Use of Commercial Off-The-Shelf (COTS) for Space Applications

R. David Gerke and Andrew A. Shapiro
Jet Propulsion Laboratory, California Institute of Technology

Commercial-off-the-shelf (COTS) plastic encapsulated microcircuits (PEM) are candidate-packaging technologies for spacecraft's due to their lower cost, lower weight, enhanced functionality and speed. PEMs can weigh half as much as their counter part ceramic packages. A lighter package results in a smaller overall payload for the same board functionality, a concern of critical importance for space missions because the payload mass dictates the launch vehicle requirements. PEMs are much more readily available than hermetic devices, because market forces (cost and volume) drive most designs to be developed first as plastic-encapsulated. At any given time, more part functions are available in plastic than in ceramic. The U.S. military and government, the major purchasers of hermetic parts, have become relatively small portions of the total electronics market. With package technology moving to surface mount, development of ceramic packages has lagged further in the microelectronic market, making adaptation of plastic-packaged integrated circuits (IC) to government and military aerospace applications even more critical. Aerospace industries are adapting trade-off and risk analysis to aid in reducing the cost while increasing performance and maintaining high reliability. NASA requires the packages to be selected depending on the type of mission, duration of mission, extreme environmental conditions such as temperature and radiation, etc.

All NASA programs are struggling with the prospect of using PEMs in their respective projects. Most of the projects are considering the use of PEMs on a case-by-case basis. PEMs are a subset of commercial off the shelf parts. One of the issues facing the space industry is that most PEMs are not screened by the manufacturer to their equivalent hermetic counterpart (if one exists). Therefore, projects must screen and qualify PEMs for each of their applications. Qualification and assessment tests estimate expected life and design integrity of a device for short and long duration NASA's missions. Most tests are not conducted at the application conditions, but incorporate accelerated levels of stress to accelerate failure mechanisms, often at known sites in a device. The main purpose of qualification and/or screening of any component are to mitigate risk to the end user. Commercial parts are not qualified or recommended by industry to stringent levels of reliability and quality required for NASA's space missions. Therefore, the COTS parts/packages need to be assessed by each NASA program/project to reduce the risk significantly for short and long duration NASA missions. Assembling a high performance electronic system with COTS PEMs components require that the end user needs to know the risk associated with such implementation. To minimize the risk involved, users employ accelerated stress testing to assess the packages and reduce the risk involved to the total system that depends on the duration of the package use. There are no standard risk mitigation techniques to accomplish this result. With the increased use of PEMs in NASA's Space applications there is an increased need to develop an assessment and reliability strategy that can be versatile enough to be used in all NASA Programs/Projects. This paper will discuss a proposed methodology intended for qualification of PEMs by NASA.