Microcircuit Reliability

This section details the reliability performance, time, and operating conditions for microcircuits and recommends microcircuit prediction guidance. Part reliability is defined in the Scope section. Use this section to select reliability requirements for microcircuit usage.

Microcircuit Performance

Defining a microcircuit's performance in today's military is extremely critical. Historically, the military microcircuit industry overstated what was satisfactory operation for the performance of microcircuits used in military applications. In addition, the military mandated the use of military qualified parts. Today consumer microcircuits are being used beside military parts in many applications. This freedom presents a potential risk to the application and makes defining satisfactory operation more difficult than in the past. To assist in developing performance criteria for microcircuits, performance specification MIL-PRF-38535 should be used.

Microcircuit Lifetime

Microcircuits qualified to MIL-PRF-38535 and listed in QML-38535 are designed to last up to 20 years. On the other hand, non-military microcircuits are designed to last from 12 months up to 5 years. The microcircuit's package has a significant effect on the part's life. Packages that dissipate heat effectively and/or protect the internal circuitry from the environment allow the Microcircuit to last longer. The environmental categories detailed in the Scope section of this document/database establish timed-based requirements for microcircuit usage.

Microcircuit Operating Conditions

With the inclusion of non-military microcircuit usage into military applications, this element of reliability has become more critical then in the past. PEMs, which are not hermetically sealed, are susceptible to humidity (moisture) contamination. In addition, PEMs packaging is more restrictive to heat dissipating out than is ceramic or metal hermetic packages. Plastic packages by design raise the temperature of the microcircuit higher than if in a hermetic package. The environmental categories detailed in the Scope section of this document/database establish operating condition requirements for microcircuit usage.

Microcircuit Reliability Prediction - Probability

The Reliability Prediction of Electronic Equipment Handbook, MIL-HDBK-217F notice 2, is used as a guideline to establish and maintain probability for microcircuits. An area of some current disagreement in the MIL-HDBK-217F notice 2 is with the Quality Factor for commercial/consumer microcircuits. The handbook lists the Quality Factor (π_Q) as 10. This was established prior to 1991. Through review with industry, the Quality Factor for consumer plastic encapsulated microcircuits (PEMs) used in NAVSEA systems, is being reduced to a Quality Factor (π_Q) of 4.0. In addition, for PEMs used in NAVSEA systems, the Environmental Factor in the MIL-HDBK-217F notice 2 should be modified to the following:

a. For microcircuits used in the Protected Environment, the Environmental Factor (π_E) is 0.5.

b. For microcircuits used in the Normal Environment, the Environmental Factor (π_E) is 5.0.

In addition to the MIL-HDBK-217F, notice 2 there are other methods used to predict microcircuit reliability. The MIL-HDBK-217F, notice 2 is the preferred method until a suitable replacement is developed.