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# Advanced FIT-Rate Estimation for Serial Systems

FIT(failures in time )-rates are a typical reliability measure for the constant part of the bathtub curve for non-repairable systems. The FIT-rate is the parameter of the exponential distribution in units of 109 hours. It is the inverse of the mean times between failures (MTBF). It is assessed at so-called MTBF-tests. For a serial system, FIT-rates of the individual components are added up. Frequently, individual FIT-rates are given as interval estimations at a certain confidence level (CL), e.g., 60% or 90% CL. Although it is common practice, adding up such FIT-rates can lead to an overly conservative estimation of the overall FIT-rate for a serial system.

We introduce a novel method to calculate FIT-rates at a given CL for serial systems. This method is based on data pooling. Raw data from individual MTBF-tests are combined. Situations of MTBF-tests with different durations are covered as well. Corner cases of various lengths of MTBF-tests, like balanced and unbalanced cases, are investigated. This data pooling forms the basis for the further FIT-rate calculation of a serial system. This new estimator is substantiated by a probability theoretical model. Statistical properties of this new estimator are examined. Special focus is put on the coverage probability of this new estimator, such that it ensures the stated CL.

The novel method is applied to multi-chip semiconductor products and supported by simulations. We see wide range of potential of this method for further applications where the raw data of MTBF-tests are available. This enables manufacturers of complex systems to achieve a competitive FIT-rate based on existing data.

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