

# **Guidance for Use of Commercial EEEE Parts in Class D Missions**

*In the context of proposals written in response to NASA  
SMD's Announcements of Opportunities (AOs)*

**Version 1.0**

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# Introduction

In April 2021, the Science Mission Directorate (SMD) introduced a new Class D Mission Assurance Requirements (MAR) document (SMD Policy Document SPD-39) that enables use of a wider range of institutional practices and commercial Electrical, Electronic, Electromechanical, and Electro-Optical (EEEE or Quad E) parts. Additionally, SPD-39 allows more flexibility for proposers to use commercial suppliers with the suppliers' own Safety and Mission Assurance (S&MA) standards that have been proven successful. NPR 8705.4 has also been updated to revision A and provides more flexibility in how proposers meet S&MA requirements. The wider range of allowable institutional practices and commercial EEEE parts introduces additional considerations, risks, and issues which should be addressed by the proposer.

This document was created to provide to provide guidance to proposers regarding missions that implement commercial EEEE parts under SPD-39 guidance. The requirements and evaluation criteria for proposals and Phase A Concept Study Reports (CSRs) are the same for missions that use commercial EEEE parts and supplier S&MA practices as they are for space-qualified parts and NASA Mission Assurance standards. However, commercial EEEE parts offer both opportunities and challenges that must be considered in the development approach. This document provides additional guidance for proposing teams to create stronger proposals and CSRs when commercial EEEE parts and supplier internal S&MA practices are proposed. Proposing teams are advised to consider the guidance in this document during the proposal and CSR process. This document is supplemental; it does not create new requirements, nor does it remove any existing requirements in the *Announcement of Opportunity (AO)* or *Criteria & Requirements for the Phase A Concept Study Report (C&R)* documents. Guidance related to deferred material is included in this document so that proposal teams may consider it as the mission concepts are defined. Deferred material should not be included in proposals.

Additional guidance for missions that use commercial EEEE parts is provided for the following five topics.

- Terminology
- Supporting Documentation
- Safety and Mission Assurance at the Mission Level
- Radiation Assessment and Mitigation
- Management of Commercial EEEE Parts and Suppliers

# Consistent Terminology

## Background

To avoid miscommunication between the proposing team and Technical, Management and Cost (TMC) evaluation team, a consistent set of terminology is necessary for discussing commercial EEEE parts.

## Potential Issues with Commercial EEEE Terminology

Commercial EEEE parts can sometimes be referred to as Commercial-Off-The-Shelf (COTS) parts. The term COTS is misleading as many space-qualified components that meet NASA Safety and Mission Assurance standards without modifications are considered COTS components. COTS has also been used to define a supplier product line that requires significant modifications to support a given mission.

## Additional Guidance for use of Commercial EEEE parts

To avoid ambiguous terminology, the following definitions are provided:

- **EEEE:** Electrical, Electronic, Electromechanical, and Electro-Optical parts. Any references to Electrical, Electronic, and Electromechanical (EEE) parts are from legacy standards released prior to incorporation of Electro-Optical parts into the industrial vernacular.
- **EEEE part:** Any part, assembly or design. This includes components, elements, subsystems, and/or systems that contain EEEE components.
- **Commercial EEEE parts:** Any EEEE parts that are readily available for procurement, usually to catalog specifications, that are not space-qualified to NASA Safety and Mission Assurance standards. This can include automotive-grade parts or parts that have been used only on commercial space systems.

# Supporting Documentation

## Background

Documents are included in the NASA AO Program Library that provide requirements on selected missions as specified in the applicable AO, as well as providing suggested guidance that the proposing team may consider as the mission concept is defined. The following is a subset of those documents that are applicable to Class-D SMD mission proposals that intend to implement a mission concept with commercial EEEE parts and/or commercial S&MA processes. This list of documents can assist proposers in understanding definitions, requirements, and best practices for the use of commercial EEEE parts. Any document that is not a NASA standard is not required nor expected to be followed by the proposing team but is meant to outline best practices that have been used during the development of NASA missions.

This subset is not intended to be a comprehensive list of applicable documents described in the AO.

## NASA Standards and Guidelines on use of Commercial EEEE parts

SPD-39 – SMD Standard Mission Assurance Requirements for Payload Classification D (Approved April 29, 2021)

- This document provides standardized Mission Assurance Requirements as defined in NPR 8705.4A. This document also includes specific items to be considered in the Parts Control Plan (PCP) and requires radiation effects analysis to be performed. SPD-39 omits a method for missions to manage radiation effects and mitigation approaches.

NPR 8705.4A – Risk Classification for NASA Payloads (Approved May 2021)

- This document provides guidance on Mission Assurance Requirements for Class D missions and identifies NASA-STD 8739.10 as the accepted standard for EEEE parts.

NASA-STD 8739.10 – Electrical, Electronic, and Electromechanical (EEE) Parts Assurance Standards (Approved June 13, 2017)

- This document establishes a consistent set of requirements for EEEE parts selection, management and control for space flight and mission critical ground support equipment for NASA programs. This document identifies Grade 4/Level 4 EEE parts as those that meet commercial vendor standards with qualification at the manufacturer’s discretion and “have not been independently verified”. Commercial EEEE parts are similar to the definition of Grade 4/Level 4 parts in SPD-39.

## Additional Guidance for use of Commercial EEEE parts

NASA/TM–20210018053 - Avionics Radiation Hardness Assurance (RHA) Guidelines (July 2021)

- This document outlines a system-level philosophy for radiation assessment and mitigation. This document provides best practices and guidelines spanning primary radiation effects, *i.e.*, Total Ionizing Dose (TID), Total Non-Ionizing Dose (TNID) and Single Event Effects

(SEEs). The document also includes content on radiation shielding and transport, radiation effects testing and analysis, and operational monitoring for radiation effects.

# **Safety and Mission Assurance at the Mission Level**

## **Background**

All proposals are expected to describe the approach to ensuring that the payload and flight system will operate successfully and provide all the data needed to meet the science requirements. From a mission level perspective, mission assurance can be demonstrated via a combination of testing, fault tolerance, system redundancy, and/or mission architecture. While proposing teams should consider all key areas of mission assurance, the following is specific to the use of commercial EEEE parts.

## **Potential Issues for use of Commercial EEEE parts**

Missions that use commercial EEEE parts and supplier practices that do not conform to typical NASA parts control boards, verification, and testing will have to rely on other methods or additional testing and verification to demonstrate mission resiliency.

## **Additional Guidance for use of Commercial EEEE parts**

Proposing teams should consider identifying any mission-critical commercial EEEE parts, at the level of system decomposition appropriate to their pre-Phase A or Phase A design (note the definition of EEEE “part” for the context of this document, defined in introduction). Proposing teams should consider describing the approach to maintaining mission resiliency by discussing any potential impacts to these parts based on the mission environment, application, and mission lifetime. Proposing teams should consider describing mitigations for these impacts.

# **Radiation Assessment and Mitigation**

## **Background**

All proposals are required to demonstrate that the proposed concept meets all Key Driving Requirements (KDRs), including those imposed by the mission environment and lifetime. Environment considerations include the expected radiation environment and any mitigation for susceptible parts. All proposing teams should therefore consider a preliminary radiation effects mitigation program, as applicable.

## **Potential Issues for use of Commercial EEEE parts**

Different commercial EEEE parts can be susceptible to various types of radiation. Upgrading parts to be more radiation-tolerant or replacing these parts with radiation-tolerant parts may be cost-prohibitive based on the cost cap for Class D missions. Various design and mission-level options may need to be considered to mitigate radiation susceptibility.

## **Additional Guidance for use of Commercial EEEE parts**

To demonstrate that the proposal includes a radiation-tolerant design, the proposing team should consider providing the following information, as applicable:

- Preliminary estimates and requirements for the mission radiation environment, including Total Ionizing Dose (TID), Total Non-Ionizing Dose (TNID) and Single Event Effects (SEEs) such as Single-Event Functional Interrupts (SEFIs) and Single-Event Latchups (SELs). All radiation environments such as Galactic Cosmic Rays, trapped particles, and solar particles need to be considered (refer to NASA/TM-20210018053 for detailed information on radiation environments).
- Identification of susceptible radiation parts and associated radiation risks, at the level of system decomposition appropriate to their pre-Phase A or Phase A design.
- Description of any aspects of the mission or design concepts that mitigate these radiation risks.

# **Management of Commercial EEEE Parts and Suppliers**

## **Background**

Plans for Safety and Mission Assurance typically involve managing and controlling EEEE parts through a Parts Control Board (PCB) and Parts Control Plan (PCP) at the mission level. Proposals are required to summarize the approach to managing EEEE parts.

## **Potential Issues for use of Commercial EEEE parts**

Commercial suppliers may be concerned about the release of their proprietary information or may not follow the standard NASA parts control approach for managing EEEE parts. The proposing team should be aware of the level of parts control oversight that will be accepted by commercial EEEE parts suppliers.

## **Additional Guidance for use of EEEE parts**

The proposing teams should consider providing a summary of the approach to selecting, managing and controlling EEEE parts that includes any specific plans for commercial EEEE parts suppliers that do not follow standard NASA practices.

The *Criteria & Requirements for the Phase A Concept Study (C&R)* document requires more information on parts management. The concept study team should consider describing the development and implementation of the Parts Control Plan (PCP), Parts Control Board (PCB), and the planned participation of major commercial EEEE parts suppliers, as applicable. For consistency with SPD-39, the concept study team should consider providing justification when any major commercial EEEE parts suppliers will not be participating in the mission-level PCB and the approach to ensure sufficient management of the parts from those suppliers. The implementation of the PCP should also be considered in the schedule and cost to accurately reflect any additional activities required to support the use of commercial EEEE parts.