Aluminum electrolytic capacitors

For automotive applications,
large size,140 °C / 2000 h

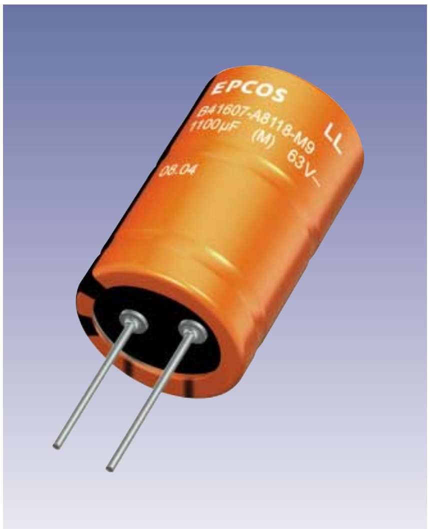
Series/Type: **B41605**
Date: July 2005

Large size Aluminum electrolytic capacitors

Introduction

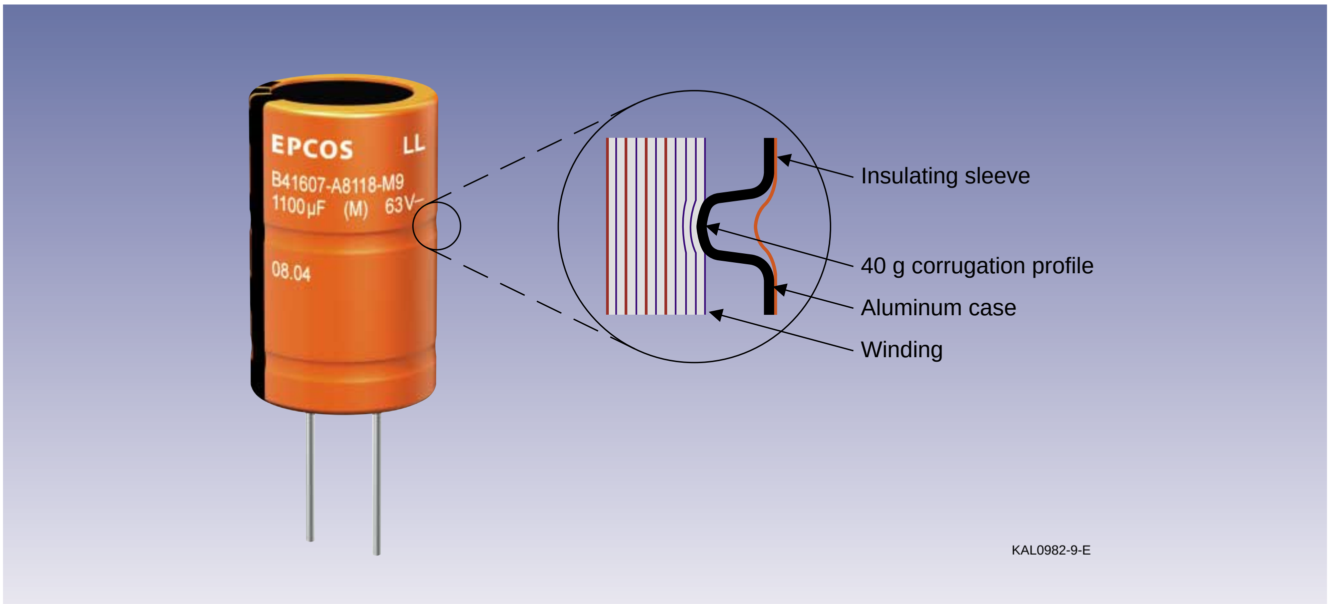
The B41605 and B41607 series were designed for applications with stringent demands for power and current carrying capacity at ambient temperatures ranging up to 150 °C. Tinned copper leads of 1.2 mm diameter, also allowing determination of the poles because of the different lead length, can be either welded or soldered.
To stand up the specified vibrational stability in an automobile, EPCOS developed a special process for these models, in the meantime patented, that fixes the capacitor winding so reliably by a sophisticated corrugation configuration that vibrational stability up to **40 *g*** can be specified even for these large-sized models.

Up to 40 *g* vibration stability version

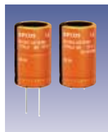


Snap-in version

Up to 40 *g* vibration stability thanks to rugged corrugation



Data sheet
B41605



Specifications and characteristics in brief

Rated voltage V_R	25 … 63 VDC		
Surge voltage V_{surge}	$1.15 \cdot V_R$		
Rated capacitance C_R	1500 … 20000 µF		
Capacitance tolerance	±20% ≙ M		
Leakage current I_{leak} (5 min, 20 °C)	$I_{leak} \le 0.006 \cdot \mu A \left(\frac{C_R}{\mu F} \cdot \frac{V_R}{V}\right) + 4\ \mu A$		
Self-inductance ESL	10 nH		
Useful life		Requirements:	
140 °C; V_R; $0.6 \cdot I_{\sim R}$	> 2 000 h	$\Delta C/C$	≤ ±30% of initial value
125 °C; V_R; $I_{\sim R}$	> 5 000 h	ESR	≤ 3 times initial specified limit
85 °C; V_R; $2.3 \cdot I_{\sim R}$	> 20 000 h	I_{leak}	≤ initial specified limit
40 °C; V_R; $2.0 \cdot I_{\sim R}$	> 500 000 h		
Voltage endurance test		Post test requirements:	
125 °C; V_R	2 000 h	$\Delta C/C$	≤ ±10% of initial value
		ESR	≤ 1.3 times initial specified limit
		I_{leak}	≤ initial specified limit
Vibration resistance	To IEC 60068-2-6, test Fc:		
	40 *g* vibration stability version	Snap-in version with 3 terminals	
	displacement amplitude 3 mm, frequency range at 10 Hz … 2 kHz, acceleration max. 40 *g*, duration 3 x 2 h	displacement amplitude 0.75 mm, frequency range at 10 Hz … 2 kHz, acceleration max. 10 *g*, duration 3 x 2 h	
IEC climatic category	To IEC 60068-1: 55/125/56 (– 55 °C/+125 °C/56 days damp heat test)		
Detail specification Sectional specification	Similar to CECC 30301-809 IEC 60384-4		

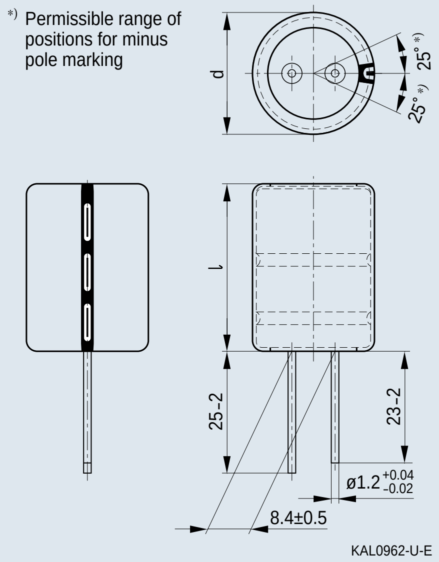
Features

- High reliability and long useful life, up to 2000 h at 140 °C
- Very high ripple current capability optimized for high frequencies
- Compact design
- Vibration resistance up to 40 *g*
- Shelf life of the capacitor up to 15 years at storage temperatures up to 40 °C. To ensure solderability, the capacitors should be built into the application within one year of delivery. After a total of two years' storage, the operating voltage must be applied for one hour to ensure the specified leakage current.
- Variable pin configurations
  - Up to 40 *g* vibration stability version with wired terminals. Weldable and solderable terminals. Tinned copper leads (∅ 1.2 mm).
  - Snap-in with 3 terminals, protection against polarity reversal.
- Without insulation sleeve upon request

Data sheet B41605

Large size capacitor, up to 40 *g* vibration stability version with wired terminals

Dimensional drawing



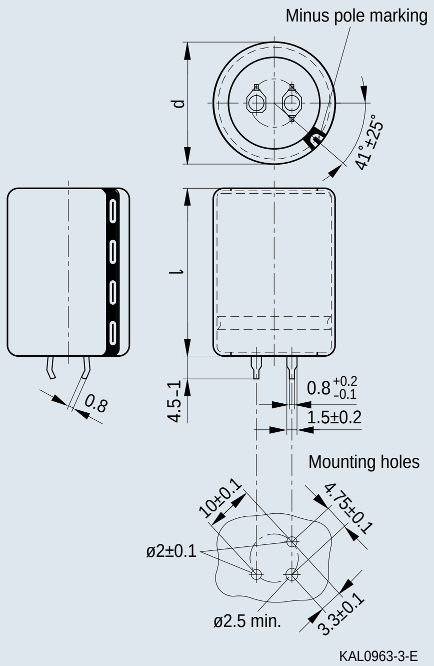
Dimensions and weights

Dimensions (mm) d +1	l ± 2	Approx. weight (g)
22	40	21
25	40	28
25	50	35
30	50	50
35	50	68

Packing units on request.

Large size capacitor, snap-in version with 3 terminals

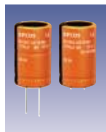
Dimensional drawing



Dimensions, weights and packing units

Dimensions (mm) d +1	l ± 2	Approx. weight (g)	Paking units (pieces)
22	40	21	160
25	40	28	130
25	50	35	130
30	50	50	80
35	50	68	60

Data sheet
B41605



Technical data, case dimensions and ordering codes

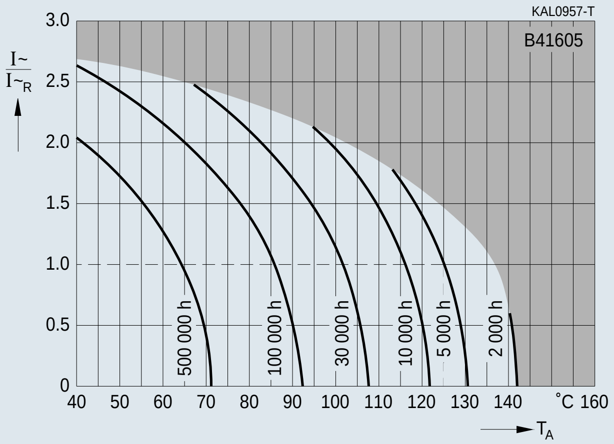
V_R VDC	C_R 100 Hz 20 °C µF	Case dimensions d x l mm	ESR_{typ} 100 Hz 20 °C mΩ	ESR_{max} 100 Hz 20 °C mΩ	ESR_{max} 100 Hz –40 °C mΩ	ESR_{max} 10 kHz 20 °C mΩ	Z_{max} 100 kHz 20 °C mΩ	$I_{\sim max}$ 10 kHz 105 °C A	$I_{\sim R}$ 10 kHz 125 °C A	$I_{\sim max}$ 10 kHz 140 °C A	Ordering code
25	5000	22 x 40	19	27	115	23	22	10.0	5.1	3.1	B41605A5508M***
	6800	25 x 40	14	19	80	15	15	13.5	6.9	4.1	B41605A5688M***
	10000	25 x 50	10	14	55	12	12	17.2	8.8	5.3	B41605A5109M***
	13000	30 x 50	9	12	45	11	11	18.8	9.6	5.8	B41605A5139M***
	20000	35 x 50	8	11	32	11	11	19.0	9.7	5.8	B41605A5209M***
40	3000	22 x 40	22	31	115	24	23	9.8	5.0	3.0	B41605A7308M***
	3800	25 x 40	16	22	80	15	15	13.5	6.9	4.1	B41605A7388M***
	5400	25 x 50	12	16	60	11	11	17.2	8.8	5.3	B41605A7548M***
55	1800	22 x 40	26	37	115	24	23	9.8	5.0	3.0	B41605A0188M***
	2700	25 x 40	17	24	80	15	15	13.5	6.9	4.1	B41605A0278M***
	3600	25 x 50	13	18	60	12	12	17.2	8.8	5.3	B41605A0368M***
	5000	30 x 50	11	15	45	11	11	18.7	9.6	5.8	B41605A0508M***
	7000	35 x 50	9	13	35	11	11	19.1	9.8	5.9	B41605A0708M***
63	1500	22 x 40	28	39	115	23	22	9.6	4.9	2.9	B41605A8158M***
	2100	25 x 40	19	26	85	15	15	13.5	6.9	4.1	B41605A8218M***
	2700	25 x 50	15	21	65	12	12	17.2	8.8	5.3	B41605A8278M***
	4000	30 x 50	11	16	45	11	11	18.7	9.6	5.8	B41605A8408M***
	5600	35 x 50	9	13	35	11	11	19.1	9.8	5.9	B41605A8568M***

*** = "002" for snap-in version with 3 terminals (protection against polarity reversal), fully insulated.
"009" for up to 40 *g* vibration stability version with wired terminals, fully insulated.

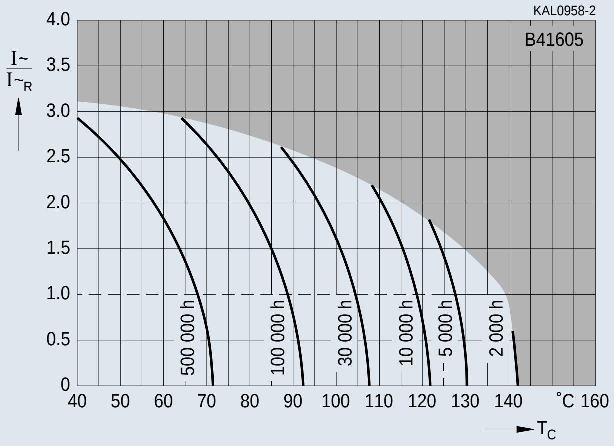
Data sheet
B41605

Characteristics

Useful life
depending on ambient temperature T_A under ripple current operating conditions at V_R

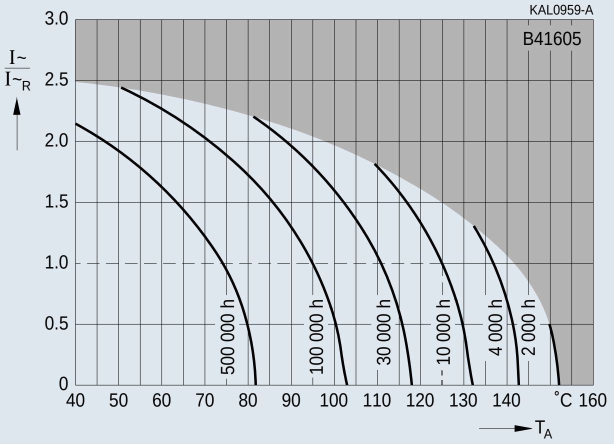


Useful life
depending on case temperature T_C under ripple current operating conditions at V_R



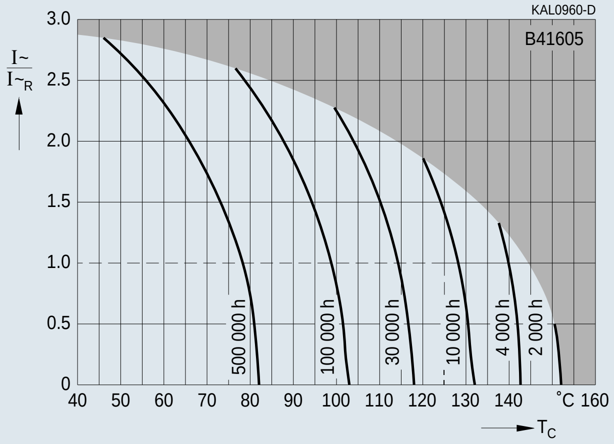
Useful life
depending on ambient temperature T_A under ripple current operating conditions at V_{op}

V_R = 25 V: $V_{op} \leq$ 20 V
V_R = 40 V: $V_{op} \leq$ 35 V
V_R = 55 V: $V_{op} \leq$ 48 V
V_R = 63 V: $V_{op} \leq$ 55 V

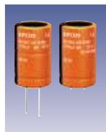


Useful life
depending on case temperature T_C under ripple current operating conditions at V_{op}

V_R = 25 V: $V_{op} \leq$ 20 V
V_R = 40 V: $V_{op} \leq$ 35 V
V_R = 55 V: $V_{op} \leq$ 48 V
V_R = 63 V: $V_{op} \leq$ 55 V

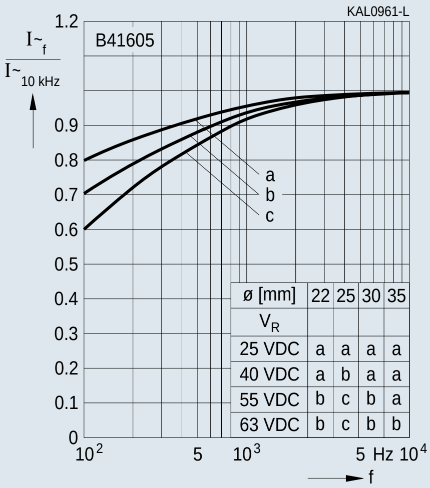


Data sheet
B41605

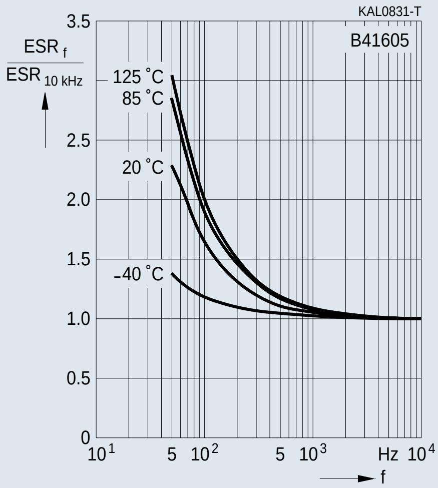


Characteristics

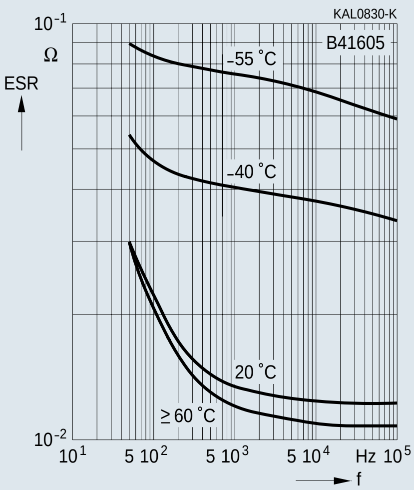
Frequency factor of permissible ripple current I~
versus frequency f



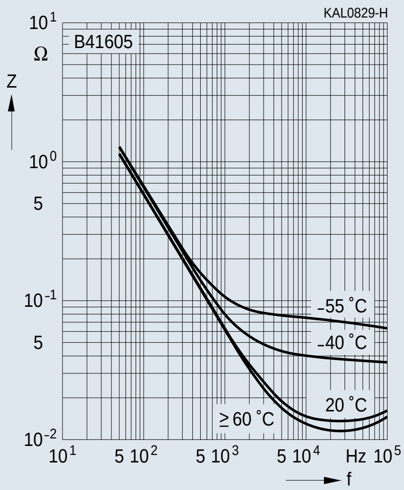
Frequency characteristics of ESR
versus frequency f at different temperatures T
Typical behavior



Equivalent series resistance ESR
versus frequency f at different temperatures
Typical behavior for 2700 µF/55 V



Impedance Z
versus frequency f at different temperatures
Typical behavior for 2700 µF/55 V



Important notes

The following applies to all products named in this publication:

1. Some parts of this publication contain **statements about the suitability of our products for certain areas of application**. These statements are based on our knowledge of typical requirements that are often placed on our products in the areas of application concerned. We nevertheless expressly point out **that such statements cannot be regarded as binding statements about the suitability of our products for a particular customer application**. As a rule, EPCOS is either unfamiliar with individual customer applications or less familiar with them than the customers themselves. For these reasons, it is always ultimately incumbent on the customer to check and decide whether an EPCOS product with the properties described in the product specification is suitable for use in a particular customer application.
2. We also point out that **in individual cases, a malfunction of passive electronic components or failure before the end of their usual service life cannot be completely ruled out in the current state of the art, even if they are operated as specified.** In customer applications requiring a very high level of operational safety and especially in customer applications in which the malfunction or failure of a passive electronic component could endanger human life or health (e.g. in accident prevention or lifesaving systems), it must therefore be ensured by means of suitable design of the customer application or other action taken by the customer (e.g. installation of protective circuitry or redundancy) that no injury or damage is sustained by third parties in the event of malfunction or failure of a passive electronic component.
3. **The warnings, cautions and product-specific notes must be observed.**
4. In order to satisfy certain technical requirements, **some of the products described in this publication may contain substances subject to restrictions in certain jurisdictions (e.g. because they are classed as “hazardous”)**. Useful information on this will be found in our Material Data Sheets on the Internet (www.epcos.com/material). Should you have any more detailed questions, please contact our sales offices.
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Cautions and warnings

Personal safety

The electrolytes used by EPCOS have not only been optimized with a view to the intended application, but also with regard to health and environmental compatibility. They do not contain any solvents that are detrimental to health, e.g. dimethyl formamide (DMF) or dimethyl acetamide (DMAC).

Furthermore, part of the high-voltage electrolytes used by EPCOS are self-extinguishing. They contain flame-retarding substances which will quickly extinguish any flame that may have been ignited.

As far as possible, EPCOS does not use any dangerous chemicals or compounds to produce operating electrolytes. However, in exceptional cases, such materials must be used in order to achieve specific physical and electrical properties because no safe substitute materials are currently known. However, the amount of dangerous materials used in our products has been limited to an absolute minimum. Nevertheless, the following rules should be observed when handling Al electrolytic capacitors:

- Any escaping electrolyte should not come into contact with eyes or skin.
- If electrolyte does come into contact with the skin, wash the affected parts immediately with running water. If the eyes are affected, rinse them for 10 minutes with plenty of water. If symptoms persist, seek medical treatment.
- Avoid breathing in electrolyte vapor or mists. Workplaces and other affected areas should be well ventilated. Clothing that has been contaminated by electrolyte must be changed and rinsed in water.

Product safety

- Make sure that polar capacitors are connected with the right polarity.
- Voltages polarity clashes should be prevented by connecting a diode.
- Do not damage the insulating sleeve, especially when ring clips are used for mounting.
- Do not exceed the upper category temperature (UCT).
- Make periodic inspections of the capacitors. Before the inspection, make sure that the power supply is turned off and carefully discharge the electricity of the capacitors.
- Do not apply any mechanical stress to the capacitor terminals.
- The internal structure of single-ended capacitors may be damaged if excessive force is applied to the lead wires.
- Avoid any compressive, tensile or flexural stress.
- Do not move the capacitor after soldering to the PC board.
- Do not pick up the PC board by the soldered capacitor.
- Do not insert the capacitor on the PC board with a hole space different to the lead space specified.
- Do not exceed the specified time or temperature limits during soldering.
- Capacitors should be dipped in solder for less than 10 seconds.
- Do not allow halogenated hydrocarbons to come into contact with aluminum electrolytic capacitors.
- Avoid external energy, such as fire or electricity.
- Avoid overload of the capacitors.

Failure to follow cautions and warnings may result in the worst case in premature failure, bursting and fire.

Product safety

Polarity

Make sure that polar capacitors are connected with the right polarity. If the opposite polarity were to be applied, this would cause an electrolytic process resulting in the formation of a dielectric layer on the cathode foil. In this case strong internal heat generation and gas emission may occur and destroy the capacitor. Polar capacitors do not tolerate a voltage reversal. Incorrect polarities of up to 1.5 V are, however, permissible for short periods of time as the formation of a damaging oxide layer on the cathode only starts at voltages of this magnitude.

Reverse voltage

Aluminum electrolytic capacitors are polar capacitors. Where necessary, voltages of opposite polarity should be prevented by connecting a diode. The diode's conducting-state voltage of approximately 0.8 V is permissible. Reverse voltages ≤1.5 V are tolerable for a duration of less than 1 second, but not in continuous or repetitive operation.

Breakdown strength of insulating sleeves

The minimum breakdown strength of the insulating sleeve is 2500 VAC or 3500 VDC. A test method for verifying the breakdown strength of the sleeves is described in IEC 60384-4.
In order to ensure full breakdown strength, care must be taken not to damage the insulating sleeve, especially when ring clips are used for mounting. The insulation can be improved by using an insulating strip. In such cases, attention must be paid to any relevant regulations (e.g. VDE, BSA or UL regulations).

Upper category temperature (UCT)

The upper category temperature is the maximum permissible ambient temperature at which a capacitor may be continuously operated. If this limit is exceeded, the capacitor may fail prematurely.
For some type series, however, operation at temperatures above the UCT is permissible for short periods of time. The maximum permissible operating temperatures are specified in the data sheets for the individual type series under "Specifications and characteristics in brief", section "Useful life".

Maintenance

Make periodic inspections for the capacitors that have been used in the devices for industrial applications. Before the inspection, make that the power supply is turned off and carefully discharge the electricity of the capacitors. To check the capacitors, make sure of the polarity when measuring the capacitors by using a volt-ohm meter, for instance. Also, do not apply any mechanical stress to the capacitor terminals.
The following items should be checked by the periodic inspections.
Significant damage to appearances: venting, electrolyte leakage, etc.
Electrical characteristics: leakage current, capacitance, tan δ and other characteristics prescribed in the catalogs or product specifications.
If any of the above is found, replace it or take any other proper measure.
Halogenated hydrocarbons may cause serious damage if allowed to come into contact with aluminum electrolytic capacitors.

Mounting position

An overpressure vent ensures that the gas can escape when the pressure reaches a certain level.
To prevent electrolyte from leaking out when the gas is "vented", the capacitor should be mounted in an upright position (90°). All of these mounting positions are intended to avoid a vent-down installation of the capacitor.

Mounting of single-ended capacitors

For further information see page 67.

Soldering

Excessive time or temperature during soldering will affect capacitor's characteristics and cause damage to the insulation sleeve. Capacitors should be dipped in solder for less than 10 seconds. Contact of the sleeve with soldering iron must be avoided.

Soldering, cleaning agents

Halogenated hydrocarbons may cause serious damage if allowed to come into contact with aluminum electrolytic capacitors. These solvents may dissolve or decompose the insulating film and reduce the insulating properties to below the permissible level. The capacitor seals may be affected and swell, and the solvents may even penetrate them. This will lead to premature component failure.
Because of this, measures must be taken to prevent electrolytic capacitors from coming into contact with the solvents when using halogenated hydrocarbon solvents to clean printed circuit boards after soldering the components, or to remove flux residues. If it is not possible to prevent the electrolytic capacitors from being wetted by the solvent, halogen-free solvents must be used in order to eliminate the possibility of damage.

Passive flammability

Under the influence of high external energy, such as fire or electricity, the flammable parts may get inflamed.
Clause 38 of the relevant specification CECC 30000 (Harmonized System of Quality Assessment for Electronic Components; Generic Specification: Fixed Capacitors) refers to IEC Publication 695-2-2 (Needle Flame Test) for testing the passive flammability of capacitors. And in CECC 30000, severities and requirements for different categories of flammability are listed. Most of aluminum electrolytic capacitors meet the requirements of category C.

Active flammability

In rare cases the component may ignite caused by heavy overload or some capacitor defect. One reason could be the following: During the operation of an aluminum electrolytic capacitor with nonsolid electrolyte, there is a small quantity of hydrogen developed in the component. Under normal conditions, this gas permeates easily out of the capacitor. But under exceptional circumstances, higher gas amounts may develop and may catch fire if a sparking would occur at the same time.
As explained above a fire risk can't be totally excluded. Therefore, it is recommended to use special measures in critical applications (e.g. additional encapsulation of the equipment for mining applications).