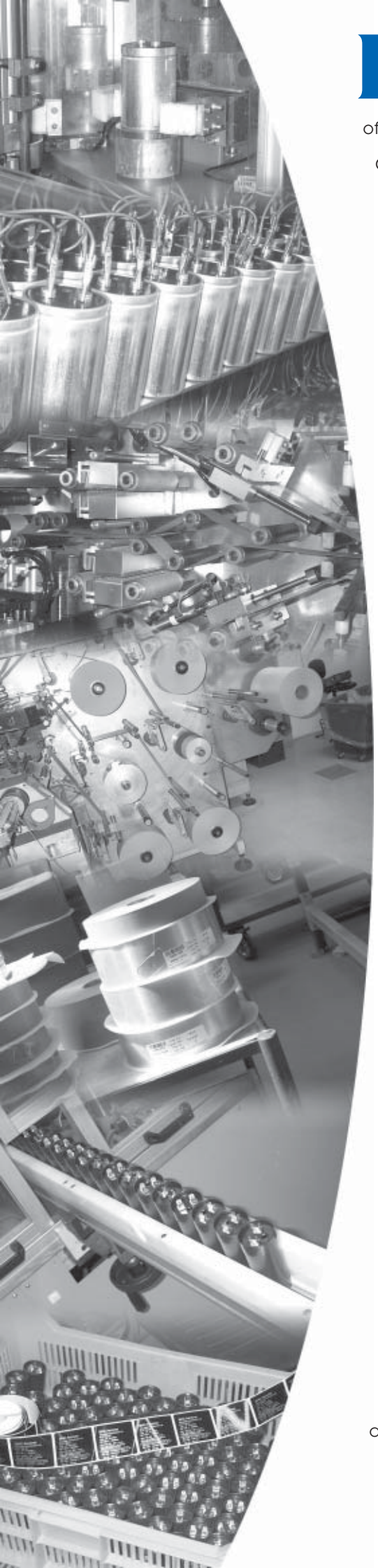
BHC COMPONENTS

part of the EVOX RIFA GROUP

Application Notes

Aluminium Electrolytic Capacitors



BHC COMPONENTS, now part of the Evox Rifa Group, is one of Europe's leading manufacturers of Large Can Aluminium Capacitors. The Evox Rifa Group is a major global capacitor manufacturer, offering a wide range of technologies and styles from production facilities in Sweden, UK, Finland, China and Singapore.

The ISO9001 approved BHC production plant at Weymouth in the South of England has been successfully manufacturing Aluminium Electrolytic Capacitors for the most demanding applications since 1968.

BHC prides itself on its ability to provide a flexible design service for unique customer requirements. The company has a history of working alongside design teams, providing the exact solution to a particular problem, and unrivalled support in the subsequent application. BHC recognises that its success depends on the future of its customers and sees itself not only as a supplier of technologically superior products but as a partner, mutually striving with our customers for competitive advantage.

The product development and customer service provided by BHC is backed by a totally integrated, real time information system that plays an important role in quality, design, and in all phases of production from planning to control.

The control offered by the use of information systems over the manufacturing process is only a part of the quality system that pervades at every level. Quality is the responsibility of every member of our team with the emphasis placed on "right first time" and "continuous improvement". Quality is the link that bonds us to our customers. We are committed to not only satisfy customers' current needs, but to improve and develop products in anticipation of their future requirements.

In formal recognition of this BHC has achieved approval to BS EN ISO 9001.

Manufacturing competitively priced products of the highest quality is the cornerstone of our success. If you wish to share in that success then contact us and see for yourself how we can provide a solution to satisfy your needs without having to make do with the closest standard available.

Contents

Introduction

This document contains five separate technical articles written to give the equipment designer detailed information on the application of BHC Components aluminium electrolytic capacitors. It augments the information already available within the standard product catalogue.

The technical support team at BHC Components are more than happy to offer any additional support that may be required if the information cannot be found in these notes. To obtain a feasibility of a capacitor for a particular application, the form at the back of the document should be completed, with as much information as possible, and faxed to BHC Components.

Introduction

The purpose of this technical data sheet is to give guidance on the reliability of the standard product ranges manufactured by BHC Components Ltd by providing failure rate data for use in reliability calculations.

It is not the intention to describe the mechanisms which contribute towards the failure of components nor to discuss the mathematical theory of the statistics and probability employed.

Many articles have been written on the subject of reliability and these and other sources should be consulted for further information.

Reliability

The reliability of a component can be defined as the probability that it will perform satisfactorily under a given set of conditions for a given length of time.

Since in practice it is impossible to predict with absolute certainty how any individual component will perform, we must utilise probability theory. It is also necessary to clearly define the level of stress involved (e.g. operating voltage, ripple current and temperature) and the duration of time involved.

Finally, the meaning of *satisfactory performance* must be defined by specifying a set of conditions which determine the end of life of the component.

Reliability as a function of time, R(t), is normally expressed as :

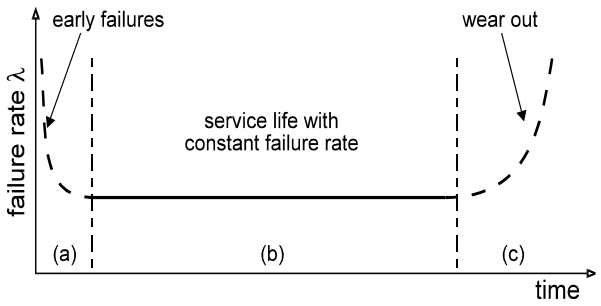
$$R(t) = e^{-\varsigma t} \qquad (1)$$

where R(t) is the probability that the component will perform satisfactorily for time t, and ς is the failure rate.

Failure Rate

The failure rate is the number of components failing per unit time. The failure rate of most electronic components follows a characteristic pattern as shown in figure 1.

Figure 1. Failure Rate vs Time



Region (a) is the early failure period, sometimes called infant mortality, these failures are removed during the manufacturing process.

Region (b) is the operational or service life, this period is characterised by an essentially constant failure rate.

Region (c) is the wearout period and is characterised by a rapidly increasing failure rate.

The failure rate is normally specified in failures per hour, e.g. 1 failure per 1 million hours can be stated as :

1×10^{-6} failures per hour or 0.1 % per 1000 Hours.

Assessment of Failure Rates

Many years of routine endurance testing have generated millions of component test hours. Most of these tests are carried out at rated temperature with full rated voltage and ripple current applied.

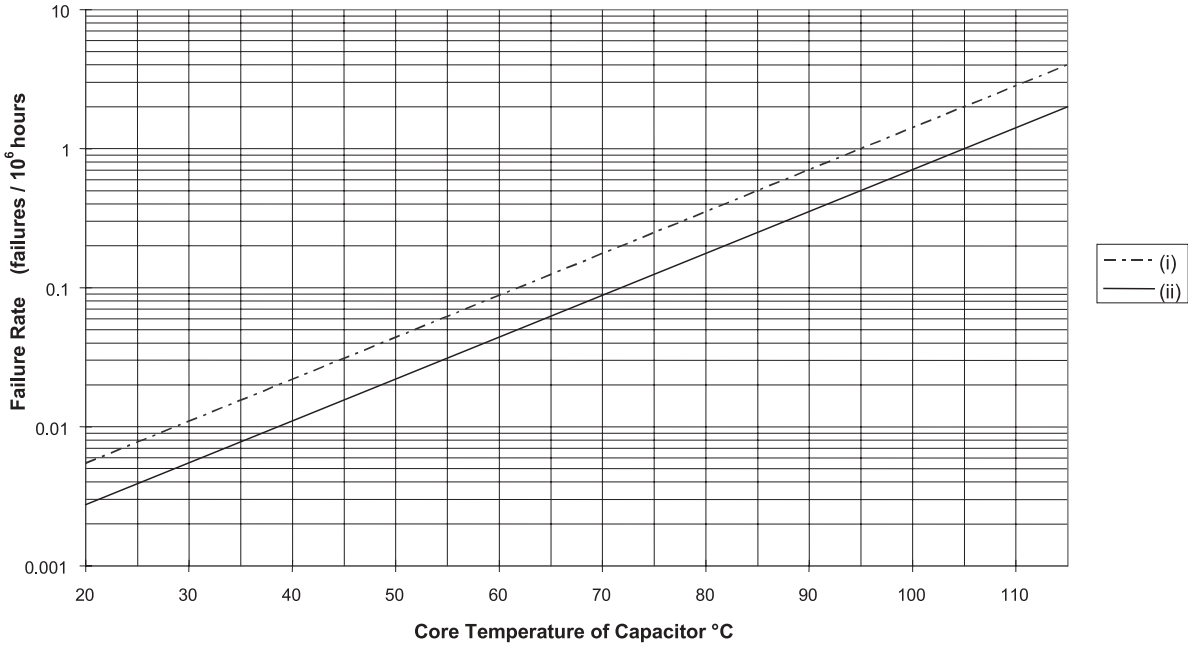
Extensive analysis of this data has enabled failure rates to be established for most product ranges. The rates are given with a 60% confidence level and the end of life definition is given below.

End of Life Definition

Catastrophic failure - short circuit, open circuit or operation of the safety vent.

Parametric failure - capacitance change of more than ±10%, leakage current greater than specified limit or ESR increase of more than two times initial value.

Figure 2. Failure Rate vs Core Temperature



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Failure Rate Values

Figure 2 gives the failure rates in failures per 10^6 hours and the variation with core temperature for most of the standard product ranges.

Graph (i) ALS10/11, ALS20/21, ALS27/29, ALP10, ALT10/11, ALP20, ALT20/21, ALP22, ALT22/23, ALC20, ALC50.

Graph (ii) ALS30/31, ALS40/41, ALC10, ALC40.

Note - for products rated at 85°C the maximum core temperature is 105°C and for products rated at 105°C the maximum core temperature is 120°C. The failure rates for core temperatures between 105°C and 120°C therefore only apply to ALC50, ALC40, ALS40/41.

It should be understood that the figures quoted in figure 2 represent the mean failure rates achieved from a large population of components tested under controlled conditions.

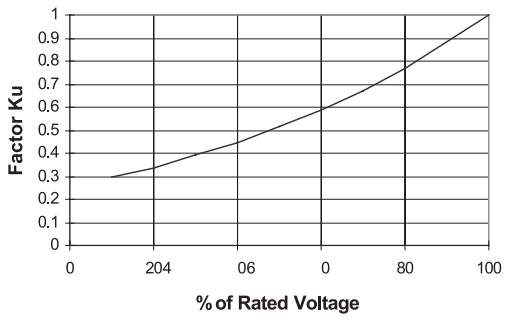
These components are taken from the normal manufacturing process and therefore represent average component performance and build quality.

As such the figures can only be taken as a guide to the reliability in any given application since the actual operational conditions are likely to deviate significantly from those used in routine testing.

Voltage Derating

The failure rates in figure 2 allow for variation in stre ss levels due to ripple current and operating temperature. Figure 3 gives an additional factor Ku to account for voltage deration.

Figure 3. Voltage Factor vs % of Rated Voltage



The operating failure rate (ςo) is therefore the rate ((ς) from figure 2 multiplied by Ku from figure 3.

$$\varsigma o = \varsigma \times Ku \qquad (2)$$

MTBF

The mean time between failures (MTBF) is simply the inverse of the failure rate.

$$MTBF = 1 / \varsigma \qquad (3)$$

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Technical Enquiry

Please complete the boxes below with as much detail as possible and either fax to: +44 1305 760670 or complete our on-line enquiry form at http://www.bhc.co.uk.

Contact Details

Name		Tel:	
Company		Fax:	
Address		Email:	

Capacitor Details

Capacitor part number (if known)				
Capacitance		µF	Rated Voltage	V dc
Size				dia. x l en. (mm)

Configuration

Number of Capacitors:

No in bank		No in series		No in parallel	

Operation details

The data below applies to : the whole bank [ ] each individual capacitor [ ]

Ripple currents		Hz Hz Hz Hz Hz Hz Hz		A rms A rms A rms A rms A rms A rms A rms
Working Voltage Vdc			Forced air cooling rate - m/s	
Ambient air temperature °C			Heat sinking °C/W	

Other details (e.g. surge voltages,...)		
Special end of life criteria (e.g. 2 x initial esr)		
Target life requirement		Hours

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