

Testing and System Health: EEE Parts and Packaging

Our desire to *enhance safety while doing more with less* emphasizes the importance of *adequate testing* for NASA missions. The rapid development of reliable NASA products requires sound, smart engineering and scientific planning and design with well-thought-out verification and test activities to ensure mission success. Our difficulties with recent failures in late stages of development—such as system integration and testing—and during mission operations, have greatly impacted our product performance, schedule, and cost. We must utilize the sound fundamentals of good design, test, and verification to provide high-quality products to our customers. *A do it right the first time* mentality will result in decreased failures and the reduction of risk in performance, schedule, and ultimately, cost. *Carefully planned test activities, based on knowledge*, are critical to ensuring system health and reducing risk.

Electrical, electronic, and electromechanical (EEE) parts and packaging technologies are the essence of the Agency's science instrumentation, spacecraft and aircraft systems, cutting-edge technology developments, and ground systems. Ensuring adequate testing of this critical hardware is key to enhancing the reliability and performance in NASA's mission environments.

Application of the faster, better, cheaper (FBC) philosophy has understandably generated interest in greater use of commercially available EEE parts and packaging technologies in NASA applications. The use of commercial-off-the-shelf (COTS) parts can simplify designs, increase functionality, and reduce cost and schedule, but their reliability may be compromised by incorrect

functional application or use in operating environments for which they have not been qualified. In addition, the use of advanced parts technology also enables systems of lower power and weight, enabling the addition of redundancy, and enhanced autonomy.

The NASA Electronic Parts and Packaging (NEPP) Program provides an Agencywide knowledge base of EEE parts and packaging performance characteristics in NASA mission environments. This cross-Enterprise activity performs testing and evaluation of newly available COTS and advanced EEE parts and packaging technologies to support the rapid, reliable insertion of this important hardware into NASA Programs and Projects. These tests and assessments provide critical data to support the selection of EEE parts and packaging technology and determination of adequate tests and qualification procedures. The focus of NEPP activity is in areas defined by the Enterprises as future needs.

Ultimately, it is the responsible engineering use of these data that increases the health of our systems that are needed to efficiently and safely complete current and future NASA missions. Wise utilization of the knowledge we gain assists in the definition of any tests required for specific mission needs, as well as the minimization of risk associated with new and advanced technology use. Our investments in activities to make critical information available are *only* effective if we proactively and responsibly make use of the data to build systems of high reliability. Let us take advantage of the expert knowledge available to make sound engineering decisions to ensure mission success.

Background

NEPP Goal:
To Provide Knowledge to Program and Project Engineers, Technologists, & Safety and Mission Assurance

NEPP EEE Parts and Packaging Assessment Process:

Understand Technology	+	Model and Test in NASA Mission Environments	=	Potential Failure Modes and Mechanisms in NASA Environments
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Recommended Engineering Use of NEPP Data:

1. Potential Failure Modes and Mechanisms (*NEPP Data*) + Understand Mission Environment + Mission-Specific Tests/Assessments = Mission-Specific Failure Modes and Mechanisms
2. Mission-Specific Failure Modes and Mechanisms + Understand Technology Application/Design = Expected Technology Performance/Reliability
3. Expected Technology Performance/Reliability + Appropriate Qualification Tests/Methods etc. = Use of Qualified Parts/Level of Assurance

- NEPP is a cross-Enterprise activity. The intent is to reduce cost by providing technology characterizations that are useful to multiple projects and Enterprises. *Project-specific* assessments may be necessary to supplement available NEPP data.
- The NEPP Web site is <http://nepp.nasa.gov>
- Points of contact for areas of expertise are found on the above referenced Web site

Proposed Next Steps

NASA Centers

- Perform EEE parts and packaging engineering and project risk decisions that are based on technical data, including results of tests, simulations, and evaluations appropriate for the specific mission environment and application.
- Properly train EEE parts and engineering personnel to ensure that they remain technically current. Encourage graduate training, specialty courses, and presentation and publication at technical conferences.
- Reward sound engineering decision-making. Support engineering recommendations regarding test or validation needs, provide systems engineers with authority and accountability in decision-making increase awards for sound engineering decisions, and teamwork.
- Ensure rigorous use of all available EEE parts and packaging information during the design phase in order to minimize application errors. Utilize the data with consideration of functional performance needs and criticality of hardware designs to perform the intended missions and a full understanding of the application environment.
- Ensure any necessary testing to cover anticipated design application and mission environment.
- Ensure regular utilization of the NEPP database by designers of information systems to proactively fertilize knowledge of parts application notes into current design activity.
- Engage the expertise within the NEPP Program support structure at the Centers to establish full understanding of the qualifiability of the technologies being considered.
- Ensure that the data is appropriate for the parts of interest — be sure to check lot numbers, mask sets, die revisions, or other parameters that may affect part consistency.
- Interact with the NEPP Program during concept phase concerning the open issues found during assessment of advanced technologies, likely availability, and qualifiability.
- Establish continual dialogue with the NEPP Program to ensure the priority technologies continue to be evaluated.