Microcircuits Introduction

There is no more complex and challenging component technology than microcircuits. The diversity of technologies and the pace of their advances present a bewildering range of design choices to the engineer. This information on microcircuits can be used as guidance or as a requirement.

The microcircuit industry has been driven by a progression of marketplaces: the military in the 1970's, personal computers in the 1980's, and networking in the 1990's. This market progression has fostered two common trends in microcircuit chip characterization: 1) increased functionality and complexity and 2) increased speed and density.

These trends have placed a great deal of pressure on the microcircuit interconnections and packaging. They have made it more difficult to lay out the interconnecting system with microcircuit chips increasing in size, I/O, power dissipation and frequency. In addition, with the demand for increased functional density, smaller package sizes, and the use of plastic encapsulated microcircuits (PEMs), the microcircuit's package reliability risk has grown tremendously.

Microcircuits have had significant technological advances resulting from these market drivers. For instance, the number of microcircuits on a motherboard has decreased as more functionality is being integrated into the microprocessor. As 0.5μm gate lengths are reached and surpassed, supply voltages are decreasing; this decrease has allowed power dissipation to be decreased. In addition, smaller microcircuits that are more capable are permitting reductions in equipment size and weight.

Through the advances of the microcircuit, the pace at which products are introduced has accelerated. A PC can be on the street in 9 to 12 months from the initial design through assembly to market. The total life cycle of a PC is just two years. This is all caused by the rate of change of the microprocessor technology. Every two years or less an old generation of microprocessors are being replaced by new ones.

The Microcircuits sections describes changes to the industry, products, and how to design and select microcircuits. Included are reliability, derating, and assessment requirements, failure mechanisms and design concerns to support insertion of microcircuits into applications.

Closing Comments

When using microcircuits in the "normal" or "severe" environments, recommend using QML-38535 qualified microcircuits.

For all military applications using microcircuits, the performance specification, MIL-PRF-38535, should be used.

Recommend applying the requirements in these microcircuit sections when using PEMs. EIA/JEDEC and IPC Standards to use are:

a. SSB-1 “Guidelines for Qualifying and Monitoring Plastic Encapsulated Microcircuits and Semiconductors”.

b. EIA/JESD22-A112-A “Moisture-Induce Stress Sensitivity for Plastic Surface Mount Devices”.

c. EIA/JEP113-A “Symbols and Labels for Moisture-Sensitive Devices”.

d. JESD22-A113-A “Preconditioning of Plastic Surface Mount Devices Prior to Reliability Testing”.

e. JEP124 “Guidelines for the Packing, Handling, and Re-packing of Moisture-Sensitive Components.

f. J-STD-020A “Moisture/Reflow Sensitivity Classification for Non-hermetic Solid State Surface Mount Devices”.

g. J-STD-033 “Standard for Handling, Packing, Shipping, and Use of Moisture/Reflow Sensitive Surface Mount Devices”.

PEMs packages are probably the most discussed subject in microcircuitry. Some general recommendations and commons are:

a. Use PEMs in the “protected” environment. Use PEMs in the “normal” environment only when: (1) the sensitivity level is acceptable, (2) it is thermally packaged to control heat dissipation, and (3) the PEM is qualified to the environment and application. Do not use PEMs in the “severe” environment.

b. Through-hole PEMs are generally a level 1-2 sensitivity, which is good. They can usually replace standard hermetic packaged microcircuits. Their replacement is usually for DMS situations only.

c. Surface mount PEMs are used for new designs and are usually a level 5-6, which is the most sensitive to moisture. In addition, the consumer industry continues to push this package smaller, which makes it even riskier. These parts are extremely sensitive and must be handled carefully. Recommend using them in the “protected” environment only. If used in the “normal” environment, the application must be one that is easily accessible for replacement or the applications life cycle must be short, 3 years or less.

d. Do not store any non-hermetic part beyond its recommended sensitivity level (1-6) shelf life.

e. Do not use parts in a long-term dormant application, beyond 7-8 years maximum.

Try to design an application for a 3 to 5 year life cycle. This will eliminate a number of problems and align with non-military industries, which lead the industries' technology changes.