contained in this catalogue does not form part of any quotation or contract, is believed to be accurate, reliable and up to date. Quality data are based on the statistical evaluations of a large quantity of parts and do not constitute a guarantee in a legal sense. However, agreement on these specifications does mean that the customer may claim for replacement of individual defective capacitors within the terms of delivery. We will not assume any liability beyond the replacement of defective components. This applies in particular to any consequential damage caused by component failure. Furthermore it must be taken into consideration that the figures stated for lifetime, failure rates and outlier percentages refer to the average production status and are therefore to be understood as mean values (statistic expectations) for a large number of delivery lots of identical capacitors. These figures are based on application experience and data obtained from preceding tests under normal conditions, or – for purpose of accelerated aging – more severe conditions. JIANGHAI reserves the right to change these specifications without prior notice. Any application information given is advisory and does not form part of any specification. The products are not primarily designed for use in life support applications, devices or systems where malfunction of these products can reasonably be expected to result in personal injury. JIANGHAI customers using or selling these products for use in such applications without prior written consent of JIANGHAI do so at their own risk and agree fully to indemnify JIANGHAI for any damage resulting from such improper use or sale. This version of the catalogue supersedes all previous versions. Latest versions of datasheets can be found on our homepage: [www.jianghai-europe.com](http://www.jianghai-europe.com). For more details on precautions and guidelines for aluminum electrolytic capacitors, please refer to CENELEC Technical Report CLC/TR 50454:2008 E, "Guide for the application of aluminum electrolytic capacitors".

### POLARITY

Electrolytic capacitors are polar and shall never be used with incorrect polarity, as there is a possible danger of shorting or destruction.

### RATED VOLTAGE $U_R$

The rated voltage is marked on the capacitor and defined in the datasheets as  $U_R$ . This voltage should never be exceeded and is the maximum peak voltage including any ripple voltages allowed to avoid a shortening of the lifetime or damage of the capacitor. When a ripple current is applied to the capacitor, the sum of the peak ripple voltage and bias DC voltage shall never exceed the rated voltage. It might be necessary to lower the maximum allowed bias DC voltage, when certain ripple currents are applied to the capacitor.

### SURGE VOLTAGE

Maximum voltage, which may be applied to the capacitor for short periods of time: max. 1000 cycles of 30 sec. per 6 min., max. 5 pulses per hour. Capacitance drift +/- 15% max.

### REVERSE VOLTAGE

Reverse voltages or voltages < 0V are not allowed.

### RECOVERY VOLTAGE

Electric potential between the positive and negative terminal may exist as a result of dielectric absorption. Please take action that this load does not damage other devices or scare workers during the production process (sparks possible). If needed please discharge the capacitor through a 1k $\Omega$  resistor.

### TEMPERATURE RANGE

Use electrolytic capacitors only within the specified operating temperature range.

### OVER-CURRENT

Currents exceeding the rated ripple currents should be avoided.

### RIPLLE CURRENT/VOLTAGE

The combined value of DC voltage and peak AC voltage (due to ripple current) shall not exceed the rated voltage and shall never be < 0V. Use of aluminum electrolytic capacitors under ripple current with wide amplitudes is equivalent to rapid charge-discharge operation.

### RAPID CHARGING/DISCHARGING

Rapid charging/discharging generates severe heat and gas may be emitted which may lead to explosion. Consult JIANGHAI about specially designed capacitors suitable for such kind of applications. Example: Servo Drive Application

### BALANCING RESISTORS

Balancing resistors should be utilized if capacitors are used in serial connection. Please choose low-tolerance resistors to limit voltage drift.

### CHARGE-DISCHARGE PROOF

JIANGHAI capacitors are charge-discharge proof, which means that 10<sup>6</sup> switching cycles will cause capacitance reduction of less than 10%.

### LIFETIME

There are many different lifetime definitions known without any true standard definition. Take special care when capacitors are compared that the capacitors fulfill the needed requirements. JIANGHAI publishes all conditions to be as transparent as possible. In the case of lifetime tests with additional ripple currents, the bias DC voltage must be reduced, so that the sum of bias DC voltage and the peak of the ripple voltage does not exceed the Rated Voltage  $U_R$ .

**Load life:** Period of time, during which the technical parameters of all capacitors stay within the given limits. JIANGHAI defines this without allowing for outliers.

**Useful life:** Defined like load life, but with a larger range of parameter change.

**Endurance test:** IEC 60384-4 defines the acceptable drift criteria of electrical parameters after the endurance tests (continuous voltage test).

**Shelf Life:** Definition of time with acceptable drift of capacitor parameters after storage at upper category temperature without load.

### VIBRATION AND MECHANICAL STRESS

Capacitors are sensitive to vibration and mechanical forces applied on the leads. Do not use capacitors, which have been dropped onto a rigid surface.

### INSULATION

If any defect of the sleeve is visible, the component should not be used – the same holds for any kind of visible damage. A capacitor should be electrically isolated from the following parts: aluminum case, cathode lead wire, anode lead wire and circuit pattern, and auxiliary terminal of snap-in type. The sleeve is not recognized as an isolator and therefore the standard capacitor should not be used in a place where insulation function is needed. Please contact JIANGHAI if a higher grade of insulation is required.

### ENVIRONMENTAL CONDITIONS

Avoid direct contact with water, salt solution, oil, dewing conditions. Halogens generally, especially fumigation treatment with bromides and flame retardant agents containing halogens must be avoided. Avoid exposing to direct sunshine, ozone, ultraviolet rays and x-ray radiation. Air Pressure: Max. 150kPa, min. 8kPa. For usage >2000m altitude above sea level current deratings might be necessary. No heavy air pressure changes are allowed. Do not use or store in an environment containing any hazardous gas (e.g., hydrogen sulphide, sulphurous acid, nitrous acid, chlorine, ammonia, bromine, methyl bromide, other halogens) or acidic or alkaline solutions.

### STORAGE

Temperature 5 to 35°C, relative humidity below 75%. Electrolytic capacitors may accumulate charge naturally during storage. In this case discharge through a 1k $\Omega$  resistor before use (Recovery voltage). Leakage current may be increased after long storage time. In this case the capacitor should be subjected to the rated voltage treatment through a 1k $\Omega$  resistor before use for 1 hour, then it should be discharged through a resistor of about 1  $\Omega$ /Volt. Storage times above 1 year should be avoided or rated voltage treatment may be necessary. In accordance to IEC 60384-4 electrolytic capacitors are subject to a reforming process before acceptance testing. Rated voltage is applied via a series resistance (100 $\Omega$ :  $U_R$   $\leq$  100VDC, 1k $\Omega$ :  $U_R$  > 100VDC).

**SOLDERING**

Soldering conditions (temperature, times) should be within specified conditions, especially for SMD components. Avoid high soldering temperatures as this may reduce lifetime or damage the capacitor. Do never dip the capacitor body into molten solder. Flux should not be adhered to the capacitor's body but only to its terminals. For details and different methods please contact us.

**GLUEING, CLEANING AND COATING**

Do not use fixing agents or cleaning substances containing halogens. Do not use coating and moulding components that completely seal the capacitor from the environment. Also, never use solvents containing: halogenated hydrocarbons, alkali, petroleum, trichloroethylene/-ethane, xylene, acetones, trichlorotrifluoroethane, tetrachloroethylene, methylenechloride, chloroform, acetates, ketones, esters, chlorides and bromides.

**MOUNTING**

Other devices, which are mounted near the capacitor, should not touch the capacitor. Additional heat coming from other components near the capacitor may reduce the lifetime of the capacitor. Do never bend or twist the capacitor after soldering to avoid stress on the leads. Radial capacitors are not protected against mechanical forces on the leads. Forces on the pins might damage the capacitor. No printed circuit board tracks are allowed between the lead pads of the capacitor. Screw Terminal capacitors should only be mounted in an upright position.

**TRANSPORT**

Avoid fumigation and spraying insecticides (especially with bromides) in the import or export procedures which can cause corrosion. This applies also to the finished devices.

**MAINTENANCE**

Periodical inspection should be carried out for the capacitor: visual inspection to check pressure relief open or leakage of electrolyte, electrical characteristics as leakage current, capacitance, and dissipation factor.

**ELECTROLYTE AND SEPARATOR PAPER**

Electrolyte and separator paper used in aluminum capacitors may be flammable. Also, electrolyte is electrically conductive. Therefore, in case electrolyte gets in contact with PC board it may cause corrosion of circuit pattern or cause short circuit between patterns, and may lead to smoke generation or ignition in worst case.

**CAUTION DURING USE OF CAPACITORS**

Do not touch the terminals of capacitors. Keep the capacitor free from conductive solution, such as acids, alkali and so on. Ensure that the operating environment of the equipment into which the capacitor has been built is within the specified conditions mentioned in the catalogue or specification sheets.

**SAFETY VENT**

The safety vent needs some free space to open properly. Allow for free headroom of at least 2mm for diameter  $\leq 16$ mm, more than 3mm for diameter 18-35mm, more than 5mm for case diameter 40mm and larger.

**EMERGENCY ACTIONS**

When the pressure relief vent is open and some gas blows out from the capacitor, please turn the main switch of the equipment off or pull out the plug from the power outlet immediately. During safety vent operation, extremely hot gas ( $>100^{\circ}\text{C}$ ) may blow out of the capacitors. Do not stand close to the capacitors. In case of eye contact, rinse the open eye(s) with clean water immediately. In case of ingestion, gargle with water immediately, do not swallow. Do not touch electrolyte but wash skin with soap and water in case of skin contact.

**DEFINITION OF ELECTRICAL PARAMETERS**

Separate documents as application notes, equivalent circuit diagrams and so on are available on request.

**PACKAGING**

Please refer to the data book for details. Further information is available on request.

**DISPOSAL**

Scrapped capacitors are classified as scrapped metal. For disposal they are handled as controllable industrial waste because of the nature of the contents (electrolyte). Most of the material is aluminum and cannot be completely burned.

*Jianghai Europe Electronic Components GmbH*  
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