EUROPEAN POWER SUPPLIES MANUFACTURERS' ASSOCIATION
(Visit the EPSMA website at www.epsma.org)

Guidelines for Lifetime Specification of Power Converters

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The European Power Supplies Manufacturers' Association was established in 1995, to represent the European power supply industry.

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1 Aim / Objectives

Customers and even suppliers sometimes confuse **lifetime** with Mean Time Between Failure (**MTBF)** of power products, as both are expressed in hours. This document will distinguish between these two specifications with an emphasis on lifetime and might be regarded as an amendment to EPSMA publication "Guidelines to Understanding Reliability Prediction" from 2005 [1] explaining reliability/MTBF.

Lifetime terminology and formulae will be shown in relation to MTBF and the stresses that affect the lifetime of components will be discussed.

Components that contribute the most significant limitation to lifetime will be examined to show what factors affect their lifetime.

The paper concludes with a summary of key points to be considered when including lifetime data in a data sheet, to help the end-user with decisions on the service life of their end product.

2 Terminology

2.1 Examples of Lifetime/MTBF confusion

When talking about reliability there has been confusion in understanding the difference between mean time between failures (MTBF) and lifetime figures in a datasheet. A power converter might be rated with an MTBF of >1,000,000 hours, but only with a lifetime expectancy of 30,000 hours. One might wonder, why there is such a large difference?

2.2 Differentiating Lifetime from MTBF

The **failure rate** λ of a PSU describes a statistical figure of fails in one hour. A more useful unit of failure rate is a **FIT** (Failure In Time) or failures in 10^9 hours defined as $\mathbf{1}\ \boldsymbol{FIT} = \frac{\mathbf{1}\boldsymbol{fail}}{\mathbf{10^9}\boldsymbol{h}}$. It can be described over the product life cycle in the so-called bathtub curve:

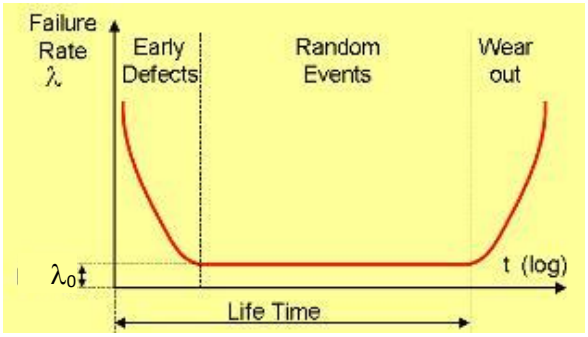

Figure 2.1 Failure Rate Bathtub Curve (© PULS LP)

After passing through a higher "infant mortality" rate in the beginning, the failure rate stays constant on a valley level λ_0 till the end of life (EOL) is reached. Thereafter, a failure rate increase can be seen, since component parameters run out of specification as they wear out. The period until EOL is defined as the **lifetime**.

Unlike lifetime, the **MTBF** represents a statistical time of how long a unit should operate until a failure could be expected. As marked in figure 2.1 It is defined by λ_0 during the lifetime valley by