Issue 2 / 2016

C H A R G E

November 2016

A Technical News Journal from Deki Electronics Ltd

Editor's Desk

Dear Reader,

In this edition of Charge we have tried to explain the concept of FIT(Failure in Time).

The term FIT is defined as a failure rate of 1 per billion hours. A component with a failure rate of 1 FIT is equivalent to a MTBF (Mean Time Between Failure) of 1 billion hours. Most components have failure rates in 100s and 1000s of FITS.

You may be aware that Deki's Technical Centre is approved as an independent laboratory by the Department of Science and Industrial Research since 2012.

We showcase some of the state-of-the-art reliability test equipment that is used by the Technical Centre.

Deki is one of the few companies in the world with a simulator that can simulate the working of the capacitor in any environment. This programmable simulator can go up to 1000 vAC and 200 kHz.

So, we can actually assure our customers that the working life of our capacitors is tested under actual working conditions in our Technical Centre.

We are happy to inform you that Deki is once again participating in Electronica 2016 in Munich between 8th and 11th November. We are in Hall B6, Booth 460/5. Do drop in if you are around.

As always, please keep your valuable comments and suggestions flowing in.

Anil Bali

Health Checkup Camp

A free health checkup camp was held at the Deki office premises on 22 July 2016. The day long camp commenced at 9.00 am and all employees got a preventive health check-up done. Held in partnership with Metro Super Specialty Hospital, NOIDA, the camp covered tests and checks for:

- Fasting Blood Sugar
- Blood Pressure
- Pulse Rate
- Body Mass Index
- Vision (near vision, far vision and colour blindness)
- Orthopaedic consultation

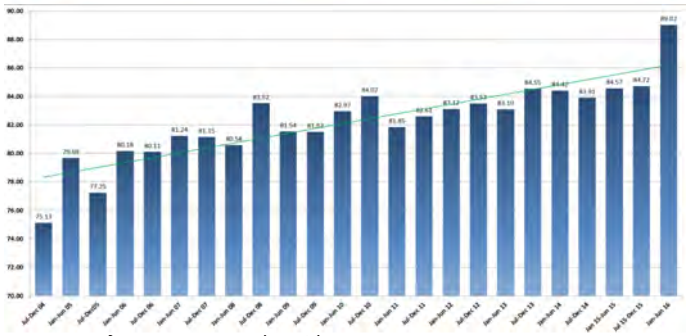
The health checkup team at Deki

Special Aadhar Camp

A special Aadhar registration camp was organised over two days at the Deki premises for employees and their families. This initiative shows the kind of dedication that the organisation has towards the well being of its workforce. As a result of the camp being held inside the office premises, the registration process was made faster, easier and less cumbersome.

External Customer Satisfaction Survey

The results of the last survey for the period Jan-June 2016 saw a major jump in the satisfaction level from around 85% to 89%. Deki has now started calculating the Net Promotor Score that measures customer experience and predicts business growth. For this we have added a question on how likely is the respondent to recommend Deki to friends/colleagues. The NPS for Deki came in at 79% this time. We are hopeful that this number too will improve over time, in keeping with the general trend of the satisfaction level growth that started at 75% in 2004.



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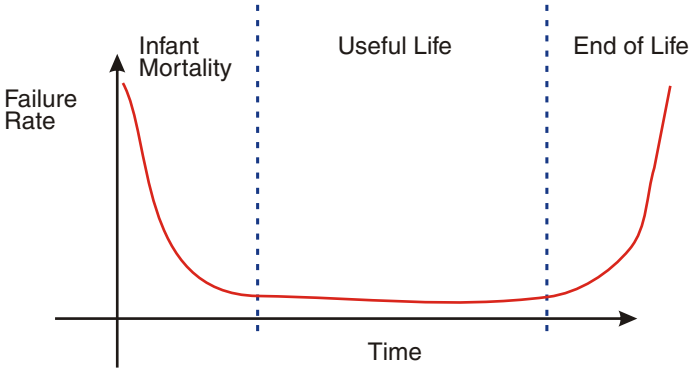
FIT and Service Life of Capacitors

The intent of this technical Charge Document is to provide an understanding of FIT calculations. Understanding the methods for the lifecycle prediction for a capacitor enables the customer to make informed decision while selecting particular series of capacitor.

Customers often must include reliability data when determining which capacitor to buy for their application. FIT (Failure In Time) is a way of providing a numeric value based on a compilation of data to quantify a failure rate and the resulting time of expected performance. The numeric value can be expressed using any measure of time, but hours is the most common unit in practice.

The evolution of the failure rate in time during the lifetime of Deki capacitor follows the typical bathtub curve.



The figure shows the characteristic shape of this curve, highlighting the three main regions that can be distinguished in a typical lifetime of any capacitor. The first region, starting when customer use commences, is characterized by a relatively high but rapidly decreasing failure rate. This is related to what is called infant mortality. The time scale here ranges from hours to weeks. After this transient, the failure rate levels off, remaining roughly constant for the majority of the useful life of the capacitor. Finally, if units from the population remain in use long enough, failure rate begins to increase significantly again as materials wear out and degradation failures occur.

A process called Burn-in is carried out to reduce the early failure rate. For electronic components, burn-in is conducted at elevated temperature and elevated voltage.

The most common inquiry about a capacitor is its life span, and is important in the decision-making process of the user. FIT reports the number of expected failures per one billion hours of operation for a device. FIT can be quantified in a number of ways: 1000 devices for 1 million hours or 1 million devices for 1000 hours each. FIT and CL (Confidence Limits) are often provided together. In common usage, a claim to 95% confidence in something is normally taken as indicating virtual certainty. In statistics, a claim to 95% confidence simply means that the event occurs only one time in twenty or less.

Reliability Standards

When we talk about reliability two significant parameters need to be mentioned: Failure rate and service life. Both figures are always given with respect to certain environmental and electrical conditions. The failure rate is usually given in the conditions indicated in the standard IEC 61709. In the subsequent sections we shall see how the calculations for the failure rates can be performed.

Failure Rate (Intrinsic Failure Rate)

The failure rate or intrinsic failure rate (λ) of any product is the statistical number of units failing per unit of time in the intrinsic failure period. The failure rate changes throughout the life of the product. The failure rate is expressed in units of fit (fit = failure in time), where 1 fit = 1×10^{9}/h (1 failure per 10^{9} component test hours).

In the case of film capacitors, the two most relevant parameters affecting the failure rate are temperature and voltage. In the IEC 61709 standard, models for stress factors are consequently applied in order to convert the failure rates under reference conditions to values applying for operating conditions. The conversion should be carried out according to:

$\lambda 0 = \lambda \text{ref} \times V \times T$

$\lambda \text{ref} = n / N \times Tb$

Here n = Number of Components Tested
N = Number of Failures
Tb = Test Time in Hour

The calculation of the Stress factors namely Voltage Stress v and temperature stress T are calculated by their respective equations. The equations used for calculation of the stress factors are modeled on the Arrhenius relationship.

In high-temperature life testing, components are subjected to elevated temperature under bias for an extended period of time. Thermally accelerated failure mechanisms follow the classical Arrhenius relationship.

For simplicity here are the respective conversion factors at various temperatures

Temperature (°C)	πT	U ref/ U rat (Load Ratio)	πV
<= 40	1.0	10%	0.26
50	1.8	25%	0.42
55	2.3	50%	1.00
60	3.1	60%	1.42
70	5.2	70%	2.04
80	9.0	80%	2.93
85	12.0	90%	4.22
90	16.0	100%	6.09
100	33.0	110%	9.00
105	50.0	120%	13.00

We shall now consider a simple example to understand the FIT calculations. Here for simplicity we shall not be considering statistical confidence levels.

Example: Let us suppose that we need to estimate the failure rate of a certain series of capacitor. To collect the required data we take 10 capacitors and test them for 1000 hours. The following results are obtained at the end of the test

FIT and Service Life of Capacitors

Capacitor	Hours	Failure
Capacitor 1	1000	No Failure
Capacitor 2	498	Failed
Capacitor 3	1000	No Failure
Capacitor 4	1000	No Failure
Capacitor 5	785	Failed
Capacitor 6	1000	No Failure
Capacitor 7	1000	No Failure
Capacitor 8	635	Failed
Capacitor 9	526	Failed
Capacitor 10	1000	No Failure

Here Total Number of Capacitor = 10
Number of Failure = 4
Total Number of Component Test Hours = 8444

Then the estimated failure rate = 4 failures / 8444 hours = 0.0004737 failures / hour = 473700×10^{-9} failures / hour

Hence for the example discussed above the estimated failure rate is 473700 failures for every billion hours of operation.

Deki's Technical Centre uses state-of-the-art equipment in its laboratory. Here are some of them:

Heratherm Oven

Our Heratherm Oven is gravity controlled which means that there is no air circulation inside the chamber. This gives us a unique facility to create the exact thermal conditions experienced by a capacitor in a circuit enclosed within housing. Therefore we can simulate the exact thermal stress condition that our capacitors may be subjected to during their service life.

Chroma Hi-pot Tester

Capacitors are subjected to various electrical stresses during their service life. To simulate the stress on capacitor we use Chroma Hi Pot tester which helps in creating the exact electrical stress parameters which the capacitor will face during its service life.

Weiss Environmental Test Chamber

Our state-of-the-art Weiss & Espec Environmental Chamber is capable of providing temperature as low as -40°C to as high as 180°C. It can also provide a relative humidity of 10%-95%. This gives us the option to test our capacitors in various environmental conditions as desired.

Espec Humidity Chamber

Chroma Power Supply

All the power supplies used in our lab are of highest standards. This ensures our tests run on the desired voltages with the least amount of variation.

For more information on FIT calculations and service life of Deki capacitors, please contact us at info@dekielectronics.com.

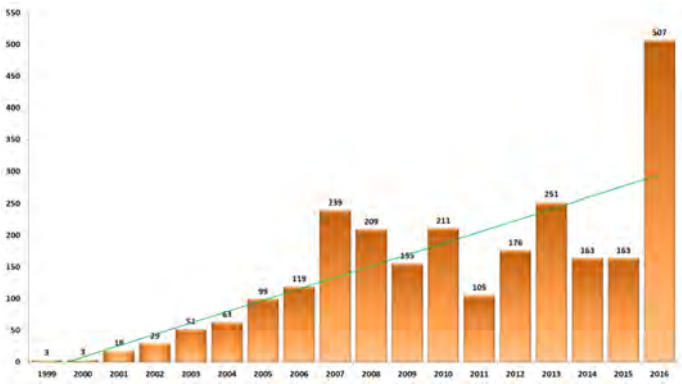
Employee Suggestion Scheme

The suggestion scheme at Deki has been growing continuously. Since the start of the scheme in 1999 we have implemented 20,057 suggestions till date.

The scheme is very simple wherein an employee fills up a suggestion form mentioning the present process, the proposed process and the savings/benefits from the proposed process. This is given to the section-in-charge who hands it over to the suggestion committee with his/her remarks. The committee meets every week and selects suggestions that can be implemented. Accepted suggestion are rewarded every week.

In 2015-16 we received 5.38 suggestions per employee per annum and set a target of >10 suggestions per employee per annum for 2016-17. We have exceeded the target within the first six months with 13.09 accepted suggestions per employee.

We firmly believe that one of the indicators of a motivated work force is in the number of suggestions its employees give. This, coupled with the ESS, gives an indication of the highly motivated Deki work force.



Employee Motivation Survey

Deki conducts an employee satisfaction survey every six months in which employees are asked a set of fifteen questions pertaining to their:

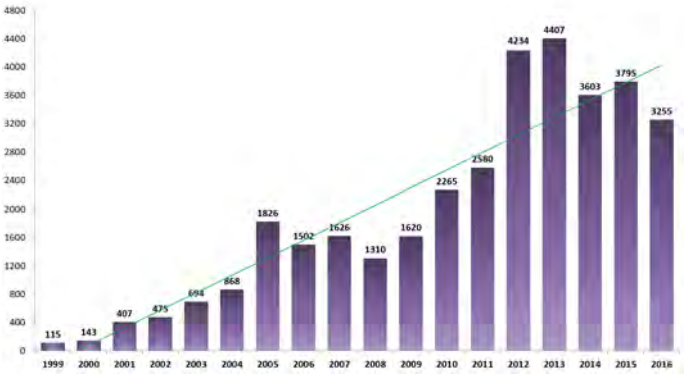
a. work environment,
b. salary,
c. satisfaction level,
d. growth opportunity,
e. knowledge of targets,
f. standard specifications, and,
g. operating procedures, etc.

The marks they give to each of the questions are consolidated and compared with the results of the most recent survey. The consolidated report along with the action points for improvement are discussed with all the employees in an “Open House” by our MD, Mr Vinod Sharma. The August 2016 survey showed an improvement from 88% to 89%.

Training in Deki

Of utmost importance at Deki, training is an integral part of continual skill enhancement and has been growing consistently. Detailed stage wise training is conducted in which knowledge of the process and the machines is imparted. This is followed by a written test. An employee has to score a minimum of 80% at critical stages to qualify to run the machine.

Deki spends close to 3% of working time on training and our training modules are well recognised, serving as a benchmark for component manufacturers.



electronica 2016 in Munich

The world’s leading trade fair for electronic components, systems and applications has grown larger this time. If you are visiting electronica 2016, do drop in at the Deki stand in Hall B6. You will find us in Booth 460/5. Update yourself with our latest application notes and see what is new from us.

LED Expo in December 2016

The 15th edition of LED Expo is scheduled to be held from the 2 – 4 December 2016 at Pragati Maidan, New Delhi, India. Deki will be present at the expo in Hall 10, Booth K101. Do drop in to meet us if you are attending the expo. It will be a pleasure exchanging notes.