

MTBF Mean Time Between Failures

A contemplation for the product series **ISM** und **e.bloxx**

1. Definition

MTBF (*mean time between failures*) is the average duration between two failures. It serves as measure for the reliability of devices and systems.

MTBF is the time, measured in hours, which one the producer declares as an average Time, before an failure first time will appear at a product. At a MTBF-declaration of 100000 hours in the average a failure will appear after 11.4 years. In case it concerns products, which are subject to a regular service or they using abrasion parts, so perhaps the so-called *Service Life* has to be considered for evaluation. (*if I change my tires regularly, I will statistically have a breakdown every 15 years*). Detailed definitions are available in the standards ISO40041 and ISO40042.

2. Method

For the determination of the MTBF different methods are available because the tests are not standardized. Therefore all methods and results are relative and depend on the manufacturer.

Method A - Calculation of the MTBF based on the used parts and components

For every single component the values will be combined according IEC 61709. In this case the weakest parts of the product or component is relevant. In electronically products and systems, like the series e.bloxx, this are the electrolyte capacitors as used in power supply circuits. This determination leads caused by a lot of unknown influences (environment temperature, vibrations, radiation, on/off cycles...) rather to bad results, means "worst case" results.

Method B - Determination MTBF based on the simulation of the live cycle

The value will be determined by exposing the product to a distinguishing aging process. That could be a special temperature-, humidity-, radiation- and vibration loading or a „real“ load like movement of a computer mouse during 24 h /day and 7 days / week to find out at what time mechanical parts will fail. That is what companies are doing in permanent test stands. This method is closer to the real conditions as method A, but of course it is a simulation only.

Method C - Determination of the MTBF based on statistically values of the past

This method is generating without doubt the most reliable results, because it is based on true and authentic values. The disadvantage of this method is the required adequate number of products that has to be in operation for a sufficient long time to get statistically analysable facts.

The calculation takes place out of

- the sum of all used products in a observation period (e.g. 1 year),
- multiplied by the average process time in the observation period (e.g. 8 h/day, 200 days/year),
- divided by the number of failures in the observation period.

3. Values for the products ISM and e.bloxx

Determination according to method A:

Up to now we only used this method with the ISM modules. As the electrolyte capacitors are the weakest parts, the result for the e.bloxx will be similar. The value of the MTBF with the modules ISM is approx. 40000 h, that means 4.6 years with continuously operation (24 h/day, 365 days/year) and a average temperature of 50 °C.

Determination according to method B:

This method wasn't used.

Determination according to method C:

Basis

- In the year 2003 more than 10000 modules are sold and with a high probability in use.
- The average operation time of our products is 5 years. So we can assume that in the observation period 50000 modules are world wide in operation.
- Due to the fact that our modules are mainly used in industrial application the assumption of an average operation time of 8 h/day and 200 days/year is rather low calculated.
- In the year 2003 at 358 modules a failure appeared.

Determination

Number of modules in operation:	$10000 \text{ modules/year} \times 5 \text{ years} = 50000 \text{ modules}$
annual operation time per module:	$8 \text{ h/day} \times 200 \text{ days/year} = 1600 \text{ h/year}$
total operation time of all modules in 2003:	$50000 \text{ modules} \times 1600 \text{ h} = 80000000 \text{ h}$
statistically calculated MTBF:	$80000000 \text{ h} / 358 \text{ failures} = 223464 \text{ h}$

is equivalent to

25.5 years

This value is very good, never the less there are some unsteady factors:

We don't know, whether customers exchange modules in case of failure without out knowledge.

We don't know the actual annual operation time.

We don't know whether all modules are in operation.

The lifetime of 5 years is an assumption.

In case of estimating lower operation times and higher failing rates the MTBF will be certainly much better than 100000 h respectively 10 years.

In case of questions don't hesitate to contact us.