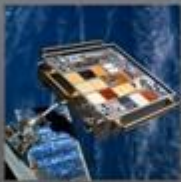
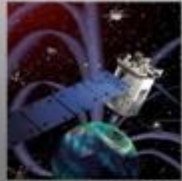


National Aeronautics and
Space Administration



NEPP Task FY22

Alternate Grade Parts Selection Tools & Processes

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Introduction



- **Mission:** Langley Research Center NEPP/NEPAG FY22 task to Identify "New Space" emerging COTS technology selection/usage analysis for high-risk community usage. Important focus will be on the qualification/screening differences when compared to Mil-Spec counterparts. This task analysis will result in accomplishing the foundation for a designer reference that allows for better technology application choices where reliability and risk assessments are required when unique COTS functionality is required by projects..
- **Deliverables:** Generate Cross Reference tool depicting what technologies & commodities are available by vendor and what features and reliability testing is being performed for those vendor offerings. The tool would also attempt to capture form fit and functions that make that product appeal to project need. When Size Weight and Power becomes increasingly important versus reliability, we will try to capture that for comparison.
- **Format**
 - Database of Vendor/Parts related information, Task Outline
 - Final Report



Background



➤ **Background:** There is an increasing interest in using alternate reliability grade parts in aerospace electronics assemblies. What are alternate reliability grade parts, who makes them & why consider using them ?

- Various Reputable Commercial/Military Electronic Vendors
- Unique functions/performance
- Typically manufactured on high volume commercial production lines

➤ **Task Goal:** Designers Guide to functionality and reliability assessment.

- Datasheet or Military SCD documentation(VID drawings) (“Web-Based Links”)
- Vendor Reliability Grade Nomenclature (Lean Rel, Enhanced Product.....)
- Understanding of Vendor Radiation Performance claims (“Space Enhanced”)
- Temperature performance range (Industrial, “Military-Like”, and Military)

➤ **Commodity Perspective**

- Research provided better understanding for reliability in contrast to Mil parts
- Select Topics – discussed in final report



Motivation



➤ Advantages of alternative reliability grade electronic parts

- Newer technology, (attractive to new & unique missions (w/ higher risk tolerance)
- Lower procurement costs
- Readily Available (COVID & Supply Chain Chaos excluded)
 - More functional selection options
 - Better project schedule mitigation
 - Better suited for shorter mission duration needs

➤ Key Requirements, Environment & Part Application Match

- Mission, Environment, Application and Lifetime Assessment
- Penalties for Mis-Match range from catastrophic failure to limited performance
- Beware [Budget, Time] ramifications
- Safe Operating Range – additional Derating – Design analysis
 - Ensure part series pedigree is clearly understood
- Radiation Performance – Datasheet – Heritage/Vendor Testing
 - Customer Testing needed when data or similarity analysis is not feasible



Activity Working Key Points



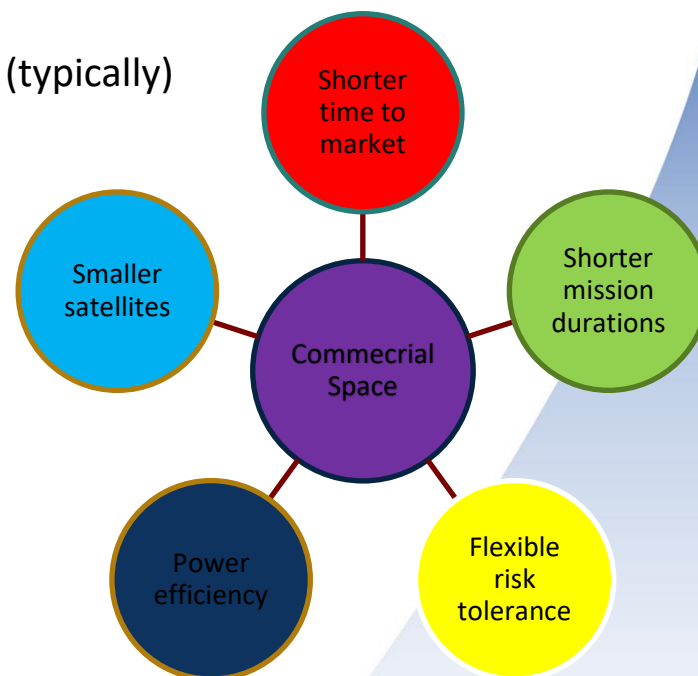
➤ Alternate Reliability Grade Parts - key attributes

➤ Benefits of alternate grade parts

- High volume production = higher degree of quality and reliability
- Lower procurement costs, shorter lead times,
- Smaller footprints, and lower power consumption (typically)
- Military Grade production lines (by request)

➤ Potential disadvantage of alternate grade parts

- Supply Chain Risk Management
- Radiation Pedigree (no RHA)
- Part Consistency (Homogeneity)





Key Points (& more)



➤ Alternate Reliability Grade Part Qual/Screening Tests/Features

➤ Review of Test Specifications (Product Example #1)

- Wafer lot uniformity and traceability
- Lower cost
- Single wafer fab location
- Wafer lot traceability
- Radiation monitors
- Outgassing characterization
- High reliability lead finishes and no Cu wire bonds
- Extended temperature
- No matte tin
- TID testing per lot and benchmark SEL at product release
- Outgassing Testing



Key Points (& more)



➤ Alternate Reliability Grade Part Qual/Screening Tests/Features

➤ Review of Test Specifications (Vendor/Product Example #2)

- Wafer lot uniformity and traceability
- Radiation monitors
- Smaller packages than traditional ceramic/hermetic
- Outgassing characterization
- High reliability lead finishes and no Cu wire bonds
- Extended temperature
- High reliability screening
- Serialized devices
- Single Event Latchup (SEL) testing
- High reliability Quality Conformance Inspection
- 100% processing attributes data
- Electrical test variable data, if applicable
- Radiographic inspection report, if applicable
- Failure analysis report, if applicable
- Certificate of Conformance



Key Points (& more)



➤ Alternate Reliability Grade Part Qual/Screening Tests/Features

- Review of Test Specifications (Vendor/Product Example #3)
 - Single Event Latch-up (SEL) immune to 43 MeV-cm² /mg.
 - Tested at maximum operating voltage and 125°C.
 - ELDRS-free to 30 krad(Si).
 - Every bipolar and BiCMOS product goes through ELDRS characterization at low dose rate (LDR) of 10 mrad(Si)/s.
 - Radiation lot acceptance testing (RLAT) to 20 krad(Si).
 - Every wafer lot is tested and qualified to 20 krad(Si) with an RLAT report available.
 - Military temperature range: -55°C to +125°C.
 - No copper bond wires. All products have gold bond wires. not have pure Sn.



Key Points (& more)



➤ Alternate Reliability Grade Part Qual/Screening Tests/Features

- Review of Test Specifications (Vendor/Product Example #3) cont'd
 - Enhanced mold compound for low outgassing.
 - Extended qualification of each assembly lot including HAST and temperature cycling.
 - 100% temperature cycling.
Every unit receives temperature cycling or equivalent.
 - Single production flow.
One wafer fab and assembly site to minimize lot-to-lot variation.
 - Long product life cycles.
 - Each product has its own Vendor Item Drawing (VID) on DLA website



Quality Assurance



➤ General Testing Summary

- Manufacturer Typically screening based on the AEC Q100 standard for automotive grade parts or similar.
- Can vary though – base line tests comparable to below:
 - Thermal cycle
 - Electrical test
 - Baseline C-SAM
 - Solderability
 - Wafer Lot Acceptance
 - Single Event Latchup (SEL) testing (for radiation die qualified/tested parts)
 - 100% temperature cycling
 - Outgassing characterization
 - Certificate of Conformance



Selection Challenges



➤ Terminology

- Vendor Marketing Terms are not standard – and unique and market specific
- Numerous vendors – web search difficulties – information location random

➤ Technical Criteria Matching

- Vendor Testing not standard in some cases –
- AEC Q100 helps standardize – thus some comparisons can be manageable
- Selection Tool intended to aid in analysis and differentiation
- Without a tool – comparison process is more laborious



Conclusion



➤ Task Effort Objectives

- Effort aimed at helping engineers select components that will ensure mission success via information database used for selection quality & reliability performance analysis
- Itemize Key High Production Volume & Reputable vendors noting their offered commodities – and differentiate the product(s) characteristics

➤ Market Place Awareness

- As with most Market Product Lines – Increased Buyer Awareness is advised
- Diligence required for part application – proper design analysis required
- Selection Tool intended to be continuous improvement activity
- Without a selection tool – hidden project costs likely with longer design and review cycles



QUESTIONS / FEEDBACK

