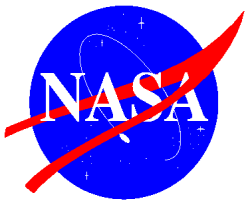

NOT
MEASUREMENT
SENSITIVE

National Aeronautics and
Space Administration

MSFC-STD-3012
BASELINE
DECEMBER 17, 1999

George C. Marshall Space Flight Center
Marshall Space Flight Center, Alabama 35812

ED16

MULTIPROGRAM/PROJECT COMMON USE DOCUMENT

EEE PARTS MANAGEMENT AND CONTROL FOR MSFC SPACE FLIGHT HARDWARE

DOCUMENT HISTORY LOG

Status (Baseline/ Revision/ Canceled)	Document Revision	Effective Date	Description
Baseline		12/17/99	Initial Release

FOREWORD

1. This Standard establishes a uniform set of requirements for electrical, electronic, and electromechanical (EEE) parts selection, management, and control for space flight and mission essential ground support equipment for Marshall Space Flight Center (MSFC) programs. The parts requirements described in this document are to be selectively applied based on equipment grade and mission needs as specified in the Project Specification. Individual equipment needs should be evaluated to determine the extent to which each requirement should be applied.

2. This Standard:

   a. Establishes four quality levels (Grade 1, 2, 3, & 4) for EEE parts.

   b. Establishes EEE parts selection, and control requirements and provides a suggested Appendix for each of the above quality levels implementation

   c. Establishes responsibility for documenting parts selection, qualification, and parts related data.

3. Questions concerning the application of this Standard shall be referred to the EEE Parts and Packaging Group of the Avionics Department.

4. Beneficial comments and suggestions for improving this Standard may be submitted to the Office of Primary Responsibility (ED16).

TABLE OF CONTENTS

LIST OF TABLES

LIST OF APPENDICES

1.0 SCOPE. This Standard sets forth the selection, testing, and application requirements which each Project Manager shall use (tailor) to manage and control the electrical, electronic, and electromechanical (EEE) parts activities for MSFC space flight and mission essential ground support equipment.

1.0.1 Implementation While the actual selection of EEE parts is an engineering process, the detailed implementation into project baselines of the selected EEE parts shall be accomplished by the process as defined in the Project Configuration Management Plan.. Should a conflict arise between this Standard and the Project Configuration Management Plan, the Project Configuration Management Plan shall govern.

1.1 **General.** Special requirements not covered by or not in conformance with the requirements of this publication shall be detailed in engineering documentation which shall take precedence over appropriate portions of this publication when approved in writing by MSFC prior to use.

1.2 **Applicability**. This publication applies to MSFC programs using EEE parts for flight hardware.

2.0 APPLICABLE DOCUMENTS.

2.1 **General** The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issue in effect on the date of invitation for bids or requests for proposal shall apply.

MIL-C-14409	Capacitors, Variable (Piston Type, Tubular Trimmer), General Specification For
MIL-C-17	Cables, Radio Frequency, Flexible And Semirigid, General Specification For
MIL-C-22992	Connectors, Plugs And Receptacles, Electrical, Waterproof, Quick Disconnect, Heavy Duty Type General Specification For
MIL-C-26482	Connector, Electrical, (Circular, Miniature, Quick Disconnect, Environment Resisting), Receptacles And Plugs, General Specification For
MIL-C-38999	Connector, Electrical Circular, Miniature, High Density, Quick Disconnect (Bayonet, Threaded and Breech Coupling), Environment Resistant, Removable Crimp And Hermetic Solder Contacts, General Specification For
MIL-C-39029	Contacts, Electrical Connector, General Specification For
MIL-C-5015	Connectors, Electrical, Circular, Threaded AN Type, General Specification For

MIL-C-55302	Connectors, Printed Circuit Subassembly And Accessories
MIL-C-85049	Connector Accessories, Electrical, General Specification For
MIL-DTL-27500	Cable, Power, Electrical And Cable Special Purpose, Electrical Shielded And Unshielded, General Specification For
MIL-DTL-81381	Wire, Electric, Polyimide-Insulated Copper Or Copper Alloy
MIL-HDBK-1547	Electronic Parts, Materials, and Processes for Space and Launch Vehicles
MIL-PRF-123	Capacitors, Fixed, Ceramic Dielectric (Temperature Stable And General Purpose), High Reliability, General Specification For
MIL-PRF-15305	Coils, Fixed And Variable, Radio Frequency General Specification For
MIL-PRF-19500	Semiconductor Devices, General Specification For
MIL-PRF-19978	Capacitors, Fixed, Plastic (Or Paper-Plastic) Dielectric, (Hermetically Sealed In Metal, Ceramic, Or Glass Cases), Established And Non-Established Reliability, General Specification For
MIL-PRF-20	Capacitors, Fixed, Ceramic Dielectric (Temperature Compensating), Established Reliability And Non-Established Reliability, General Specification For
MIL-PRF-21038	Transformers, Pulse, Low Power, General Specification For
MIL-PRF-23269	Capacitors, Fixed, Glass Dielectric, Established Reliability, General Specification For
MIL-PRF-23648	Resistor, Thermal (Thermistor), Insulated, General Specification For
MIL-PRF-24308	Connectors, Electric, Rectangular, Nonenvironmental, Miniature, Polarized Shell, Rack and Panel, General Specification For
MIL-PRF-27	Transformers And Inductors (Audio, Power, And High-Power Pulse), General Specification For
MIL-PRF-28861	Filters And Capacitors, Radio Frequency/Electromagnetic Interference Suppression, General Specification For
MIL-PRF-3098	Crystal Units, Quartz, General Specification For
MIL-PRF-38534	Hybrid Microcircuits, General Specification For
MIL-PRF-38535	Integrated Circuits Manufacturing, General Requirements For

MIL-PRF-39001	Capacitors, Fixed, Mica Dielectric Established Reliability, and Nonestablished Reliability, General Specification For
MIL-PRF-39003	Capacitors, Fixed, Electrolytic (Solid-Electrolyte) Tantalum, Established Reliability, General Specification For
MIL-PRF-39005	Resistors, Fixed, Wire-Wound, (Accurate), Nonestablished Reliability, Established Reliability, General Specification For
MIL-PRF-39006	Capacitors, Fixed, Electrolytic (Non-Solid Electrolyte) Tantalum, Established Reliability, General Specification For
MIL-PRF-39007	Resistors, Fixed, Wirewound (Power Type), Nonestablished Reliability, Established Reliability, and Space Level, General Specification For
MIL-PRF-39009	Resistors, Fixed, Wire-Wound (Power Type, Chassis Mounted), Nonestablished Reliability, and Established Reliability, General Specification For
MIL-PRF-39010	Coil, Radio Frequency, Fixed, Molded, Established Reliability And Non-Established Reliability, General Specification For
MIL-PRF-39014	Capacitors, Fixed, Ceramic Dielectric (General Purpose) Established Reliability, and Nonestablished Reliability, General Specification For
MIL-PRF-39015	Resistors, Variable, Wire-Wound (Lead Screw Actuated), Nonestablished Reliability, and Established Reliability, General Specification For
MIL-PRF-39016	Relays, Electromagnetic, Established Reliability, General Specification For
MIL-PRF-39017	Resistors, Fixed, Film (Insulated) Nonestablished Reliability, and Established Reliability, General Specification For
MIL-PRF-39019	Circuit Breakers, Magnetic, Low-Power, Sealed, Trip-Free, General Specification For
MIL-PRF-39022	Capacitors, Fixed, Metallized, Paper- Plastic Film or Plastic Film Dielectric, Direct and Alternating Current, (Hermetically Sealed in Metal or Ceramic Cases), Established Reliability, General Specification For
MIL-PRF-39035	Resistors, Variable, Nonwire-Wound (Adjustment Type) Nonestablished Reliability, and Established Reliability, General Specification For
MIL-PRF-49142	Connectors, Triaxial, Radio Frequency, General Specification For

MIL-PRF-49467	Capacitor, Fixed, Ceramic, Multilayer, High Voltage (General Purpose), Established Reliability, General Specification For
MIL-PRF-55182	Resistors, Fixed, Film, Nonestablished Reliability, and Established Reliability General Specification For
MIL-PRF-55310	Oscillator, Crystal Controlled, General Specification For
MIL-PRF-55342	Resistors, Fixed, Film, Chip, Nonestablished Reliability Established Reliability, General Specification For
MIL-PRF-55365	Capacitor, Fixed, Electrolytic (Tantalum), Chip, Nonestablished Reliability, Established Reliability, General Specification For
MIL-PRF-55681	Capacitors, Chip, Multiple Layer, Fixed, Ceramic Dielectric, Established Reliability and Nonestablished Reliability, General Specification For
MIL-PRF-81	Capacitors, Variable, Ceramic Dielectric, General Specification For
MIL-PRF-83401	Resistor Networks, Fixed, Film, And Capacitor-Resistor Networks, Ceramic Capacitor And Fixed Film Resistors, General Specification For
MIL-PRF-83421	Capacitors, Fixed, Metallized, Plastic Film Dielectric (DC, AC, Or DC And AC) Hermetically Sealed In Metal or Ceramic Case, Established Reliability, General Specification For
MIL-PRF-83446	Coils, Chips, Fixed Or Variable, General Specification For
MIL-PRF-83513	Connectors, Electrical, Rectangular, Microminiature, Polarized Shell, General Specification For
MIL-PRF-87164	Capacitors, Fixed, Mica Dielectric, High Reliability, General Specification For
MIL-PRF-87217	Capacitors, Fixed, Supermetallized Plastic Film Dielectric, Direct Current For Low Energy, High Impedance Applications, Hermetically Sealed In Metal Cases, High Reliability, General Specification For
MIL-R-122	Resistors, Fixed, Precision, Established Reliability, General Specification For
MIL-STD-1553	Digital Time Division Command/Response Multiplex Databus
MIL-STD-1580	Destructive Physical Analysis For Electronic, Electromagnetic, and Electromechanical Parts
MIL-STD-1686	Electrostatic Discharge Control Program For Protection Of Electrical and Electronic Parts, Assemblies And Equipment (Excluding Electrically Initiated Explosive Devices)

MIL-STD-202	Test Methods For Electronic and Electrical Component Parts
MIL-STD-750	Test Methods For Semiconductor Devices
MIL-STD-883	Test Method Standard Microcircuits
MIL-STD-981	Design, Manufacturing And Quality Standards For Custom Electromagnetic Devices For Space Applications
MIL-W-16878	Wire, Electrical, Insulated, General Specification For
MIL-W-22759	Wire, Electrical, Fluoropolymer-Insulated Copper Or Copper Alloy
MSFC-RQMT-2918	Requirements For Electrostatic Discharge Control
MSFC-SPEC-548	Specification For Vacuum Baking Of Electrical Connectors For Spacelab Payloads
MSFC-SPEC-684	Specification For Vacuum Baking Of Electrical Cables For Spacelab Payloads
MSFC-STD-355	Standard Radiographic Inspections Of Electronic Parts
MWI 1280.5	MSFC Alert Processing
NASA GSFC PPL-21	Goddard Space Flight Center Preferred Parts List
NASA GSFC S-311-P-10	Connectors, Electrical, Rectangular, Miniature, Polarized Shell, Rack and Panel, for Space Flight Use
NASA GSFC S-311-P-18	Thermistor, (Thermally Sensitive Resistor), Insulated and Uninsulated, Negative Temperature Coefficient, Specification for
NASA GSFC S-311-P-4	Connectors (And Contacts), Electrical, Rectangular, For Space Flight Use, General Specification For
NASA Technical Memorandum 102179	Selection of Wires and Circuit Protective Devices for STS Orbiter Vehicle Payload Electrical Circuits
NASA/MSFC 40M38277	Connectors, Electrical, Circular, Miniature High Density, Environment Resisting, Specification For
NASA/MSFC 40M38298	Connectors, Electrical, Special, Miniature Circular, Environment Resisting 200 °C, Specification For
NASA/MSFC 40M39513	Wire, Electrical, Hook Up, General Specification For
NASA/MSFC 40M39526	Cable, Electrical, Shielded, Jacketed, Specification For
NASA/MSFC 40M39569	Connectors, Electrical, Miniature Circular, Environment Resisting, Specification For

NEMA-MW-1000	Magnet Wire
NHB 8060.1	Flammability, Odor, Offgassing, And Compatibility Requirements And Test Procedures For Materials In Environments That Support Combustion
NSTS 1700.7	Safety Policy and Requirements For Payloads Using the Space Transportation System
SP-R-0022A	Specification, Vacuum Stability Requirements Of Polymeric Material For Spacecraft Application
SSP 30312	Electrical, Electronic, and Electromechanical Parts Management and Implementation Plan for Space Station
SSQ 21635	Connectors And Accessories, Electrical, Circular, Miniature, IVA/EVA Compatible, Space Quality, General Specification For
SSQ 21637	Connectors And Accessories, Electrical, Umbilical Interface, Environmental, Space Quality, General Specification For
SSQ 21654	Cable, Single Fiber, Multimode, Space Quality, General Specification For
SSQ 21678	Switch, MIL-STD-1553B, Data Bus, Space Quality, General Specification For

3.0 **DEFINITIONS AND ACRONYMS.**

3.1 **Definitions.**

µCkt	Microcuit
CAGE code	An identifying code assigned by the Government that unambiguously identifies EEE part sources.
Commercial	A classification for an assembly, part, or design for which the item manufacturer or vendor establishes performance and quality standards pursuant to market forces rather than by enforceable compliance to a government or industry standard.
Derating	The process of providing for enhanced reliability and life of a EEE part in an application by designing so that the electrical/thermal stresses applied to the part are significantly below the parts rating.
Destructive Physical Analysis	A series of inspections and tests performed on samples of a EEE part and resulting in damage to the samples. Usually part of a failure analysis or quality conformance inspection.
GIDEP	An organization through which users and suppliers of EEE parts may exchange information such as part design changes and failure experiences.
Grade 1	A classification which designates EEE parts of the highest practical quality standards.
Grade 2	A classification which designates EEE parts of high, but generally not the highest, quality standards.
Grade 3	A classification which designates EEE parts which generally meet some formal industry quality standards, but usually the lowest quality class option that is available under the standards.
Grade 4	A classification which designates EEE parts for which no predefined quality classification is imposed.
Hi-Rel	A term used to describe “high reliability” parts which have been screened and qualified to requirements determined solely by the manufacturer.
Lot Date Code	An identification, usually marked on a EEE part and prescribed by the applicable specification, to identify parts which have been processed as a batch.
Multi-Chip Module	A type of hybrid microcircuit consisting of multiple semiconductor chips mounted on a substrate.

Off-The-Shelf	Assembly, part, or design that is readily available for procurement, usually to catalog specifications, without the necessity of generating detail procurement.specifications for the item.
Qualified Manufacturing Line	A classification issued by a qualifying agency that identifies products, processes, and manufacturers that have met certain standards for qualification.
Qualified Parts List	A classification issued by a qualifying agency that identifies products and manufacturers that have met certain standards for qualification.
Quality Conformance Inspection	Inspection, or test, used to verify conformance with requirements.
Standard part	A EEE part that meets program piece part qualification requirements. and is designated “standard” in the applicable Grade level table.

3.2 **Acronyms**.

CAGE	Commercial And Government Entity
DPA	Destructive Physical Analysis
EEE	Electrical, Electronic, and Electromechanical
ER	Established Reliability
ESD	Electrostatic Discharge
FRL	Failure Rate Level
GIDEP	Government Industry Data Exchange Program
GSFC	Goddard Space Flight Center
LDC	Lot Date Code
MCM	Multi-Chip Module
MSFC	Marshall Space Flight Center
MTBF	Mean Time Between Failure
NASA	National Aeronautics and Space Administration
NSPAR	Nonstandard Part Approval Request
OTS	Off-The-Shelf
PDR	Preliminary Design Review
PEM	Plastic Encapsulated Microcircuit
PIND	Particle Impact Noise Detection

PPL	Preferred Parts List
QCI	Quality Conformance Inspection
QML	Qualified Manufacturing Line
QPL	Qualified Parts List
RHA	Radiation Hardness Assurance
SCD	Source Control Drawing
VICD	Vendor Item Control Drawing

4.0 **GENERAL**.

4.1 **Selection of EEE Part Grade**. Project planning shall establish for each end item which EEE part Grade described in Table I is required. The choice of the appropriate Grade in large part determines the reliability, and the cost associated with EEE parts. The following provides some guidance for selection of an appropriate Grade.

4.1.1 Grade 1. Grade 1 EEE parts typically meet the highest reliability standards, and have been subjected to independent verification. Grade 1 should be selected for equipment requiring maximum feasible reliability because of critical mission objectives and safety. The related project typically would have high visibility both within and outside of NASA, and could involve objectives which may be difficult to repeat in another mission. Missions of 5 years or longer may also require Grade 1 parts. Repair during the mission is not a practical or desirable option. The mission requires complete functional or block redundancy and requires project manager approval of single point failure situations. The application is space flight equipment.

4.1.2 Grade 2. Grade 2 EEE parts typically meet rigorous (but not the highest) industry reliability standards, and have been subjected to independent verification. Grade 2 should be selected for equipment that requires high reliability, but for which a low risk of failure can be tolerated to meet cost constraints. Missions of 1 to 5 years duration may also use Grade 2 parts. The mission may be multiple or single purpose, with a repeat mission possible. Repair during the mission may be practical. Functional or block redundancy for all primary objectives is desirable but single string design may be acceptable. The application usually is space flight equipment or critical ground support equipment.

4.1.3 Grade 3. Grade 3 EEE parts typically meet standards for high reliability, but there may be significant exceptions and they may not have been independently verified. Grade 3 should be selected for equipment where high reliability is desired, but is not mandatory. Also, the missions are typically for a single purpose or routine mission, with repeat missions possible. Mission duration also may be less than 1 year. Repair during the mission would not necessarily be considered worthwhile. Single string design would normally be acceptable. The application could be space flight experiments or ground support equipment.

4.1.4 Grade 4.- Grade 4 EEE parts typically meet vendor standards for high reliability or commercial market place reliability, but have not been independently verified. Grade 4 should be selected for equipment where high reliability is not a primary factor, the mission is not critical or a repeat mission is possible. The duration of a mission would typically not be lengthy. Repair may be very practical. This is a typical choice for flight experiments and ground support equipment.

Table I – EEE Parts Grade Description

Grade	Summary	Reliability	MTBF	Cost	Typical Use
1	"Space" quality class qualified parts, or equivalent.	Highest	Longest	Very High	Space flight
2	"Full Military" quality class qualified parts, or equivalent.	Very High	Very Long	High	Space flight or critical ground support equipment
3	"Low Military" quality class parts, and Vendor Hi-Rel or equivalent.	High	Long	Moderate	Space flight experiments and ground support
4	“Commercial" quality class parts. No qualification required.	Variable	Variable	Low	Flight experiments and ground support

5.0 **EEE PARTS SELECTION AND CONTROL REQUIREMENTS.**

5.1 **EEE Parts Plan**. All equipment containing EEE parts shall be produced under the control of an approved EEE parts control plan. The requirements of the plan shall be established to obtain the appropriate quality level (Grade 1, 2, 3 or 4), or equivalent, for EEE parts (reference Table II). Project requirements shall specify which Grade of EEE parts is to be applied to project equipment, and shall identify the applicable EEE Parts Plan.

5.1.1 Parts Plan Scope. The plan shall control EEE parts activities from the equipment design and development phase though use and maintenance of the system and equipment. The plan shall document the requirements for part qualification, quality assurance for parts, parts application criteria, parts related data, parts configuration control, life time availability of parts, manufacturing and handling considerations, and parts in Off-The-Shelf (OTS) assemblies.

5.1.2 Administration. Project management shall approve and oversee the administration of the EEE parts plan. The plan shall identify the authority or organization that will serve

as the focal point in matters pertaining to the plan. The plan, or requirements of the plan, shall be imposed on each sub-tier organization, as applicable.

5.1.3 Affected Parts. The plan shall apply to the following listed EEE part types (Federal Stock Codes shown in parenthesis):

Capacitors (5910)	Fiber Optic Devices (6030)	Relays (5945)
Circuit Breakers (5925)	Fiber Optic Interconnect (6060)	Resistors (5905)
Connectors (5935)	Filters (5915)	Switches (5930)
Crystal oscillators (5955)	Fuses (5920)	Thermistors (5950)
Diodes (5961)	Hybrid microcircuits (5962)	Transistors (5961)
Fiber optic Cables (6030)	Magnetics (5950)	Wire and Cable (6145)
	Monolithic microcircuits (5962)	

5.1.4 Structure. The plan shall meet applicable requirements herein. The EEE parts control plan shall be organized clearly, concisely and unambiguously. The plan may be a separate document or part of the Project Plan, Quality Plan, or other project document. The responsible organization may prepare a tailored plan, or adopt one of the plans contained herein as appendices (Appendix A for Grade 1 parts, Appendix B for Grade 2 parts, Appendix C for Grade 3 parts, and Appendix D for Grade 4 parts).

5.2 **Qualification Requirements**. Grades 1, 2, and 3 EEE parts shall be qualified at the piece part level. For projects using Grade 4 EEE parts, assembly level qualification shall be sufficient.

5.2.1 Piece part level. Qualification at the piece part level shall be achieved by meeting designated military or NASA standards, piece part qualification requirements, or by other means as documented for nonstandard part approval. Requirements for qualification of nonstandard parts shall be equivalent to the requirements imposed on similar standard parts, or shall otherwise satisfactorily demonstrate that the part has an approved margin of safety beyond the demands of the equipment in which it will be used.

5.2.2 Application level. Part qualification at the application level shall be based upon qualification testing of the assembled equipment. A part shall be qualified for a given application within the equipment by successful performance during the equipment qualification testing, or by similarity to a part which has been so qualified.

Table II - Comparison of EEE Part Grades

(Shading of side by side entries indicates they are the same.)

ITEM	GRADE 1	GRADE 2	GRADE 3	GRADE 4
Typical Minimum Quality Class for First Choice.	µCkt: Class S, V, or K Discrete Semicond.: JANS Cap. Or Resistor: FRL S, R or C Other: Various	µCkt: Class B, Q, or H Discrete Semicond.: JANTXV Cap. Or Resistor: FRL R, P, or B Other: Various	µCkt: Class M, N, T, G, D, or E, and "/883" Discrete Semicond.: JANTX, JAN and JANJ Cap. Or Resistor: P or B, and Other Other: Vendor Hi-Rel	Commercial
PIND & X-Ray	Intrinsic to Class	Yes	Recommended but not required	No
Typical Minimum Piece Part Qualification	Military or NASA or equivalent	Military or NASA or equivalent	Variable	Not Specified
RHA by Analysis and/or Test	Yes	Yes	Yes	Yes, Where Feasible
Procurement Limited to Qualified Source	Yes	Yes	Yes	No
Lot Quality Conformance Inspection Required	Yes	Yes	Yes	No
Screening	100% Minimum	100% Minimum	Yes, but Minimum Not Specified	No
Hazard Avoidance	Yes	Yes	Yes	Yes
Specification and Control Drawings	Military or NASA Standard, or Project Prepared Control Drawing (e.g. , VICD)	Mostly Military or NASA Standards, or Project Prepared Control Drawing, but also Limited Use of Vendor Specifications.	Vendor Specifications, Industry and Organizational Standards, and Military or NASA Standards.	Optional
ASSOCIATED PROJECT REQUIREMENTS				
Derating	Yes	Yes	Yes	Optional
Nonstandard Part Approval	for Parts Less Than Specified Grade and Without Standard Qualification	for Parts Less Than Specified Grade and Without Standard Qualification	for Parts Without Military/NASA Standard Qualification, or Equivalent.	No

Table II - Comparison of EEE Part Grades

(Shading of side by side entries indicates they are the same.)

ITEM	GRADE 1	GRADE 2	GRADE 3	GRADE 4
As-Designed EEE Parts List	Yes	Yes	Yes	Yes
Traceability	By Lot as a Minimum	By Lot as a Minimum	By Lot as a Minimum	By part manufacturer
Part Selection Preferences Specified	Yes	Yes	Yes	Yes,recommended only
Substitutions Restricted	Yes	Yes	Yes	No
As-Built EEE Parts List	Yes	Yes	Yes	Yes

5.3 **Quality Assurance Requirements**. Quality assurance shall include: assurance of procurement from qualified sources, lot Quality Conformance Inspection (QCI), screening, and receiving inspection. All inspections and test procedures that are used by the procuring activity to determine the quality and/or conformance of a part to the controlling specification shall be documented by the procuring activity. Established test methods and acceptance criteria such as those in MIL-STD-202, MIL-STD-750, MIL-STD-883, and military Established Reliability specifications shall be used as applicable.

5.3.1 Procurement Sources. Grades 1 and 2 parts shall be procured only from qualified sources or their authorized distributors. Grade 3 parts shall be procured from qualified sources their distributers or from MSFC approved sources.

5.3.2 Quality Conformance Inspection (QCI). QCI shall ensure that each lot of Grade 1, 2, or 3 parts meets the requirements of the part controlling specification.

5.3.2.1 Destructive Physical Analysis (DPA). DPA, per MIL-STD-1580 or equivalent, shall be performed on each lot of Grade 1, 2, or 3 parts not procured from a military QPL or QML. This requirement applies to semiconductors, microcircuits, metal film and wire-wound resistors, resistor networks, capacitors, relays, filters, crystal oscillators, fuses, hybrids, MCMs and hybrid oscillators. DPA is not required for composition resistors, monolithic glass capacitors, coils, inductors and transformers. Any lot of parts not meeting the DPA acceptance criteria shall not be used in equipment without procuring activity approval.

5.3.3 Screening. All Grades 1, 2 and 3 parts shall be subjected to screening. Part screening shall be designed to remove defective parts and thus increase reliability. For Grades 1 and 2 parts, screening shall consist of testing of 100% of the parts to the requirements of the most applicable military specification for the part type, and any additional tests needed to meet the application requirements.

5.3.4 Receiving inspection. All parts shall be subjected to receiving inspection, by the procuring activity, to verify compliance with the controlling specifications. Testing shall be defined in the procurement requirements as specified by Design Engineering

5.4 **Application Criteria Requirements**. Parts shall be properly applied in the design.

5.4.1 Derating. Derating guidelines of Table III, or equivalent, shall be met by the design. A derating analysis shall be performed by the cognizant design organization and shall be submitted for project review. Project approval shall be obtained prior to use of a part in an application where derating guidelines are not met. For Grade 4, derating of parts and the derating analysis are optional.

5.4.2 Operating Environment. Consideration shall be given to the operating environment requirements including but not limited to the temperature, humidity, shock, and vibration to which EEE parts will be exposed. For most space applications, military qualified parts (i. e. Grades 1 and 2) will satisfy these requirements except for radiation.

5.4.2.1 Ionizing radiation. For Grades 1, 2, and 3 parts, and where feasible for Grade 4 parts, used in space flight applications, the effects of the projected ionizing radiation on each part shall be determined by analysis and/or test. Failure mitigation or a design margin shall be established by the project to assure acceptable performance in the projected radiation environment.

5.4.3 Hazard Avoidance. EEE parts shall comply with the hazard avoidance of NSTS 1700.7, Table IV herein, and the following.

5.4.3.1 Oxygen Enriched Atmosphere. EEE parts exposed to an oxygen-enriched atmosphere capable of sustaining combustion shall operate without introducing any fire hazard due to either normal operation or malfunctions occurring during the life of the equipment. This requirement may be met though use of hermetically sealed parts, hermetically sealed equipment enclosures, suitable conformal coatings, or choice of materials.

5.4.3.2 Parts and Materials. The hazardous characteristics of arc generation, flammability, and offgassing of all parts and materials shall be considered and the requirements of NHB 8060.1, or equivalent, shall be met. Also, organic, polymeric, and inorganic materials (i.e. potting compounds, coatings, films, adhesives, elastomers, etc.) used in the construction of EEE parts shall meet the outgassing requirements of SP-R-0022A or equivalent.

5.5 **Configuration Control Requirements**. The procuring activity's focal point organization shall review and approve all EEE part selections (reference 5.1.2).

5.5.1 Part Selection. Parts shall be selected in accordance with the order of selection preference indicated in Tables V, VI, VII, and VII.

5.5.2 Part Substitutions. For Grades 1, 2, and 3, substitution of different parts for the part numbers listed in assembly parts lists and bills of material shall be prohibited, or restricted to criteria or specific substitution lists having the prior approval of the procuring activity. Substituted parts shall comply with applicable requirements of the EEE parts plan, including listing in the As-Designed EEE Parts List.

5.5.3 Verification of Parts. As-built EEE parts lists, except for Grade 4 parts, shall be compared to the As-Designed EEE parts list by the procuring activity to verify use of approved parts and sources.

5.5.4 Standard and Nonstandard parts. Grades 1, 2, and 3 parts which are deemed piece part level qualified by virtue of their military standard or NASA standard qualification shall be considered "Standard Parts," and are so designated in the part selection preference tables, Tables V, VI, VII, and VIII. Any part not meeting the above criteria is a nonstandard part. A nonstandard part shall not be selected if a suitable standard part is available. For Grade 4 all parts are considered standard.

5.6 **Parts Related Data Requirements**.

5.6.1 Nonstandard Part Approval. Parts not designated as standard parts in Table V, VI, or VII as applicable, are nonstandard and their use must be approved by the procuring

activity. Unless otherwise specified by the procuring activity, a Nonstandard Part Approval Request (NSPAR) form shall be submitted by the equipment design activity for each nonstandard part. The NSPAR shall be reviewed and approved before submittal to the next higher tier procuring activitiy. The NSPAR shall include any applicable part specification or control documents, other than military or NASA standards. NSPARs shall identify additional screening applied to military standard parts. NSPARs shall not be required for design within MSFC, but the use of nonstandard parts shall still be subject to approval by project management. There are no nonstandard Grade 4 parts, therefore NSPARs are not required.

5.6.2 Waivers and Deviations. A waiver/deviation, as appropriate, shall be submitted to the procuring activity by the equipment design activity for any part that does not meet requirements for use.

5.6.3 As-Designed EEE Parts List. The equipment design activity shall submit an As-Designed EEE Parts List for procuring activity approval. As a minimum, the As-Designed EEE Parts List shall identify the using equipment, EEE part number and specification, EEE part qualification method and status, nonstandard part approval status, and part manufacturer(s). A preliminary As-Designed EEE Parts List shall be submitted at Preliminary Design Review (PDR). Changes to the baselined As-Designed EEE Part List shall be monitored and controlled at all levels of procurement, test, and fabrication to ensure the prompt identification, reporting, review, and disposition (approval/disapproval) of changes.

5.6.4 As-Built EEE Parts List. The equipment manufacturing activity shall submit an As-Built EEE Parts List for each deliverable end item. The as-built list shall identify the EEE parts actually used in fabricating each unit. As a minimum, the As-Built EEE Parts List shall identify the using end item and serial number, the using assembly and serial number, EEE part number, EEE part circuit location or reference designation (R1, CR2, etc.), EEE part manufacturer's CAGE code or equivalent identification, and EEE part Lot Date Code (LDC) or equivalent lot identification. However, the LDC or lot identification information is not required for Grade 4 EEE parts.

5.6.5 GIDEP. EEE part problems shall be reported by the equipment design organization through the Government Industry Data Exchange Program (GIDEP), either directly for GIDEP participants or through the procuring activity for nonparticipants

5.6.6 ALERTs. The equipment design organization shall assess and report to the project office the impact of an MSFC ALERT on the equipment end item.

5.6.7 Traceability. The equipment manufacturer shall have a system for providing two way traceability for all EEE parts used in the equipment. For projects using Grade 1, 2, or 3 EEE parts, the system shall provide for tracing a specific part lot through all process steps, identifying which equipment contains specific part lots, and retrieving information relative to the part manufacturer's processing. For projects using Grade 4 EEE parts, the system shall provide for tracing a specific part by its manufacturer through all in-house process steps, identifying which equipment contains a specific manufacturer's part.

5.6.8 Quality Assurance Data. Results of receiving inspection, destructive physical analyses, materials review boards, failure review boards, and parts problems reported from the field shall be documented and submitted to the project office.

5.6.9 Specifications and Control Drawings. Grade 1 parts shall be defined and controlled by military/industry standard specifications and/or by control drawings. (Examples of control drawings are Source Control Drawings (SCDs), or Vendor Item Control Drawings (VICDs)). Grade 2 parts shall be defined and controlled by military/industry standard specifications and/or by control drawings where feasible, but where necessary may rely on vendor data that is complete and reliable. Grade 3 parts may be defined and controlled by vendor specifications, or applicable military/industry standard specifications where available. Grade 4 parts may be defined and controlled by purchase orders and vendor specifications or any other suitable means.

5.7 **Lifetime Parts Availability Requirements**. Consideration shall be given in EEE parts selection and procurement to ensuring parts availability for equipment repair and new builds throughout the projected life of the equipment and design.

5.8 **Manufacturing and Handling Requirements**.

5.8.1 Electrostatic Discharge (ESD) Control. ESD control shall be in accordance with MIL-STD-1686, MSFC-RQMT-2918, or an approved equivalent.

5.8.2 Environmental Control. Environmental controls such as temperature, humidity, and particulate contamination shall be identified for parts handling, packaging, and storage.

5.8.3 Retest. Each EEE part shall be retested in accordance with predetermined requirements if a maximum period, determined by the project, has elapsed since the part successfully completed 100% screening testing.

5.8.4 Allowance for Testing Fallout. Procured quantities should allow for nominal fallout of parts in lot sample or screening tests where these losses would deduct from the quantity available for use. Where practical, it is recommended that parts be ordered from a single lot date code to reduce the number of parts needed for destructive qualification testing.

5.8.5 Manufacturing Process Compatibility. Consideration shall be given to part compatibility with planned equipment manufacturing processes. This may include guidance for or against use of surface mount or through hole parts, preferences or restrictions for lead finish, and if plastic encapsulated microcircuits (PEMs) are used, manufacturing processes shall be reviewed for compatibility with PEMs.

5.8.6 Suspect Parts. Parts affected by MSFC ALERTS, and GIDEP issuances shall not be used in manufacturing without procuring activity approval.

5.9 **Off-The-Shelf Assemblies Requirements**. For projects using Grade 1, 2 or 3 EEE parts , Off-the-shelf (OTS) equipment shall meet the following requirements.

5.9.1 Identification of Parts. Constituent EEE parts in OTS equipment shall be included in the As-Built EEE Parts List of the using equipment when identification of EEE parts is obtainable.

5.9.2 Parts Qualification. EEE parts in OTS equipment shall have been qualified to the application by the OTS equipment manufacturer, or else the OTS equipment shall be qualified at the application level by the user.

5.9.3 Use of Standard Parts. It shall be a goal to use standard parts in OTS designs.

Table III – Derating Guidelines

Part Type		Critical Stress Parameter	Derating	Condition	Note
Capacitor - Ceramic	CCR style /cap1	Voltage /cap2	0.60	110°C Max Ambient Temp	
	CKS style	Voltage /cap2	0.60		
	CKR style /cap1	Voltage /cap2	0.60		
	CDR style /cap1	Voltage /cap2	0.60		
Capacitor - Glass	CYR style	Voltage /cap2	0.50	110°C Max Ambient Temp	
Capacitor – Plastic Film	CRH style	Voltage /cap2	0.60	85°C Max Ambient Temp	
	CHS style	Voltage /cap2	0.60		
Capacitor – Tantalum, Foil	CLR25 style	Voltage /cap2	0.50	70°C Max Ambient Temp	
	CLR27 style	Voltage /cap2	0.50		
	CLR35 style	Voltage /cap2	0.50		
	CLR37 style	Voltage /cap2	0.50		
Capacitor – Tantalum, Wet Slug	CLR79 style	Voltage /cap2	0.60	70°C Max Ambient Temp	
		Voltage /cap2	0.40	110°C Max Ambient Temp	
	CLR81 style	Voltage /cap2	0.60	70°C Max Ambient Temp	
		Voltage /cap2	0.40	110°C Max Ambient Temp	
Capacitor – Tantalum, Solid	CSR style /cap3	Voltage /cap2	0.50	70°C Max Ambient Temp	
		Voltage /cap2	0.30	110°C Max Ambient Temp	
	CSS style /cap3	Voltage /cap2	0.50	70°C Max Ambient Temp	
		Voltage /cap2	0.30	110°C Max Ambient Temp	
	CWR style /cap3	Voltage /cap2	0.50	70°C Max Ambient Temp	
		Voltage /cap2	0.30	110°C Max Ambient Temp	
Circuit Breaker		Resistive	0.75	20°C below the maximum specified temperature.	
		Capacitive	0.75 /cb1		
		Inductive	0.40		
		Motor	0.20		
		Filament	0.10		
Connector		Voltage	/con1	/con2	
Crystal		Current	/cry1		
Crystal Oscillator		/cryo1	/cryo1	/cryo1	

Table III – Derating Guidelines

Part Type		Critical Stress Parameter	Derating	Condition	Note
Diode - General Purpose, Rectifier, Switching, Pin/Schottky, and Thyristors		PIV	0.70	125°C Max Junction Temp	
		Surge Current	0.50		
		Forward Current	0.50		
		Junction Temperature	0.80		
Diode - Varactor		Power	0.50	125°C Max Junction Temp	
		Reverse Voltage	0.75		
		Forward Current	0.75		
		Junction Temperature	0.80		
Diode - Voltage Regulator		Power	0.50	125°C Max Junction Temp	
		Zener Current	/d1		
		Junction Temperature	0.80		
Diode - Voltage Reference		Zener Current	/d2	125°C Max Junction Temp	
		Junction Temperature	0.80		
Diode - Zener Voltage Suppressor		Power Dissipation	0.50	125°C Max Junction Temp	
		Junction Temperature	0.80		
Diode - Bidirectional Voltage Suppressor		Power Dissipation	0.50	125°C Max Junction Temp	
		Junction Temperature	0.80		
Diode - FET Current Regulator		Peak Operating Voltage	0.80	125°C Max Junction Temp	
		Junction Temperature	0.80		
Fiber Optic – Cables	NFOC-2FFF-1GRP-1	/fo1	/fo1	/fo1	
	Other	/fo2	/fo2	/fo2	
Fiber Optic – Devices		/fo2	/fo2	/fo2	
Fiber Optic – Interconnects	NZGC-F-16PB, NZGC-F-16SB	/fo1	/fo1	/fo1	
	Other	/fo2	/fo2	/fo2	
Filter - All		Voltage	0.50	85°C Max Ambient Temp	
		Current	0.50		
Fuses	0.125 Amp	Current	0.25	25°C Max Ambient Temp	/f1
	0.25 Amp	Current	0.30		/f1
	0.375 Amp	Current	0.375		/f1
	0.5 & 0.75 Amp	Current	0.40		/f1
	1 & 1.5 Amp	Current	0.45		/f1
	2-15 Amps	Current	0.50		/f1

Table III – Derating Guidelines

Part Type			Critical Stress Parameter							Derating	Condition		Note
Inductor	Insulation Class										Rated Operating Temperature	Derated Operating Temperature	
	MIL-C-39010	MIL-C-15305											
	-	O	/it1							/it2	+85°C	+65°C	/it1
	A	A	/it1							/it2	+105°C	+85°C	/it1
	B	B	/it1							/it2	+125°C	+105°C	/it1
	F	-	/it1							/it2	+150°C	+130°C	/it1
Microcircuit - Digital	Style		Open Collector (or drain) DC output voltages			Operating AC or DC output current or fanout			Maximum clock frequency	Derating values are listed under Critical Stress Parameter.	100°C Max Junction Temp /md1		/md2, /md3
	Bipolar		0.80 /md7			0.80 /md8			N/A				
	MOS		N/A			0.80 /md8			0.85				
	CMOS 4000 &B /md4		N/A			0.80 /md8			0.85				
	CMOS HC & HCT /md5		N/A			0.80 /md8			0.85				
	CMOS AC & ACT /md6		N/A			0.80 /md8			0.85				
	Line Drivers and Receivers		0.75			0.80			0.80				
	Gate Array Bipolar MOS		0.80			0.80			0.80				
Microcircuit - Linear	Style		/ml1	/ml2	/ml3	/ml4	/ml5	/ml6	/ml7	Derating values are listed under Critical Stress Parameter.	100°C Max Junction Temp /ml9		/ml10
	Operational or Differential Amplifiers		0.80	0.75	1.00	1.00	N/A	0.80	0.90				
	Comparators		0.90	0.75	1.00	N/A	0.90	0.80	0.90				
	Sense Amplifiers		0.80	0.75	1.00	N/A	0.90	0.80	0.90				
	Current Amplifiers		0.80	0.75	1.00	1.00	N/A	0.80	0.90				
	Voltage Regulators		N/A, /ml8	0.80	N/A	N/A	N/A	0.80	0.90				
	Ananlog Switches		0.90	0.80	N/A	N/A	N/A	0.80	N/A				

Table III – Derating Guidelines

Part Type		Critical Stress Parameter			Derating		Condition	Note
Relay		T: Temperature Range	-65°C to -21°C		0.85			/rel4
			-20°C to +39°C		0.90			
			+40°C to +84°C		0.85			
			+85°C to +125°C		0.70			
		R: Cycle Rate per hour	<1.0		0.85			
			1.0 to 10		0.90			
			>10		0.85			
		L: Load Applications	A: to 0.5 seconds /rel1		1.00			
			B: to 5.0 minutes /rel2		1.50			
			C: other /rel3		0.80			
Resistors	Style of Resistor	Derating Temperatures (°C)			Derating Factors /res1, /res2			
		T1	T2	T3	Pwr	Volts		
	RBR, 1%, Wirewound	125	137	145	0.60	0.80		
	RBR, 0.5%, Wirewound	125	132	145	0.35	0.80		
	RBR, 0.1%, Wirewound	125	130	145	0.25	0.80		
	RWR, Wirewound	25	160	250	0.60	0.80		
	RCR, Composition	70	/res3	/res3	0.60	0.80		
	RER, Wirewound	25	160	250	0.60	0.80		
	RTR, Wirewound	85	124	150	0.60	0.80		
	RLR, 100ppm, Film	70	118	150	0.60	0.80		
	RLR, 350ppm, Film	70	103	125	0.60	0.80		
	RNX, Film	125	155	175	0.60	0.80		
	RM, Film	70	118	150	0.60	0.80		
	RZ, Film	70	103	125	0.60	0.80		
	Other	/res4	/res4	/res4	0.50	0.80		
Switch	NASA SSQ-21678	/sw1			/sw1		/sw1	/sw1
	Other	Resistive			0.75			/sw2, /sw3, /sw4, /sw5, /sw6, /sw7, /sw8
		Inductive			0.40			
		Filament			0.10			
		Motor			0.20			

Table III – Derating Guidelines

Part Type			Critical Stress Parameter	Derating	Condition		Note
Thermistor	Positive Temperature Coefficient (PTC)		Power	0.50			/th1
	Negative Temperature Coefficient (NTC)		Power	/th2			/th2
Transformer	Insulation Class				Rated Operating Temperature	Derated Operating Temperature	
	MIL-T-27	MIL-T-21038					
	Q	Q	/it1	/it2	85°C	65°C	/it1
	R	R	/it1	/it2	105°C	85°C	/it1
	S	S	/it1	/it2	130°C	105°C	/it1
	V	T	/it1	/it2	155°C	130°C	/it1
	T	U	/it1	/it2	170°C	155°C	/it1
Transistor – Bipolar: General Purpose, Switching, Power			Power	0.50	125°C Max Junction Temp /xsis3		
			Current	0.75			
			Voltage	0.75 /xsis1			
Transistor – Field Effect: JFET, MOSFET /xsis2			Power	0.50	125°C Max Junction Temp /xsis3		
			Current (I_D)	0.75			
			Voltage	0.75 /xsis1			
Wire and Cable			Current	/wc1, /wc2	/wc1, /wc2		/wc1, /wc2

Table III Notes:

/cap1. For low voltage applications (<10 Vdc), rated voltage shall be at least 100 Vdc.

/cap2. Applies to the sum of peak AC ripple and DC polarizing voltages.

/cap3. For applications where the effective circuit resistance is less than 1 ohm per volt contact EEE part group.

/cb1. Series resistance shall be used to assure that circuits do not exceed the derated value.

/con1. Operating voltage derating equals 25% of the rated Dielectric Withstanding Voltage at sea level.

/con2. Temperature rating of the dielectric insert equals $T_{(ambient)}$ + 50°C.

/cry1. Crystal current shall be limited to 50% of the rated value. In cases where the start up time is critical 75% of the rated value can be used.

/cryo1. Crystal oscillators shall be derated to the individual level.

/d1. $0.5(I_z max + I_z nom)$.

/d2. Operate at the manufacturer's specified zener current (I_{ZT}) to optimize temperature compensation.

/fo1. See SSP-30312, EEE and Mechanical Parts Management for Space Station Program.

/fo2. None established. Requirements for Fiber Optic – Cables, Other will have to be developed upon application.

/f1. If calculations result in fractional values use the next highest standard fuse rating. Derating factors are based upon data from fuses mounted on printed circuit boards and conformal coated. For other types of mounting consult the EEE parts engineer for recommendations. Derating allows for loss of pressure, which lowers the blow current rating and allows for a decrease of current capability with time. There is an additional derating of 0.5% per °C for an increase in the ambient temperature above 25°C.

/it1. Inductors and transformers are derated by reducing the maximum operating temperature based on the insulation class used and reducing the operating voltage to 50% of rated dielectric withstanding voltage. See below.

a) Maximum operating temperature equals ambient temperature plus temperature rise plus 10°C (allowance for hot spot). Compute temperature rise time as follows:

Temperature Rise Test (per MIL-T-27, para. 4.8.12)

Temperature rise (°C) = ((RE – RA)/RA * (TI + 234.5°C)) - (TM – TI)

Where RE = winding resistance at elevated temperature
RA = winding resistance at ambient temperature
TI = specified initial ambient temperature (°C)
TM = maximum ambient temperature (°C) at time of power shutoff

TM shall not differ from TI by more than 5°C

b) The insulation classes of MIL-style inductive parts generally have maximum temperature ratings based on a life expectancy of 10,000 hours. The maximum operating temperatures in this table are selected to extend the life expectancy to 50,000 hours.

c) Custom-made inductive devices shall be evaluated on a materials basis and stressed at levels below the maximum rated operating temperature for the materials used. Devices having a maximum rated operating temperature in the range from +85° to +130°C shall be derated as follows: maximum operating temperature (°C) equals 0.75 times maximum rated operating temperature (°C). For devices with maximum rated temperatures outside this temperature range, consult the EEE parts engineer for temperature derating recommendations.

/it2. Derate to 50% of the rated Dielectric Withstanding Voltage.

/md1. Junction temperature must be calculated and maintained below the maximum limit of 100°C.

/md2. Under no circumstances shall the input voltage be allowed to exceed the supply voltage.

/md3. For those technologies where no supply voltage derating is given in no case shall the device be operated at the absolute maximum supply voltage.

/md4. The operating supply voltage shall not exceed 79% of the absolute maximum voltage.

/md5. The operating supply voltage shall not exceed 79% of the absolute maximum voltage.

/md6. The operating supply voltage shall not exceed 92% of the absolute maximum voltage.

/md7. The derating factor for TTL open collector devices shall be 0.75.

/md8. Further derating may be required for radiation environments (i.e., minimum V_{cc} to insure minimum DC reference for transients).

/ml1. Absolute maximum supply voltage.

/ml2. Power dissipation (percent of rated power at maximum operating temperature).

/ml3. AC input voltage. Under no circumstances shall the input voltage be allowed to exceed the supply voltage.

/ml4. Output voltage.

/ml5. Open collector (or drain) DC output voltage.

/ml6. Operating AC or DC output voltage.

/ml7. Maximum short-circuit output current.

/ml8. V_{in} - V_{out} should be derated 0.80.

/ml9. Junction temperature must be calculated and maintained below the maximum limit of 100°C.

/ml10. Under no circumstances shall the input voltage be allowed to exceed the supply voltage.

/rel1. Make, break, and/or carry loads with an on-time duration of 0 to 500 milliseconds. Off-time is equal or greater than on-time.

/rel2. Carry-only loads. (Carry-only means that the relay contacts are closed before there is current flowing through the contacts.) Relay does not make or break the load. Maximum on-time is 5 minutes. Off-time is equal to or greater than on-time.

/rel3. Make, break, and/or carry. Those loads that do not fall into the category of loads A or B. (Limited use.)

/rel4. The derated contact current (I_{DR}) is found by multiplying the contact current rating (I) and the product of T, R, and L from the table.

Derated Contact Current $I_{DR} = I * T * R * L$

Where:

I = Contact Current Rating
T = Ambient Operating Temperature
R = Cycle Rate
L = Load Application

/res1. Compute the resistor's derated power level by multiplying its nominal power rating by the appropriate derating factor for ambient temperatures less than or equal to T1. If the resistor is operated above T1 derate linearly from the T1 power level to the zero power level at T2. Exposing the resistor to temperatures exceeding T3, even under no load conditions, may result in permanent degradation.

/res2. The maximum applied voltage shall not exceed the lesser of the following:

a) 80% of the specified maximum voltage rating, or

b) the square root of (P * R) where

P = Derated power (watts)
R = Resistance of that portion of the element actually active in the circuit

This voltage derating applies to DC and regular AC waveform applications. For pulse and other irregular waveform applications consult MIL-HDBK-978 or the manufacturer.

/res3. Determine the zero power temperature (T3) from the applicable detail specification. Compute the derated zero power temperature (T2) from the following formula:

$$T2 = (D_F * (T3 – T1)) + T1$$

Where:

T2 = Derated zero power temperature
D_F = Derating factor
T3 = Zero power temperature
T1 = Rated power temperature

/res4. Determine the rated power, the rated temperature (T1), and the zero power temperature (T3) from the manufacturer's specification. Calculate the derated zero power temperature (T2) as per note /res3.

/sw1. Derate NASA SSQ-21678 switches per SSP-30312 Section B.3.4.4.

/sw2. Transient suppression by diodes or bifilar coils should be provided except in cases where the delay in contact release time caused by the damping could promote contact damage during switching of the inductive load currents, or where contact reclosure during drop-out could cause a system malfunction.

/sw3. Suppress arcing by paralleling loads with absorption circuits.

/sw4. Precious metal materials shall be used in dry low signal level circuits.

/sw5. The director of motion of the contacts shall not be coincident with the expected direction of shock.

/sw6. Proper support should be used to prevent any deflection of the part due to shock, vibration, or acceleration.

/sw7. Peak in-rush current shall not exceed rated value.

/sw8. Minimum coil current requirements must be maintained to ensure good contacting.

/th1. Positive temperature coefficient thermistors are generally operated in the “self-heat” mode. Derate to 50% of the rated power, or as required by the detail specification.

/th2. Negative temperature coefficient (NTC) type thermistors operated in the “self-heat” mode should be derated in accordance with the applicable dissipation constant curve to prevent “thermal runaway.” Such parts should be derated to a power level causing a maximum increase of 50 times the dissipation constant, or a maximum part temperature of 100°C., whichever is less. The dissipation constant curve runs at 100% out to 25°C., then drops linearly to approach zero at 200°C (case temperature).

/wc1. Use this derating for environments other than a hard vacuum. Derating for electrical wire and cable shall comply with NASA Technical Memorandum 102179.

/wc2. Use this derating for a hard vacuum environment only. Derating is accomplished by determining a single wire maximum current from a combination of wire size and bundle size as listed below. Adjustments are made if the insulation is other than Teflon® (see remark 3 in /wc2 table)

Note /wc2 Derating Table

Wire Size (AWG)	Single Wire Current (I_{SW}) (Amps)	Remark
30	1.3	1. Current ratings are based on wires at +70ºC in a hard vacuum (10^{-6} to 10^{-9} torr). 2. When wires are bundled, the max design current for each individual wire shall be derated according to: For $1 < N \leq 15$: $I_{BW} = I_{SW} * ((29 – N)/28)$ For $N > 15$: $I_{BW} = (0.5) * I_{SW}$ Where: N = number of wires I_{BW} = current, bundled wires I_{SW} = current, single wire 3. Deratings listed are for Teflon® insulated wire (Type TFE) rated for +200ºC a. For 150ºC wire, use 80% of value shown in table. b. For 135ºC wire, use 70% of value shown in table. c. For 105ºC wire, use 50% of value shown in table. 4. Dielectric withstanding voltage rating required: at least two times the highest application voltage. 5. Derating values listed apply only to single round conductors on helically wound bundles. See EEE parts engineer for derating information for ribbon cable and flat conductors.
28	1.8	
26	2.5	
24	3.3	
22	4.5	
20	6.5	
18	9.2	
16	13.0	
14	19.0	
12	25.0	
10	33.0	
8	44.0	
6	60.0	
4	81.0	
2	108.0	
0	147.0	
00	169.0	

/xsis1. Worst case combination of DC, AC, and transient voltages should be no greater than the derated limit.

/xsis2. For power MOSFET devices, also derate the gate to source voltage (V_{GS}) to 60% of the maximum rated.

/xsis3. Junction temperature must also be maintained below 125°C.

Table IV – Hazard Avoidance

ITEM	PROHIBITED
1	Zinc chromate as a finish
2	Cadmium or zinc, whether plated, unfused or fused, as a finish coat or internal to the device, must not be used in a vacuum environment or in close proximity to personnel during flight or flight simulation
3	Mercury liquid (because of its toxicity and tendency to penetrate joints amalgamate with structural materials)
4	Polyvinyl chloride-outgasses products that are hazardous and corrosive
5	Pure tin plated parts or hardware
6	Nylon materials

Table V – Standard Parts and Selection Preferences for Grade 1. /1

Part Type	Selection	Standard Part /2	Selection Preference Ranking /3	Note /4
Capacitor	MIL-PRF-20/27 - /31, /35 - /38 (CCR)	FRL S	1st	Lot Sample Test per /27
	MIL-PRF-123 (CKS)	Yes		
	MIL-PRF-23269/1 - /4 (CYR)	FRL S		
	MIL-PRF-39003/1, /2, /10 (CSR & CSS)	FRL C		Surge Test per /30
	MIL-PRF-39006/1-/4, /22, /25 (CLR)	FRL R		
	MIL-PRF-55365/4 (CWR)	FRL C		
	MIL-PRF-55681/1-/4 (CDR)	FRL S		Lot Sample Test per /29
	MIL-PRF-83421/1 (CRH)	FRL S		
	MIL-PRF-87217/1 (CHS)	Yes		
	Grade 1 Capacitors Listed in GSFC PPL	Yes		Apply & Screen per /32
Circuit Breaker	MIL-PRF-39019/1 - /6	No	1st	/5
	Other		2nd	
Connector – Coaxial and other Radio Frequency (RF)	MIL-PRF-39012	Yes	1st	Restrict & Bakeout per /39
	MIL-PRF-49142			
	Other	No	2nd	Restrict per /37
Connector – Circular	NASA MSFC 40M38277	Yes	1st	
	NASA MSFC 40M38298			
	NASA MSFC 40M39569			
	NASA SSQ 21635			
	MIL-C-38999		2nd	Restrict & Bakeout per /38 /39
	MIL-C-26482 Series 2			
	MIL-C-5015			Restrict & Bakeout per /38 /39 /40
	Other	No	3rd	Restrict per /37
	MIL-C-22992	No	N/A	GSE Only /41
Connector – D Subminiature	NASA GSFC S-311-P-4	Yes	1st	
	NASA GSFC S-311-P-10			
	MIL-PRF-24308			Restrict & Bakeout per /38 /39
	Other	No	2nd	Restrict per /37
Connector - Microminiature	MIL-PRF-83513	Yes	1st	Restrict & Bakeout per /38 /39
	Other	No	2nd	Restrict per /37
Connector – Printed Circuit	MIL-C-55302	Yes	1st	Restrict & Bakeout per /38 /39
	Other	No	2nd	Restrict per /37
Connector – Other	Other	No	1st	Restrict per /37
Connector – Contacts – Signal, Power, Coaxial, Shielded, Thermocouple, etc.	NASA MSFC 40M38277	Yes	1st	
	NASA MSFC 40M38298			
	NASA MSFC 40M39569			
	NASA SSQ 21635 and 21637			
	NASA GSFC S-311-P4			
	MIL-C-39029			
	Other	No	2nd	Restrict per /37
Connector – Backshell	NASA MSFC 40M38277	Yes	1st	
	NASA MSFC 40M38298			
	NASA MSFC 40M39569			
	NASA SSQ 21635			

Table V – Standard Parts and Selection Preferences for Grade 1. /1

Part Type	Selection	Standard Part /2	Selection Preference Ranking /3	Note /4
	MIL-C-85049			Restrict & Bakeout per /38
	Other	No	2nd	Restrict per /37
Crystals and Crystal Oscillator	MIL-PRF-55310/8, /14, /16 Type 1	Class S	1st	
	Grade 1 Crystal Oscillator in GSFC PPL	Yes		
	MIL-PRF-3098	No	2nd	Apply & Screen per /32
Discrete Semiconductor - Diodes, Transistors, Optical Couplers	QML-19500: JANS	Yes	1st	OK to Use As Is
	JANTXV		2nd	Screen per /6 /7
	JANTX		3rd	Screen per /6 /7 /8
	Custom processed part	No	4th	Specify per /8 /9
	Other		5th	Qualify & Screen per /6 /7 /8 /10
Fiber Optic – Cables	NFOC-2FFF-1GRP-1	Yes	1st	Space Station per /11
	Other	No	2nd	Requirements per /5
Fiber Optic – Devices	All	No	N/A	Requirements per /5
Fiber Optic - Interconnects	NZGC-F-16PB (Pin)	Yes	1st	Space Station per /15
	NZGC-F-16SB (Socket)			
	Other	No	2nd	Requirements per /5
Filter	MIL-PRF-28861/1, /2, /4, /5	Class S	1st	Non-Grade 1 Screen /33
	Grade 1 Filters Listed in GSFC PPL	Yes		Apply & Screen per /32
Fuse	Rockwell Spec	Yes	1st	Drawings per /16
	MIL-PRF-23419/4, /8		2nd	Select per /26
	Other	No	3rd	Qualify & Screen per /5
Hybrid Microcircuit	QML-38534: Class K	Yes	1st	Use as is
	Class H	No	2nd	Screen per /17
	Custom processed part		3rd	Qualify & Screen per /18
	Other		4th	Approval per /12
Magnetics – Inductors, Coils	MIL-STD-981	Class S	1st	
	MIL-C-83446/4, /5, /7, /9, /10; Families 50, 51	No		Build & Screen per /34
	MIL-PRF-39010/1, /2, /3, /6, /7			
	Grade 1 Inductors and Coils in GSFC PPL			Apply & Screen per /32
Magnetics - Transformers	MIL-STD-981	Class S	1st	
	MIL-PRF-27 Families 03, 04, 20, 21, 36, 37, 40, 41	Product Level T		Build & Screen per /34
	MIL-T-21038 Family 31			
	Grade 1 Transformers in GSFC PPL	Yes		Apply & Screen per /32
Monolithic Microcircuit	QML-38535: Class V or S	Yes	1st	Use as is
	Class Q or B	No	2nd	Screen per /19
	Custom processed part			Qualify & Screen per /20
	MIL-PRF-38535 Class M		3rd	Screen per /19
	/883, /883B or /883S per MIL-STD-883			
	MIL-PRF-38535 Class N		4th	Screen per /21

Table V – Standard Parts and Selection Preferences for Grade 1. /1

Part Type	Selection	Standard Part /2	Selection Preference Ranking /3	Note /4
Relay	MIL-PRF-39016/6, /9, /11, /12, /13, /20, /21, /30, /38	No	1st	Apply & Screen per /32
	Grade 1 Relays Listed in GSFC PPL	Yes		
Resistor – Film/Foil	MIL-PRF-39017, RLR	FRL R or S	1st	
	MIL-PRF-55182, RNR, RNC, RNN			
	MIL-PRF-55342, RM			
	MIL-PRF-39035, RJR			
	MIL-PRF-83401, RZ	Level M		
	NASA SSQ Type 1 Qualified parts	Yes		
	MIL-PRF-122, RFP	FRL .01 or .001		FRL per /
	Other	No	2nd	Qualify & Screen per /5
Resistor – Wirewond	MIL-PRF-39007, RWR	FRL R or S	1st	
	MIL-PRF-39005, RBR			
	MIL-PRF-39009, RER			
	MIL-PRF-39015, RTR			
	Other	No	2nd	Qualify & Screen per /5
Resistor – Other	Other	No	3rd	Qualify & Screen per /5
Switch	NDBS1-P-X-X-X-X-X (Data Bus)	Yes	1st	Space Station per /22
	NDBS-P-X-X-X-X-X (Data Bus)			Space Station per /23
	Other	No	2nd	Screen & Approve per /5
Thermistor	MIL-PRF-23648 (Pos. & Neg. Coeff.)	Yes	1st	Apply per /35
	GSFC S-311P-18 (Negative Coeff.)			
	Other	No	2nd	Qualify & Screen per /45
Wire and Cable – Coaxial Cable	MIL-C-17	Yes	1st	Restrict per /42 /43
	Other	No	2nd	Restrict per /37
Wire and Cable – Multiconductor Cable	40M39526	Yes	1st	
	MIL-DTL-27500		2nd	Restrict per /42 /43
	Other	No	3rd	Restrict per /37
Wire and Cable – Hookup Wire	40M39513	Yes	1st	
	MIL-W-22759			Restrict per /42 /43 /25
	MIL-DTL-81381			Restrict per /42 /43 /44
	Other	No	2nd	Restrict per /37
	MIL-W-16878	No	N/A	GSE Only /31
Wire and Cable – Magnet Wire	NEMA-M-1000	Yes	1st	Restrict per /42
	Other	No	2nd	Restrict per /37

Table V Notes:

/1 This table identifies information for the part selection process, standard parts, and associated restrictions and verifications. The requirements listed shall be implemented in addition to other requirements herein.

/2 All standard parts are identified in this column. The standard part designation is predicated on compliance with all applicable requirements. All nonstandard parts require nonstandard part approval.

/3 Parts selection shall be accomplished in the order indicated. A lower ranked selection shall not be used if a higher ranked selection can be obtained.

/4 This column identifies screening and associated verifications and restrictions that are required for the part to be classified as acceptable. The project EEE parts plan shall specify details as necessary to implement these requirements, and may specify additional requirements.

/5 Qualification and screening requirements shall be determined to suit the specific application.

/6 PIND and X-ray screening required on cavity devices.

/7 Supplemental 100% screening (so called upscreening) shall be applied so as to match as much as is feasible the standard 100% screening that would be applied to a similar JANS quality part.

/8 A sample of each production lot shall be subjected to destructive physical analysis (DPA).

/9 A controlling document shall specify the part performance characteristics and manufacturing requirements. The controlling document shall specify design, processing, qualification, and screening requirements so as to match as much as is feasible the standard requirements that would be applied to a similar JANS quality part.

/10 A controlling document shall specify the part performance characteristics, required lot qualification, and screening tests. A sample of each production lot shall be subjected to qualification, including life testing, so as to match as much as is feasible the standard requirements that would be applied to a similar JANS quality part.

/11 Approved for use on Space Station. See SSQ-21654.

/12 Any other quality assurance levels shall be considered for approval on a case by case basis.

/13 Refer to MIL-PRF-122 for explanation of FRL.

/14 Note deleted

/15 NASA Zero-G, contact size 16, fiber optic termini. Approved for use on Space Station. See SSQ-21635.

/16 Use Rockwell Drawings ME451-0009 (Bussman type GNZ), ME451-010 (Bussman type GQR), ME451-016 (Bussman type ANG, ME451-017 (Bussman type HOB, and ME451-0018 (Bussman type GMV)

/17 Screen per MIL- PRF-38534, Appendix C, Table C-IX as follows: PIND, serialization, electrical test, burn-in for 160 hours, final electrical test and delta limits,

seal, radiographic inspection, and external visual. A two piece DPA shall be performed. If the part is very expensive and/or only a few parts are required for the design, a one piece DPA may be performed.

/18 Qualification and screening shall be per MIL-PRF-38534 for Class K devices. A two piece DPA is required. Radiation tolerance testing may be required depending on the part application. A controlling document shall be generated to specify the part performance characteristics and manufacturing requirements.

/19 Screen per MIL-STD-883, Method 5004, Table I, paragraphs: 3.1.7 (PIND); 3.1.8 Serialization; 3.1.9 Pre burn-in electrical parameters; 3.1.10 Burn-in for 160 hours; 3.1.11 Interim electrical parameters; 3.1.12 Reverse bias burn-in as stated; 3.1.13 Interim electrical parameters; 3.1.14 Percent defective allowable and delta limits (when specified) calculations as stated; 3.1.15 Final electrical parameters; 3.1.16 Seal; 3.1.17 Radiographic inspection. A two piece Destructive Physical Analysis (DPA) is required and radiation latch-up testing may be required depending on the radiation environment.

/20 Qualification and screening shall be per MIL-PRF-38535, Appendix A for class S devices or Appendix B for class V devices. A two piece DPA per MIL-STD 883, Method 5009 or equivalent is required. A controlling document shall be generated to specify the part performance characteristics and manufacturing requirements.

/21 The environment must be considered when using plastic encapsulated microcircuits (PEMs). PEMs should not be used in an environment where moisture is present. Where their use can be accommodated special handling and storage procedures must be followed to prevent exposure to moisture. Also, the radiation tolerance of the PEM must be acceptable for the environment in which it will be used. Screen per MIL-STD 883, Method 5004, Table I Paragraphs: 3.1.8 Serialization; 3.1.9 Pre burn-in electrical parameters; 3.1.10 Burn-in for 160 hours; 3.3.11 Interim (post burn-in) electrical parameters; 3.1.12 Reverse bias burn-in; 3.1.13 Interim electrical parameters; 3.1.14 Per-cent defective allowable (PDA) and delta limits calculations; 3.1.15 Final electrical parameters; 3.1.17 Radiographic inspection; 3.1.19 External visual inspection. A two piece DPA per MIL-STD 883, Method 5009 as applicable shall be performed. Inspection for delamination is required: e.g. Method 1034 (dye penetrant), cross sectioning, CSAM, etc.

/22 Approved for use on Space Station. See SSQ-21678.

/23 Approved for EVA-only use on Space Station. See SSQ-21678.

/24 Note deleted

/25 Some ETFE (ethylene-tetrafluoroethylene copolymer / tradename “Tefzel”) insulated wire has been found to fail flammability testing in a 30 percent oxygen environment. Consult the project parts engineer for recommendations.

/26 To select part have manufacturer screen per Table IX.

/27 For Grade 1 low voltage applications, perform lot sample testing of MIL-C-123 group B, Subgroup 2. Reference MIL-HDBK-978, Vol. 1, 2.2.7.2. c & d. Sample parts subjected to this testing shall not be used.

/28 Note deleted

/29 Lot performance characteristics shall be assessed by use of sample test required by Appendix B, MIL-STD-975, Reference MIL-HDBK-978, Vol. 1,2.2.7.2 & .3. Sample parts subjected tot this testing shall not be used.

/30 CSR parts shall be subjected to screening in accordance with Appendix B of MIL-STD-975 prior to use. Reference MIL-HDBK-978, Vol 1, 2.6.7.2 & 3. Not applicable for style CSS.

/31 All wire products per this specification shall be restricted to ground support equipment/GSE (non-flight) use only.

/32 PPL application and screening notes apply.

/33 If no applicable Class S part is listed, perform additional screening test as indicated in GSFC PPL-21 Appendix C, Table 13.

/34 Magnetics shall comply with Table XII.

/35 Refer to GSFC PPL-21 for application information.

/36 Note deleted

/37 Consult the project parts engineer for recommendations.

/38 Cadmium, zinc, or anodized plated connectors and connector accessories (i.e., backshells, contacts, jam nuts, protective caps, jackscrews, etc.) shall not be used in space flight applications. Nickel is an acceptable plating material. Prior to use, connectors and backshells shall be thermal vacuum baked per MSFC-SPEC- 548, or equivalent. Consult the project parts engineer for recommendations.

/39 Stress corrosion and outgassing properties of these connectors are not controlled and must be evaluated for compliance to project engineering requirements. Prior to use, connectors shall be vacuum baked per MSFC-SPEC-548, or equivalent. Consult the project parts engineer for recommendations.

/40 The rear side of several connectors per this specification is not protected against moisture or debris. Consult the project parts engineer for recommendations.

/41 All connectors per this specification are restricted to ground support equipment/GSE (non-flight) use only.

/42 Wire and cable products per these specifications may require material testing per SP-R-0022A and NHB 8060.1, or equivalents. Consult the project parts engineer for recommendations.

/43 Silver-coated copper is susceptible to cuprous oxide ("red plague") corrosion when produced, stored, or used in a moist or high humidity environment. The environment for this wire must be controlled.

/44 Polyimide (trade name "Kapton") insulated wire is susceptible to "arc tracking" when used in certain applications. Consult the project parts engineer for recommendations.

/45 Screen per Table X.

Table VI – Standard Parts and Selection Preferences for Grade 2. /1

Part Type	Selection	Standard Part /2	Selection Preference Ranking /3	Note /4
Capacitor	MIL-PRF-20/27 - /31, /35-/38 (CCR)	FRL P or R	1st	
	MIL-PRF-81 (CV)	Yes		
	MIL-C-123 (CKS)	Yes		
	MIL-C-14409 (PC)	Yes		
	MIL-PRF-19978 (CQR)	FRL R		
	MIL-PRF-23269/1 - /4 (CYR)	FRL R		
	MIL-PRF-39001 (CMR)	FRL R		
	MIL-PRF-39003/1, /2, /10 (CSR & CSS)	FRL C		
	MIL-PRF-39006/1 - /4, /22, /25 (CLR)	FRL R		
	MIL-PRF-39014/1, /2, /5 (CKR)	FRL R		
	MIL-PRF-39022 (CHR)	FRL R		
	MIL-PRF-49467 (HVR)	FRL R		
	MIL-PRF-55365/4 (CWR)	FRL C		
	MIL-PRF-55681/1 - /4 (CDR)	FRL P or R		
	MIL-C-83421/1 (CRH)	FRL R		
	MIL-PRF-87164 (CMS)	Yes		
	MIL-PRF-87217/1 (CHS)	Yes		
	DESC 87106, Switch Mode Pwr Supply	Yes		
	Grade 1 & 2 Capacitors in GSFC PPL	Yes		Apply & Screen per /32
	Grade 1 Capacitors in MSFC-STD-3012	Yes		
	Other	No	2nd	Evaluate per /37
Circuit Breaker	MIL-PRF-39019/1 - /6	Yes	1st	/5
	Other	No	2nd	
Connector – RF	MIL-C-39012	Yes	1st	Restrict & Bakeout per /43
	MIL-PRF-49142			
	Other	No	2nd	Restrict per /41
Connector – Circular	NASA MSFC 40M38277	Yes	1st	
	NASA MSFC 40M38298			
	NASA MSFC 40M39569			
	NASA SSQ 21635			
	MIL-C-38999			Restrict & Bakeout per /42 /43 /16
	MIL-C-26482			
	MIL-C-5015			
	Other	No	2nd	Restrict per /41
	MIL-C-22992	No	N/A	GSE Only per /20
Connector – D Subminiature	NASA GSFC S-311-P4	Yes	1st	
	NASA GSFC S-311-P-10			
	MIL-PRF-24308			Restrict & Bakeout per /42 /43
	Other	No	2nd	Restrict per /41
Connector - Microminiature	MIL-PRF-83513	Yes	1st	Restrict & Bakeout per /42 /43
	Other	No	2nd	Restrict per /41

Table VI – Standard Parts and Selection Preferences for Grade 2. /1

Part Type	Selection	Standard Part /2	Selection Preference Ranking /3	Note /4
Connector – Printed Circuit	MIL-C-55302	Yes	1st	Restrict & Bakeout per /42 /43
	Other	No	2nd	Restrict per /41
Connector – Other	Other	No	1st	Restrict per /41
Connector – Contacts – Signal, Power, Coaxial, Shielded, Thermocouple, etc.	NASA MSFC 40M38277	Yes	1st	
	NASA MSFC 40M38298			
	NASA MSFC 40M39569			
	NASA SSQ 21635 and 21637			
	MIL-C-39029			
	NASA GSFC S-311-P4			
	Other	No	2nd	Restrict per /41
Connector – Backshell	NASA MSFC 40M38277	Yes	1st	
	NASA MSFC 40M38298			
	NASA MSFC 40M39569			
	NASA SSQ 21635			
	MIL-C-85049			Restrict & Bakeout per /42
	Other	No	2nd	Restrict per /41
Crystals and Crystal Oscillator	MIL-PRF-55310/8, /14, /16 Type 1	Class B	1st	
	Grade 1 & 2 Crystal Oscillators in GSFC PPL	Yes		Apply & Screen per /32
	Grade 1 Crystal Oscillators in MSFC-STD-3012	Yes		
	MIL-PRF-3098	No	2nd	Build & Screen per /34
	Other			Evaluate per /37
Discrete Semiconductor – Diodes, Transistors, Optical Couplers	QML-19500: JANS	Yes	1st	JANS Exceeds Rqmt
	JANTXV			PIND & X-ray per /6
	JANTX		2nd	Screen per /6, /8
	Custom processed part	No	3rd	Specify per /6, /9
	Other		4th	Qualify & Screen per /6 /10
Fiber Optic – Cable	NFOC-2FFF-1GRP-1	Yes	1st	Space Station per /11
	Other	No	2nd	Requirements per /5
Fiber Optic - Devices	All	No	N/A	Requirements per /5
Fiber Optic - Interconnects	NZGC-F-16PB (Pin)	Yes	1st	Space Station per /15
	NZGC-F-16SB (Socket)			
	Other	No	2nd	Requirements per /5
Filter	MIL-PRF-28861/1, /2, /4, /5	Class B	1st	
	Grade 1 & 2 Filters Listed in GSFC PPL	Yes		Apply & Screen per /32
	Grade 1 Filters Listed in MSFC-STD-3012	Yes		
	Other	No	2nd	Evaluate per /37

Table VI – Standard Parts and Selection Preferences for Grade 2. /1

Part Type	Selection	Standard Part /2	Selection Preference Ranking /3	Note /4
Fuse	MIL-PRF-23419/4, /8	Yes	1st	Select per /26
	Other	No	2nd	Qualify & Screen per /5
Hybrid Microcircuit	QML-38534: Class K	Yes	1st	Class K Exceeds Rqmt
	Class H			Screen per /6
	/883, /883B or /883S per MIL-STD-883			Screen & DPA per /6, /8
	Custom processed part	No	2nd	Qualify & Screen per /7
	Commercial		3rd	Qualify & Screen per /14
Magnetics – Inductors, Coils	MIL-STD-981	Class B	1st	
	MIL-PRF-39010/1, /2, /3, /6, /7	FRL P		Build & Screen per /34
	MIL-PRF-83446/4, /5, /7, /9, /10 Families 50, 51	Yes		
	Grade 1 & 2 Inductors and Coils in GSFC PPL	Yes		Apply & Screen per /32
	Grade 1 Inductors and Coils in MSFC-STD-3012	Yes		
	Other	No	2nd	Evaluate per /37
Magnetics - Transformers	MIL-STD-981	No	1st	
	MIL-PRF-27 Families 03, 04, 20, 21, 36, 37, 40, 41	Class M		Build & Screen per /34
	MIL-PRF-21038 Family 31	Class M		
	Grade 1 & 2 Transformers in GSFC PPL	Yes		Apply & Screen per /32
	Grade 1 Transformers in MSFC-STD-3012	Yes		
	Other	No	2nd	Evaluate per /37
Monolithic Microcircuit	QML-38535: Class V or S Class Q or B	Yes	1st	Class V & S Exceed Rqmt
	MIL-PRF-38535 Class M		2nd	DPA & Screen per /12
	/883, /883B or /883S per MIL-STD-883			
	Custom processed part	No		Qualify & Screen per /17
	QML-38535: Class N		3rd	Screen per /18
	Commercial		5th	Qualify & Screen per /19
Relay	MIL-PRF-39016/6, /9, /11, /12, /13, /20, /21, /30, /38	FRL P	1st	Restrict per /38 /39 /40
	Grade 1 & 2 Relays in GSFC PPL	Yes		Apply & Screen per /32
	Grade 1 Relays in MSFC-STD-3012	Yes		
	Vendor Hi-Rel Equivalent Relays	No	2nd	Evaluate per /37
	Other			
Resistor – Film/Foil	MIL-PRF-39017, RLR	FRL P	1st	
	MIL-PRF-55182, RNR, RNC, RNN			
	MIL-PRF-55342, RM			

Table VI – Standard Parts and Selection Preferences for Grade 2. /1

Part Type	Selection	Standard Part /2	Selection Preference Ranking /3	Note /4
	MIL-PRF-39035, RJR			
	MIL-PRF-83401, RZ	Level M		
	NASA SSQ Type 1 Qualified parts	Yes		
	MIL-PRF-122, RFP	FRL .01 or .001		FRL per /25
	Other	No	2nd	Qualify and Screen per /5
Resistor – Wirewound	MIL-PRF-39007, RWR	FRL P	1st	
	MIL-PRF-39005, RBR			
	MIL-PRF-39009, RER			
	MIL-PRF-39015, RTR			
	Other	No	2nd	Qualify and Screen per /5
Resistor – Other	Other	No	3rd	Qualify and Screen per /5
Switch	NDBS1-P-X-X-X-X-X (Data Bus)	Yes	1st	/22
	NDBS-P-X-X-X-X-X (Data Bus)	Yes	1st	/23
	Other	No	2nd	Qualify and Screen per /5
Thermistors	MIL-T-23468 (Pos. & Neg. Coeff.)	Yes	1st	Apply per /35
	GSFC S-311P-18 (Negative Coeff.)			
	Other	No	2nd	Qualify & Screen per Table X
Wire & Cable – Coaxial Cable	MIL-C-17	Yes	1st	Restrict per /21 /24
	Other	No	2nd	Restrict per /41
Wire & Cable – Multiconductor Cable	40M39526	Yes	1st	
	MIL-DTL-27500			Restrict per /21 /24
	Other	No	2nd	Restrict per /41
Wire & Cable – Hookup Wire	40M39513	Yes	1st	
	MIL-W-22759			Restrict per /21 /24 /29
	MIL-DTL-81381			Restrict per /21 /24 /27
	Other	No	2nd	Restrict per /41
	MIL-W-16878	No	N/A	Restrict per /30
Wire & Cable – Magnet Wire	NEMA-MW-1000	Yes	1st	Restrict per /21
	Other	No	2nd	Restrict per /41

Table VI Notes:

/1 This table identifies information for the part selection process, standard parts, and associated restrictions and verifications. The requirements listed shall be implemented in addition to other requirements herein.

/2 All standard parts are identified in this column. The standard part designation is predicated on compliance with all applicable requirements. All nonstandard parts require nonstandard part approval.

/3 Parts selection shall be accomplished in the order indicated. A lower ranked selection shall not be used if a higher ranked selection can be obtained.

/4 This column identifies screening and associated verifications and restrictions that are required for the part to be classified as acceptable. The project EEE parts plan shall specify details as necessary to implement these requirements, and may specify additional requirements.

/5 Qualification and screening requirements shall be determined to suit the specific application.

/6 PIND and X-ray screening required on cavity devices.

/7 Qualification and screening shall be per MIL-PRF 38534 for Class H devices. PIND testing , radiographic inspection, and a two piece DPA are required. Radiation tolerance testing may be required depending on the part environment. A controlling document shall be generated to specify the part performance characteristics and manufacturing requirements.

/8 A sample of each production lot shall be subjected to destructive physical analysis (DPA).

/9 A controlling document shall specify the part performance characteristics and manufacturing requirements. The controlling document shall specify design, processing, qualification, and screening requirements so as to match as much as is feasible the standard requirements that would be applied to a similar JANTXV quality part.

/10 A controlling document shall specify the part performance characteristics, required lot qualification, and screening tests. A sample of each production lot shall be subjected to qualification, including life testing, so as to match as much as is feasible the standard requirements that would be applied to a similar JANTXV quality part.

/11 Approved for use on Space Station. See SSQ-21654.

/12 Particle Impact Detection (PIND) testing, Radiographic inspection and a two piece Destructive Physical Analysis (DPA) per MIL-STD 883, Method 5009 are required and radiation latch-up testing may be required depending on the radiation environment.

/13 Qualification, screening, and approval requirements to be developed to suit the application.

/14 See Note /7. The use of plastic encapsulated hybrid microcircuits is not recommended.

/15 NASA Zero-G, contact size 16, fiber optic termini. Approved for use on Space Station. See SSQ-21635.

/16 The rear side of several connectors per this specification is not protected against moisture or debris. Consult the project parts engineer for recommendations.

/17 Qualification and screening shall be per MIL-PRF-38535, Appendix A for Class Q devices. In addition PIND and a two piece DPA are required. A controlling document shall be generated to specify the part performance characteristics and manufacturing requirements.

/18 The environment must be considered when using plastic encapsulated microcircuits (PEMs). PEMs should not be used in an environment where moisture is present. Where their use can be accommodated special handling and storage procedures must be followed to prevent exposure to moisture. Also, the radiation tolerance of the PEM must be acceptable for the environment in which it will be used. Radiographic inspection and a two piece DPA per MIL-STD 883, Method 5009 as applicable are required. Inspect for delimination per MIL-STD-38535, Table lB. Test/monitor 12.

/19 Qualification and screening shall be per MIL-PRF 38535 Appendix A for Class B devices or Appendix B for Class Q devices. PIND testing (when applicable), radiographic inspection, and a two piece DPA are required.

/20 All connectors per this specification are restricted to ground support equipment/GSE (non-flight) use only.

/21 Wire and cable products per these specifications may require material testing per SP-R-0022A and NHB 8060.1, or equivalents. Consult the project parts engineer for recommendations.

/22 Approved for use on Space Station. See SSQ-21678.

/23 Approved for EVA-only use on Space Station. See SSQ-21678.

/24 Silver-coated copper is susceptible to cuprous oxide (“red plague”) corrosion when produced, stored, or used in a moist or high humidity environment. The environment for this wire must be controlled.

/25 Refer to MIL-PRF-122 for explanation of FRL.

/26 To select part have manufacturer screen per Table IX

/27 Polyimide (tradename “Kapton”) insulated wire is susceptible to “arc tracking” when used in certain applications. Consult the project parts engineer for recommendations.

/28 Note deleted

/29 Some ETFE (ethylene-tetrafluoroethylene copolymer / tradename “Tefzel”) insulated wire has been found to fail flammability testing in a 30 percent oxygen environment. Consult the project parts engineer for recommendations.

/30 All wire products per this specification shall be restricted to ground support equipment/GSE (non-flight) use only.

/31 Note deleted

/32 PPL application and screening notes apply.

/33 Note deleted

/34 Magnetics shall comply with Table XII

/35 Refer to GSFC PPL-21 for application information.

/36 Note deleted

/37 NSPAR or equivalent evaluation process required.

/38 Platings of Cadmium or Zinc shall not be used. Molybdenum contact material shall not be used.

/39 Components shall not be selected with "Known Reliability Suspect Designs," reference MIL-HDBK-1547.

/40 Components shall not be selected with "Known Material Hazards," reference MIL-HDBK-1547.

/41 Consult the project parts engineer for recommendations.

/42 Cadmium, zinc, or anodized plated connectors and connector accessories (i.e., backshells, contacts, jam nuts, protective caps, jackscrews, etc.) shall not be used in space flight applications. Nickel is an acceptable plating material. Prior to use, connectors and backshells shall be thermal vacuum baked per MSFC-SPEC- 548, or equivalent. Consult the project parts engineer for recommendations.

/43 Stress corrosion and outgassing properties of these connectors are not controlled and must be evaluated for compliance to project engineering requirements. Prior to use, connectors shall be vacuum baked per MSFC-SPEC-548, or equivalent. Consult the project parts engineer for recommendations.

Table VII – Standard Parts and Selection Preferences for Grade 3. /1

Part Type	Selection	Standard Part /2	Selection Preference Ranking /3	Note /4
Capacitor	MIL-PRF-20/27 - /31, /35-/38 (CCR)	Yes	1st	
	MIL-PRF-81 (CV)			
	MIL-C-123 (CKS)			
	MIL-C-14409 (PC)			
	MIL-PRF-19978 (CQR)			
	MIL-PRF-23269/1 - /4 (CYR)			
	MIL-PRF-39001 (CMR)			
	MIL-PRF-39003/1, /2, /10 (CSR & CSS)			
	MIL-PRF-39006/1 - /4, /22, /25 (CLR)			
	MIL-PRF-39014/1, /2, /5 (CKR)			
	MIL-PRF-39022 (CHR)			
	MIL-PRF-49467 (HVR)			
	MIL-PRF-55365/4 (CWR)			
	MIL-PRF-55681/1 - /4 (CDR)			
	MIL-C-83421/1 (CRH)			
	MIL-PRF-87164 (CMS)			
	MIL-PRF-87217/1 (CHS)			
	DESC 87106, Switch Mode Pwr Supply			
	Grade 1 & 2 Capacitors in GSFC PPL			Apply & Screen per /32
	Grade 1 & 2 Capacitors in MSFC-STD-3012			
	Established Reliability (ER) and Non-ER Capacitors Equivalent to Standard Selections			
	Vendor Hi-Rel Equivalent Capacitors			
	Other	No	2nd	Evaluate per /37
Circuit Breaker	Any Military Specification or Source Control Drawings	Yes	1st	
	Other	No	2nd	/24
Connector – RF	MIL-C-39012	Yes	1st	Restrict & Bakeout per /46
	MIL-PRF-49142			
	Other	No	2nd	Restrict per /44
Connector – Circular	NASA MSFC 40M38277	Yes	1st	
	NASA MSFC 40M38298			
	NASA MSFC 40M39569			
	NASA SSQ 21635			
	MIL-C-38999			Restrict & Bakeout per /45 /46
	MIL-C-26482			
	MIL-C-5015			Restrict & Bakeout per /45 /46 /47
	Other	No	2nd	Restrict per /44
	MIL-C-22992	No	N/A	GSE Only per /48
Connector – D Subminiature	NASA GSFC S-311-P4	Yes	1st	
	NASA GSFC S-311-P-10			

Table VII – Standard Parts and Selection Preferences for Grade 3. /1

Part Type	Selection	Standard Part /2	Selection Preference Ranking /3	Note /4
	MIL-PRF-24308			Restrict & Bakeout per /45 /46
	Other	No	2nd	Restrict per /44
Connector – Microminiature	MIL-PRF-83513	Yes	1st	Restrict & Bakeout per /45 /46
	Other	No	2nd	Restrict per /44
Connector – Printed Circuit	MIL-C-55302	Yes	1st	Restrict & Bakeout per /45 /46
	Other	No	2nd	Restrict per /44
Connector – Other	Other	No	1st	Restrict per /44
Connector – Contacts – Signal, Power, Coaxial, Shielded, Thermocouple, etc.	NASA MSFC 40M38277	Yes	1st	
	NASA MSFC 40M38298			
	NASA MSFC 40M39569			
	NASA SSQ 21635 and 21637			
	MIL-C-39029			
	NASA GSFC S-311-P4			
	Other	No	2nd	Restrict per /44
Connector – Backshell	NASA MSFC 40M38277	Yes	1st	
	NASA MSFC 40M38298			
	NASA MSFC 40M39569			
	NASA SSQ 21635			
	MIL-C-85049			Restrict & Bakeout per /45
	Other	No	2nd	Restrict per /44
Crystals and Crystal Oscillator	MIL-PRF-55310/8, /14, /16 Type 1	Yes	1st	
	MIL-PRF-3098			
	Grade 1 & 2 Crystal Oscillators in GSFC PPL			Apply & Screen per /32
	Grade 1 & 2 Crystal Oscillators in MSFC-STD-3012			
	Established Reliability and Non-ER Military Crystal Oscillators Equivalent to Standard Selections			
	Vendor Hi-Rel Equivalent Crystal Oscillators			
	Other	No	2nd	Evaluate per /37
Discrete Semiconductor – Diodes, Transistors, Optical Couplers	QML-19500: JANS	Yes	1st	Exceeds Requirement
	JANTXV, JANTX			PIND and X-ray per /6
	JAN			
	Vendor Hi-Rel Product			
	Other	No	2nd	Qualify & Screen per /16
Fiber Optic – Cable	NFOC-2FFF-1GRP-1	Yes	1st	Space Station per /20
	Other	No	2nd	Requirements per /5
Fiber Optic – Devices	All	No	1stt	Requirements per /5
Fiber Optic - Interconnects	NZGC-F-16PB (Pin)	Yes	1st	Space Station per /21
	NZGC-F-16SB (Socket)			

Table VII – Standard Parts and Selection Preferences for Grade 3. /1

Part Type	Selection	Standard Part /2	Selection Preference Ranking /3	Note /4
	Other	No	2nd	Requirements per /5
Filter	MIL-PRF-28861/1, /2, /4, /5	Yes	1st	
	Grade 1 & 2 Filters Listed in GSFC PPL			Apply & Screen per /32
	Grade 1 & 2 Filters Listed in MSFC-STD-3012			
	Established Reliability and Non-ER Military Filters Equivalent to Standard Selections			
	Vendor Hi-Rel Equivalent Filters			
	Other	No	2nd	
Fuse	MIL-PRF-23419/4, /8	Yes	1st	
	Other	No	2nd	
Hybrid Microcircuit	QML-38534 Class K	Yes	1st	Use as is
	Class H			Screen per /25
	/883S or /883B			
	Custom Processed part			Screen per /27
	Vendor /883 compliant, Vendor "Hi Rel"		2nd	Screen per /29
	QML-38534 Class G	No	3rd	Screen per /30
	QML-38534 Class D, E		4th	Screen per /41
	Commercial and commercial off the shelf		5th	Screen per /42
Magnetics – Inductors, Coils	MIL-PRF-39010/1, /2, /3, /6, /7	Yes	1st	
	MIL-PRF-83446/4, /5, /7, /9, /10 Families 50, 51			
	Grade 1 & 2 Inductors and Coils in GSFC PPL			Apply & Screen per /32
	Grade 1 & 2 Inductors and Coils in MSFC-STD-3012			
	Established Reliability and Non-ER Military Inductors and Coils Equivalent to Standard Selections			
	Vendor Hi-Rel Equivalent Inductors and Coils			
	Other	No	2nd	
Magnetics - Transformers	MIL-PRF-27 Families 03, 04, 20, 21, 36, 37, 40, 41	Yes	1st	Build & Screen per /43
	MIL-PRF-21038 Family 31			
	Grade 1 & 2 Transformers in GSFC PPL			Apply & Screen per /32
	Grade 1 & 2 Transformers in MSFC-STD-3012			
	Established Reliability and Non-ER Military Transformers Equivalent to Standard Selections			
	Vendor Hi-Rel Equivalent Transformers			
	Other	No	2nd	

Table VII – Standard Parts and Selection Preferences for Grade 3. /1

Part Type	Selection	Standard Part /2	Selection Preference Ranking /3	Note /4
Monolithic Microcircuit	QML 38535: Class V, S	Yes	1st	V & S Exceed Rqmt
	Class Q, B			Screen per /25
	MIL-PRF-38535 Class M			
	/883S or /883B			
	QML-38535: Class N			Use As Is
	Custom Processed part			Screen per /19
	Vendor /883 compliant, Vendor "Hi Rel"		2nd	Screen per /34
	Commercial and commercial off the shelf	No	3rd	Screen per /18
Relay	MIL-PRF-39016/6, /9, /11, /12, /13, /20, /21, /30, /38	Yes	1st	Restrict per /38 /39 /40
	Grade 1 & 2 Relays in GSFC PPL			
	Grade 1 & 2 Relays in MSFC-STD-3012			
	Vendor Hi-Rel Equivalent Relays			
	Other	No	2nd	
Resistor - Film/Foil	MIL-PRF-39017, RLR	FRL P	1st	
	MIL-PRF-55182, RNR, RNC, RNN			
	MIL-PRF-55342, RM			
	MIL-PRF-39035, RJR			
	MIL-PRF-83401, RZ	Yes		
	NASA SSQ Type 1 Qualified parts			
	MIL-PRF-122, RFP			
	Other	No	2nd	
Resistor - Wirewound	MIL-PRF-39007, RWR	FRL P	1st	
	MIL-PRF-39005, RBR			
	MIL-PRF-39009, RER			
	MIL-PRF-39015, RTR			
	Other	No	2nd	
Resistor Other	Other	No	3rd	
Switch –	NDBS1-P-X-X-X-X-X (Data Bus)	Yes	1st	/22
	NDBS-P-X-X-X-X-X (Data Bus)			/23
	Other	No	2nd	Requirements per /5
Thermistor	Any Military Specification	Yes	1st	Apply per /24
	Other	No	2nd	Screen & Apply per /5 /24
Wire & Cable – Coaxial Cable	MIL-C-17	Yes	1st	Restrict per /49 /50
	Other	No	2nd	Restrict per /44
Wire & Cable – Multiconductor Cable	40M39526	Yes	1st	
	MIL-DTL-27500			Restrict per /49 /50
	Other	No	2nd	Restrict per /44
Wire & Cable – Hookup Wire	40M39513	Yes	1st	
	MIL-W-22759			Restrict per /49 /50 /52
	MIL-DTL-81381			Restrict per /49 /50 /51

Table VII – Standard Parts and Selection Preferences for Grade 3. /1

Part Type	Selection	Standard Part /2	Selection Preference Ranking /3	Note /4
	Other	No	2nd	Restrict per /44
	MIL-W-16878	No	N/A	Restrict per /53
Wire & Cable – Magnet Wire	NEMA-MW-1000	Yes	1st	Restrict per /49
	Other	No	2nd	Restrict per /44

Table VII Notes:

/1 This table identifies information for the part selection process, standard parts, and associated restrictions and verifications. The requirements listed shall be implemented in addition to other requirements herein.

/2 All standard parts are identified in this column. The standard part designation is predicated on compliance with all applicable requirements. All nonstandard parts require nonstandard part approval.

/3 Parts selection shall be accomplished in the order indicated. A lower ranked selection shall not be used if a higher ranked selection can be obtained.

/4 This column identifies screening and associated verifications and restrictions that are required for the part to be classified as acceptable. The project EEE parts plan shall specify details as necessary to implement these requirements, and may specify additional requirements.

/5 Qualification and screening requirements shall be determined to suit the specific application.

/6 PIND and X-ray screening strongly recommended on cavity devices.

/7 Qualification and screening shall be per MIL-PRF 38534 for Class H devices. PIND testing , radiographic inspection, and a two piece DPA are required. Radiation tolerance testing may be required depending on the part environment.

/8 A sample of each production lot shall be subjected to destructive physical analysis (DPA).

/9 A controlling document shall specify the part performance characteristics and manufacturing requirements. The controlling document shall specify design, processing, qualification, and screening requirements so as to match as much as is feasible the standard requirements that would be applied to a similar JANTXV quality part.

/10 A controlling document shall specify the part performance characteristics, required lot qualification, and screening tests. A sample of each production lot shall be subjected to qualification, including life testing, so as to match as much as is feasible the standard requirements that would be applied to a similar JANTXV quality part.

/11 Note deleted

/12 Particle Impact Detection (PIND) testing, Radiographic inspection and a two piece Destructive Physical Analysis (DPA) per MIL-STD 883, Method 5009 are required and radiation latch-up testing may be required depending on the radiation environment.

/13 Qualification, screening, and approval requirements to be developed to suit the application.

/14 See Note /7. The use of plastic encapsulated hybrid microcircuits is not recommended.

/15 Note deleted

/16 The controlling documentation shall identify the part performance characteristics, required lot qualification, and screening tests. A sample of each production lot shall be subjected to qualification, including life testing and destructive physical analysis. 100% screening should include 100% Particle Impact Noise Detection (PIND) and x-ray examination of devices with internal cavities.

/17 Qualification and screening shall be per MIL-PRF-38535, Appendix A for Class Q devices. In addition PIND testing is required.

/18 Commercial parts may be screened and qualified per MIL-PRF 38535 for Class Q, M, or N as appropriate. PIND testing, when applicable, is also strongly recommended. Commercial- off-the-shelf assemblies may be considered qualified upon successful completion of box level environmental testing.

/19 Qualification and screening may be per MIL-PRF 38535 Appendix A for Class B devices or Appendix B for Class Q devices. PIND testing (when applicable), radiographic inspection, and a two piece DPA are strongly recommended.

/20 Approved for use on Space Station. See SSQ-21654.

/21 NASA Zero-G, contact size 16, socket, fiber optic termini. Approved for use on Space Station. See SSQ-21635.

/22 Approved for use on Space Station. See SSQ-21678.

/23 Approved for EVA-only use on Space Station. See SSQ-21678.

/24 Refer to MIL-HDBK-1547 for application information.

/25 PIND testing is strongly recommended.

/26 Standard Bussman or Littlefuse fuse, sample screened by the manufacturer. See Table IX for screening.

/27 Qualification and screening may be per MIL-PRF 38534 for Class H devices. PIND testing and radiographic inspection are strongly recommended.

/28 Note deleted

/29 PIND testing and radiographic inspection are strongly recommended for devices with internal cavities.

/30 PIND testing and radiographic inspection are strongly recommended. User should verify that the device temperature range is adequate for the application.

/31 Note deleted

/32 PPL application and screening notes apply.

/33 Note deleted

/34 PIND testing (when applicable) is strongly recommended. For vendor Hi-Rel verify that the part has received burn-in and that the temperature range of the part meets project requirements.

/35 Note deleted

/36 Note deleted

/37 NSPAR or equivalent evaluation process required.

/38 Platings of Cadmium or Zinc shall not be used. Molybdenum contact material shall not be used.

/39 Components shall not be selected with "Known Reliability Suspect Designs," reference MIL-HDBK-1547.

/40 Components shall not be selected with "Known Material Hazards," reference MIL-HDBK-1547.

/41 PIND testing and radiographic inspection are strongly recommended. User should obtain the device specification from the vendor and verify that the part meets project requirements.

/42 Commercial hybrid microcircuits shall as a minimum be screened as follows: Burn-in at the appropriate temperature for 100 hours; Final electrical tests; PIND testing; Radiographic inspection. The use of plastic encapsulated hybrid microcircuits is not recommended. Commercial-off-the-shelf assemblies containing hybrid microcircuits may be considered qualified upon successful completion of environmental testing.

/43 Comply with the Class B build and screening requirements of MIL-STD-981.

/44 Consult the project parts engineer for recommendations.

/45 Cadmium, zinc, or anodized plated connectors and connector accessories (i.e., backshells, contacts, jam nuts, protective caps, jackscrews, etc.) shall not be used in space flight applications. Nickel is an acceptable plating material. Prior to use, connectors and backshells shall be thermal vacuum baked per MSFC-SPEC- 548, or equivalent. Consult the project parts engineer for recommendations.

/46 Stress corrosion and outgassing properties of these connectors are not controlled and must be evaluated for compliance to project engineering requirements. Prior to use, connectors shall be vacuum baked per MSFC-SPEC-548, or equivalent. Consult the project parts engineer for recommendations.

/47 The rear side of several connectors per this specification is not protected against moisture or debris. Consult the project parts engineer for recommendations.

/48 All connectors per this specification are restricted to ground support equipment/GSE (non-flight) use only.

/49 Wire and cable products per these specifications may require material testing per SP-R-0022A and NHB 8060.1, or equivalents. Consult the project parts engineer for recommendations.

/50 Silver-coated copper is susceptible to cuprous oxide ("red plague") corrosion when produced, stored, or used in a moist or high humidity environment. The environment for this wire must be controlled.

/51 Polyimide (tradename "Kapton") insulated wire is susceptible to "arc tracking" when used in certain applications. Consult the project parts engineer for recommendations.

/52 Some ETFE (ethylene-tetrafluoroethylene copolymer / tradename "Tefzel") insulated wire has been found to fail flammability testing in a 30 percent oxygen environment. Consult the project parts engineer for recommendations.

/53 All wire products per this specification shall be restricted to ground support equipment/GSE (non-flight) use only.

Table VIII – Standard Parts and Selection Preferences for Grade 4. /1

Part Type	Selection /3	Standard Part /2	Selection Preference Ranking /5	Note /4
Capacitor		Yes		
	Military Specification		N/A	
	Vendor Hi-Rel			
	Commercial and Other			
Circuit Breaker				
	Military Specification		N/A	
	Commercial and Other			
Connector				
Connectors and Accessories	Military Specification		N/A	
	Vendor Hi-Rel			
	Commercial and Other			
Crystal Oscillator				
	Military Specification		N/A	
	Vendor Hi-Rel			
	Commercial and Other			
Discrete Semiconductor				
Diodes, Transistors, Optical Couplers	MIL-PRF-19500		N/A	
	Vendor Hi Rel			
	Commercial and Other			
Fiber Optic				
Cables, Devices, Interconnects	All		N/A	
Filter				
	Military Specification		N/A	
	Vendor Hi-Rel			
	Commercial and Other			
Fuse				
	Bussman or Littlefuse		N/A	
	Commercial and Other			
Hybrid Microcircuit				
	MIL-PRF-38534		N/A	
	MIL-STD-883 Compliant			
	Vendor Hi Rel			
	Commercial and Other			
Magnetics				
	Military Specification		N/A	
	Vendor Hi-Rel			
	Commercial and Other			
Monolithic Microcircuit				
	MIL-PRF-38535		N/A	
	MIL-STD-883 Compliant			
	Vendor Hi Rel			
	Commercial and Other			
Relay				
	Military Specification		N/A	
	Vendor Hi-Rel			

Table VIII – Standard Parts and Selection Preferences for Grade 4. /1

Part Type	Selection /3	Standard Part /2	Selection Preference Ranking /5	Note /4
	Commercial and Other			
Resistor				
	Military Specification		N/A	
	Vendor Hi-Rel			
	Commercial and Other			
Switch				
	Military Specification		N/A	
	Vendor Hi-Rel			
	Commercial and Other			
Thermistor				
	Military Specification		N/A	
	Commercial and Other			
Wire & Cable				
	Military Specification		N/A	
	Vendor Hi-Rel			
	Commercial and Other			

Table VIII Notes:

/1 This table identifies information for the part selection process, standard parts, and associated restrictions and verifications. The requirements listed shall be implemented in addition to other requirements herein. All parts used in flight applications shall comply with the Hazard Avoidance requirements per MSFC-STD-3012.

/2 All parts are considered standard parts for Grade 4.

/3 Refer to MIL-HDBK-1547 for selection guidance.

/4 This column identifies screening and associated verifications and restrictions for the part, if any. The project EEE parts plan shall specify details as necessary to implement these requirements, and may specify additional requirements.

/5 Selection preference ranking is not applicable for Grade 4.

Table IX - Fuse Screening

INSPECTION/TEST	TEST METHODS, CONDITIONS, AND REQUIREMENTS /1	FOR PART GRADES	NOTES
Visual Inspection	Materials, design, construction, marking, and workmanship.	1, 2, 3, 4	
Mechanical Inspection	Body and lead dimensions to specification.	1, 2, 3, 4	/2
Resistance (Cold)	MIL-STD-202, Method 303, Resistance to specification	1, 2, 3, 4	/3
Voltage Drop (Hot-1)	100% rated current for 5 minutes (minimum). Voltage drop to specification (when specified).	1, 2, 3	/4
Thermal Shock	MIL-STD-202, Method 107, Condition B	1, 2, 3	/5, /6
Voltage Drop (Hot-2)	100% rated current for 5 minutes (minimum). Ratio voltage drop (Hot-1/Hot-2) = 0.97 to 1.03.	1, 2, 3	
Resistance (Cold)	MIL-STD-202, Method 303, Resistance to specification	1, 2, 3	/3
Seal	MIL-STD-202, Method 112, Condition A	1, 2, 3	
Percent Defective Allowable (PDA)	5%	1, 2, 3	/7

Table IX Notes:

/1 The test conditions and the pass/fail criteria shall be based on the nearest equivalent military specification, the manufacturer's specification, or the application, whichever is most severe.

/2 A minimum of three fuses shall be measured. In the event of failure, the entire lot shall be screened for dimensions and rejects discarded.

/3 The source current for the resistance measurement shall not exceed 10% of the nominal current rating at room temperature.

/4 The voltage drop (hot) measurement must be recorded to calculate the voltage drop ratio regardless of whether or not it is a specification requirement.

/5 Fuses rated < +125°C shall be tested to Condition A.

/6 External visual examination is required after testing to verify no evidence of mechanical damage.

/7 Marking and voltage ratio rejects shall not be counted for purposes of establishing the defect rate.

.

Table X - Thermistor Screening Requirements (Page 1 of 2)

Inspection/Test	Test Methods, Conditions and Req's (Note 1)	Notes	Part Type/Grade Level (Note 8)			
			Positive Temp. Coefficient		Negative Temp. Coefficient	
			1 & 2	3	1 & 2	3
Visual Inspections	Materials, design, construction, marking, & workmanship		X	X	X	X
Mechanical Inspections	Body and lead dimensions to specification	2	X	X	X	X
Zero-Power Resistance	MIL-STD-202, Method 203 Zero-power resistance at specified reference temp. Zero-power resistance at + 125 Deg. C. Zero-power resistance at specified ref. Temp. Delta R (zero-power) to specification	3,4,5	X	X	X	X
Thermal Shock	MIL-STD-202, Method 107 Grade 1 – 25 cycles Grade 2 – 10 cycles High temperature – 125 Deg. C. Low temperature – minimum rated operating	3,4,5	X		X	
High Temperatue Storage	+ 125 Deg. C. , 100 hours, no load	4,5,6	X		X	
Zero-Power Resistance	MIL-STD-202, Method 203 Zero-power resistance at specified reference temp. Delta R (zero-power) to specification	3,4,5	X	X	X	X
Insulation Resistance	MIL-STD-202, Method 302 Between leads & conductive mateial surrounding body Specified minimum resistance		X	X	X	X

Table X - Thermistor Screening Requirements (Page 2 of 2)

Inspection/Test	Test Methods, Conditions and Req's	Notes	Part Type/Grade Level			
			Positive Temp. Coefficient		Negative Temp. Coefficient	
			1 & 2	3	1 & 2	3
Resistance Temperature Characteristic	Specified temperature points Stabilization time ≥ 10 times the thermal time constant. Zero-power resistance at each temp. point. Resistance curve to specification within tolerance limits at each temperature point. Temperature points: Grade 1 & 2 - reference temp., each temp. extreme, and a minimum of 5 points between Reference temperature and each temp. extreme. Grade 3 - reference temp., each temp. extreme, And a minimum of 3 points between reference Temp. and each temp. extreme.	3,4,5	X			
Percent Defective Allowable (PDA)	Grade 1 - 5% Grade 2 - 10% Grade 3 - 15% Grade 4 - N/A	7	X	X	X	X

Table X Notes:

1. It is the responsibility of the user to define minimum and/or maximum values for each parameter (pass/fail criteria). These values should be based on the nearest equivalent military specification, manufacturing specification, or the application, whichever is most stringent.
2. A minimum of three thermistors shall be measured.
3. Zero-power resistance shall be measured in a controlled uniform medium capable of maintaining an accuracy of

plus or minus 0.05% Deg. C. for beads (any mounting construction) and plus or minus 0.05% Deg. C. for all other types. The resistance shall be measured using a wheatstone bridge (or equivalent), accuracy to plus or minus 0.05% Deg. C.

4. The specified reference temperature is usually ambient + 25 Deg. C. However, since the resistance curve tolerance varies on either side of this reference ambient, for particular applications, it may be advantageous to specify the reference temperature at some point, up to and including the temperature extremes. If a temperature extreme is used as the reference temperature, the complementary temperature for zero-power resistance and resistance ratio shall be the midpoint temperature between the temperature extremes. If the high temperature extreme is greater than + 125 Deg. C., this temperature shall be used for thermal shock and high temmperature storage testing.
5. Never expose a thermistor to an ambient temperature greater than its maximum operating temperature during testing under no load conditions. Such exposure, even for brief periods, can permanently destabilize the thermistor if the Curie temperature is exceeded. The maximum operating temperature, which can be determined from the power rating, is the maximum body temperature at which the thermistor will continue to operate with acceptable stability of its characteristics. The temperature at which the power has been linearly derated to 0 % corresponds to the maximum ambient temperature under no load conditions.
6. External visual examination required after testing to verify no evidence of mechanical damage.
7. Marking defects shall not be counted for purposes of establishing the failure rate.
8. Grade 4 is not shown in the Table….will be screened to suit the application.

Table XI - Thermistor Qualification Requirements (Page 1 of 4)

Inspection/Test	Test Methods, Conditions and Requirements 1/	Notes	Quantity (Accept Number)					
			Positive Temp Coefficient 2/			Negative Temp Coefficient 2/		
			Grade 1	Grade 2	Grade 3	Grade 1	Grade 2	Grade 3
Group 1								
Screening to Table X	Table X	3/	X	X	X	X	X	X
Group 2			3(0)	3(0)		3(0)	3(0)	
Solderability (when applicable)	MIL-STD-202, Method 208		X	X		X	X	
Resistance to Solvents	MIL-STD-202, Method 215	4/	X	X		X	X	
Group 3			10(0)	5(0)		10(0)	5(0)	
Short Time Overload	Specified zero-power resistance Use dissipation constant and resistance value to compute average voltage and current at maximum power rating Energize time: 5 minutes at specified reference temperature De-energize for 10 minutes Repeat for 10 complete cycles ΔR (zero-power) to specification	4/	X	X		X	X	
Dielectric Withstanding Voltage	MIL-STD-202, Method 301 Between leads and conductive material surrounding body	4/	X	X		X	X	
Insulation Resistance	MIL-STD-202, Method 302 Between leads and conductive material surrounding body Specified minimum resistance		X	X		X	X	

Table XI - Thermistor Qualification Requirements (Page 2 of 4)

Inspection/Test	Test Methods, Conditions and Requirements 1/	Notes	Quantity (Accept Number)					
			Positive Temp Coefficient 2/			Negative Temp Coefficient 2/		
			Grade 1	Grade 2	Grade 3	Grade 1	Grade 2	Grade 3
Group 3 (continued)								
Low Temperature Storage	Specified low temperature for 3 hours min. ΔR (zero-power) to specification	4/	X X	X X		X X	X X	
Dissipation Constant	Specified zero-power resistances Specified test chamber , chamber temperature, or temperature controlled bath Specified test circuit schematic Loading to specified voltage and current levels Specified load dwell time Specified dissipation formula Dissipation constant to specification							
Thermal Time Constant	Specified zero-power resistances Specified test chamber, chamber temperature and controlled temperature bath (if applicable) Specified test circuit schematic Loading to specified voltage and current levels Specified load dwell time Specified vertical travel and travel rate (if applicable) Thermal time constant to specification	5/	X	X		X	X	
Terminal Strength	MIL-STD-202, Method 211 Test Condition A (disk and bead types) Test Conditions A and D (rod types) ΔR (zero-power) to specification	4/	X	X		X	X	

Table XI - Thermistor Qualification Requirements (Page 3 of 4)

Inspection/Test	Test Methods, Conditions and Requirements 1/	Notes	Quantity (Accept Number)					
			Positive Temp Coefficient 2/			Negative Temp Coefficient 2/		
			Grade 1	Grade 2	Grade 3	Grade 1	Grade 2	Grade 3
Group 4			5(0)	3(0)	3(0)	5(0)	3(0)	3(0)
Resistance Temperature Characteristic	Specified temperature points Stabilization time ≥ 10 times the thermal time constant Zero-power resistance at each temperature point Resistance curve to specification within tolerance limits at each temperature point Temperature points: Grade 3- reference temperature, each temperature extreme, and a minimum of 1 point between reference temperature and each temperature extreme				X			X
Resistance to Soldering Heat	MIL-STD-202, Method 210 Specified solder temperature Specified dwell time ΔR (zero-power) to specification	4/	X	X		X	X	
Moisture Resistance	MIL-STD-202, Method 106 Loading: 50% at maximum rated power 50% at no load IR to specification ΔR (zero-power) to specification	4/	X	X		X	X	

Table XI - Thermistor Qualification Requirements (Page 4 of 4)

Inspection/Test	Test Methods, Conditions and Requirements 1/	Notes	Quantity (Accept Number)					
			Positive Temp Coefficient 2/			Negative Temp Coefficient 2/		
			Grade 1	Grade 2	Grade 3	Grade 1	Grade 2	Grade 3
Group 5 Load Life	MIL-STD-202, Method 108 Specified zero-power reference temperature Specified maximum rated power, 1.5 hours on, 0.5 hours off Grade 1- 1000 hours Grade 2- 500 hours	4/	10(0) X	5(0) X		10(0) X	5(0) X	
Group 6 Thermal Outgassing	ASTM E595 TML = 1.0% maximum CVCM = 0.10% maximum	6/	X	X	X	X	X	X

Table XI Notes:

1/ It is the responsibility of the user to define test conditions and pass/fail criteria for each inspection not specified herein. These values should be based on the nearest equivalent military specification, manufacturer specification, or the application, whichever is most severe.

2/ No Inspection/Testing required for Grade 4 thermistors.

3/ The qualification samples shall be subdivided as specified in the table for Groups 3 through 6 inclusive. Group 2 inspections can be performed on unscreened samples or on samples that have completed one of the other qualification test groups. These minimum samples sizes are required for qualification:

Grade 1- 25 thermistors
Grade 2- 13 thermistors
Grade 3- 3 thermistors

4/ External visual examination required after testing to verify no evidence of mechanical damage.

5/ A controlled temperature bath and drive mechanism are used for beads in probes and beads in rods.

6/ Materials listed in Revision 3 of NASA Reference Publication 1124 that meet TML and CVCM limits are acceptable for use without further testing.

Table XII - Compliance with MIL-STD-981 Requirements for Parts Qualified to Certain Military Specifications

MIL-STD-981 REQUIREMENT		COMPLIANCE /1					
PARAGRAPH	SYNOPSIS	MIL-PRF-27	MIL-PRF-15305	MIL-PRF-21038	MIL-PRF-39010	MIL-T-55631	MIL-PRF-83446
		Power and Audio Transformers & Inductors	RF Coils	Pulse Transformers	Molded RF Coils	RF Transformers (Inactive except for replacement)	RF Coil Chips
For MIL-STD-981 Class S Devices							
4.2 Power Transformers, power inductors …	Meet specified grade and class requirements of MIL-PRF-27	grades 4 or 5, all classes, T level	N/A	N/A	N/A	N/A	N/A
4.3 Radio frequency … transformers	Meet specified grade and class requirements of MIL-PRF-55631	N/A	N/A	N/A	N/A	Grade 1, class A or B	N/A
4.4 Radio frequency … coils	Meet specified grade and class requirements of MIL-PRF-15305	N/A	Grade 1, class A or B	N/A	All classes, FRL S	N/A	N/A
4.5 Low power pulse transformers	Meet specified grade and class requirements of MIL-PRF-21038	N/A	N/A	T level	N/A	N/A	N/A
4.6 Radio frequency, chip … coils	Meet requirements of MIL-PRF-83446	N/A	N/A	N/A	N/A	N/A	Yes
5.1.1 Outgassing	Maximum total mass loss and collected volatile condensable for nonhermetic sealed	The military specification does not assure compliance. Additional selection or testing shall be required to assure compliance.					
5.1.2 Hydrolytic stability	Verify by test for polymeric materials						
5.1.4.1 Magnet wire	Use J-W-1177 wire of specified Min. size	Military specification is equivalent, except minimum wire size is not assured. Additional selection shall be required to assure compliance					
5.1.4.2 Insulated wire	Use MIL-W-22759 wire of specified minimum size						
5.1.5 Solder and soldering flux	QQ-S-571 solder, except not pure tin, and MIL-F-14256 flux of specified type	Referenced material specifications have been superceded, use: ANSI J-STD-004, J-STD-005 and J-STD-006. Military specification is equivalent for solder. The military specification does not assure compliance with the flux restriction for Class S. Additional selection shall be required to assure compliance with type R, or equivalent, flux.					
5.2 Internal elements	Select internal nonmagnetic EEE parts from MIL-STD-975. Request approval for any other parts	The military specification does not assure compliance. Also MIL-STD-975 is canceled. Additional selection shall be required to assure compliance with Grade 1 parts in accordance with MSFC-STD-3012, or equivalent.					
5.3 Radiographic inspection	Inspect per Appendix C	Military specification is equivalent	The military specification does not comply. Additional test shall be required to assure compliance.				
5.5.9.5 Tapes	Restricted use of adhesive tape	The military specification does not assure compliance. Additional selection or testing shall be required to assure compliance.					
5.5.9.8 Antirotation feature	Terminal lead construction specified						
5.5.12.1 Examination	Inspect for conformance to following						
5.5.12.2 Solder joints	Shall not show listed defects at 3X to 10X magnification						
5.5.12.3 Lead wires	Stress relief, minimum bend radius requirements. No sharp bends						
5.5.12.4 Coils	Wind C cores and laminations on bobbins or core tubes						
5.5.12.5 Crossover of turns	No uninsulated cross over.						
5.5.12.6 Splices	Prohibition of magnet wire splices						

Table XII - Compliance with MIL-STD-981 Requirements for Parts Qualified to Certain Military Specifications

MIL-STD-981 REQUIREMENT		COMPLIANCE /1					
PARAGRAPH	SYNOPSIS	MIL-PRF-27	MIL-PRF-15305	MIL-PRF-21038	MIL-PRF-39010	MIL-T-55631	MIL-PRF-83446
		Power and Audio Transformers & Inductors	RF Coils	Pulse Transformers	Molded RF Coils	RF Transformers (Inactive except for replacement)	RF Coil Chips
5.5.12.7 Extraneous material							
5.5.512.8 Cores							
5.5.12.8.1 Protective coating	Coat or tape ferrite and powder cores where possible; protect wire from abrasion	The military specification does not assure compliance. Additional selection or testing shall be required to assure compliance.					
5.5.13.7.1 Internal voids	Size and position restrictions on internal voids						
5.5.13.7.2 Surface voids and depressions	Restriction on reduction in thickness of the covering						
5.6.2.1 Magnet wire	Wire supplier to verify Groups A, B and C. Specified tests on each spool. Age restrictions. Protective storage	Military specifications do not assure compliance with wire age restrictions. Additional selection shall be required to assure compliance.					
5.6.7.3.1 Lot acceptance	LTPD 5% or 1 device	Military specification is equivalent		The military specification does not comply. Additional selection shall be required to assure compliance.	Military specification FRL is equivalent	Military specification is equivalent	The military specification does not comply. Additional selection shall be required to assure compliance
For MIL-STD-981 Class B Devices							
4.2 Power Transformers, power inductors …	Meet specified grade and class requirements of MIL-PRF-27	grades 4 or 5, all classes, T level	N/A	N/A	N/A	N/A	N/A
4.3 Radio frequency … transformers	Meet specified grade and class requirements of MIL-PRF-55631	N/A	N/A	N/A	N/A	Grade 1, class A or B	N/A
4.4 Radio frequency … coils	Meet specified grade and class requirements of MIL-PRF-15305	N/A	Grade 1, class A or B	N/A	All classes, FRL S, P or R	N/A	N/A
4.5 Low power pulse transformers	Meet specified grade and class requirements of MIL-PRF-21038	N/A	N/A	T level	N/A	N/A	N/A
4.6 Radio frequency, chip … coils	Meet requirements of MIL-PRF-83446	N/A	N/A	N/A	N/A	N/A	Yes
5.1.1 Outgassing	Maximum total mass loss and collected volatile condensable for nonhermetic sealed	The military specification does not assure compliance. Additional selection or testing shall be required to assure compliance.					
5.1.2 Hydrolytic stability	Verify by test for polymeric materials						
5.1.4.1 Magnet wire	Use J-W-1177 wire of specified minimum size	Military specification is equivalent, except minimum wire size is not assured. Additional selection shall be required to assure compliance					
5.1.4.2 Insulated wire	Use MIL-W-22759 wire of specified minimum size						

Table XII - Compliance with MIL-STD-981 Requirements for Parts Qualified to Certain Military Specifications

MIL-STD-981 REQUIREMENT		COMPLIANCE /1					
PARAGRAPH	SYNOPSIS	MIL-PRF-27	MIL-PRF-15305	MIL-PRF-21038	MIL-PRF-39010	MIL-T-55631	MIL-PRF-83446
		Power and Audio Transformers & Inductors	RF Coils	Pulse Transformers	Molded RF Coils	RF Transformers (Inactive except for replacement)	RF Coil Chips
5.2 Internal elements	Select internal nonmagnetic EEE parts from MIL-STD-975. Request approval for any other parts	The military specification does not assure compliance. Also MIL-STD-975 is canceled. Additional selection shall be required to assure compliance with Grade 2 parts in accordance with MSFC-STD-3012, or equivalent.					

Table XII Notes:

/1 Parts qualified in accordance with the indicated military specification shall be considered in compliance with the applicable requirements of MIL-STD-981, except as indicated.

APPENDIX A

ELECTRICAL, ELECTRONIC, AND ELECTROMECHANICAL

(EEE) PARTS PLAN FOR GRADE 1 PARTS

1.0 **SCOPE** – This plan implements requirements set forth in MSFC-STD-3012 for Grade 1 parts. Requirements are specified for EEE parts activities from the equipment design and development phase through use and maintenance of the system and equipment. Some special requirements, applicable only to MSFC, are included for MSFC in-house activities. Requirements herein are intended to apply only to flight hardware, except that a requirement is levied on ground equipment connectors that mate with flight connectors.

1.1 **General** – Special requirements not covered by or not in conformance with the requirements of this publication shall be detailed in engineering documentation which shall take precedence over appropriate portions of this publication when approved in writing by MSFC prior to use.

1.2 **Applicability** - This plan applies to the following EEE part types (Federal Stock Codes shown in parenthesis). Part types not listed are not subject to the controls herein.

Capacitors (5910)	Fiber optic devices (6030)	Relays (5945)
Circuit breakers (5925)	Fiber optic interconnect (6060)	Resistors (5905)
Connectors (5935)	Filters (5915)	Switches (5930)
Crystal oscillators (5955)	Fuses (5920)	Thermistors (5950)
Diodes (5961)	Hybrid microcircuits (5962)	Transistors (5961)
Fiber optic cables (6030)	Magnetics (5950)	Wire and Cable (6145)
	Monolithic microcircuits (5962)	

2.0 **APPLICABLE DOCUMENTS** –

2.1 General. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issue in effect on the date of invitation for bids or request for proposal shall apply.

MIL-STD-1686	Electrostatic Discharge Control Program For Protection Of Electrical and Electronic Parts, Assemblies And Equipment (Excluding Electrically Initiated Explosive Devices)
MIL-STD-750	Test Methods For Semiconductor Devices
MIL-STD-883	Test Methods And Procedures For Microelectronics
MPG 1280.5	GIDEP ALERTS Specification For
MSFC-RQMT-2918	Requirements For Electrostatic Discharge Control
MSFC-SPEC-548	Specification For Vacuum Baking Electrical Connectors For Spacelab Payloads

MSFC-SPEC-684	Specification For Vacuum Baking Electrical Cables For Spacelab Payloads
MSFC-STD-3012	EEE Parts Management And Control For MSFC Space Flight Hardware
MSFC-STD-355	George C. Marshall Flight Center National Aeronautics And Space Administration Standard Radiographic Inspections Of Electronic Parts
NSTS 1700.7	Safety Policy and Requirements For Payloads Using the Space Transportation System

3.0 **DEFINITIONS AND ACRONYMS** – Definitions and acronyms are in accordance with MSFC-STD-3012.

4.0 **REQUIREMENTS**

4.1 **General** – This plan, or MSFC approved equivalent requirements, shall be applied to each subcontract tier for applicable equipment. The requirements of MSFC-STD-3012 for Grade 1 parts and the implementation requirements herein shall be met.

4.1.1 Focal Point Organization – The organization serving as the focal point in matters pertaining to this plan shall be MSFC's EEE Parts Engineering.

4.2 **Part Qualification** – Qualification at the piece part level shall meet the requirements of MSFC-STD-3012. Where guidance is not provided within MSFC-STD-3012 for qualification of nonstandard parts, the qualification shall be equivalent to the requirements imposed on similar standard parts, or shall otherwise satisfactorily demonstrate that the part has a MSFC approved margin of safety beyond the demands of the equipment in which it will be used.

4.3 **Quality Assurance Requirements** – Quality assurance shall comply with the requirements of MSFC-STD-3012 and the following.

4.3.1 Procurement Sources - Parts shall be procured only from qualified manufacturers or their authorized distributors.

4.3.2 Quality Conformance Inspection (QCI) –The QCI provisions of applicable military standards shall be sufficient for parts listed in military or NASA QPLs or QMLs.

4.3.2.1 Destructive Physical Analysis (DPA) - All microcircuits, semiconductors (except noncavity diodes), and crystal oscillators, when not procured from a Military QPL/QML, shall be subjected to DPA on a sample basis from each lot. JANTX semiconductors shall also be subjected to DPA on a sample basis from each lot. The DPA shall be in accordance with MIL-STD-883, Method 5009, MIL-STD-750, Method 2101 or 2102 as appropriate, or to an approved equivalent method. This requirement may be met in the part manufacturer's processing, in third party laboratory testing, or by the procuring activity.

4.3.2.2 In-house DPA – Microcircuits: DPA radiography is required. Die shear testing is not required when radiographic means are used to verify die attachment. DPA electrical testing and internal water vapor content testing are not required. Quality Class S, or equivalent, shall apply where requirements are differentiated by quality class.

4.3.3 Screening – Screening requirements shall be as listed in Table V in MSFC-STD-3012 and as follows.

4.3.3.1 Particle Impact Noise Detection (PIND) - All internal cavity devices of appropriate construction shall be PIND tested, or equivalent, per Method 2020 of MIL-STD-883 (for Microcircuits and crystal oscillators), Method 2052 of MIL-STD-750 (for Semiconductors), or manufacturer's recommendations (for relays). This requirement may be met in the part manufacturer's processing, in third party laboratory testing, or by the procuring activity.

4.3.3.1.1 In-house PIND - Cavity devices shall be tested in accordance with the latest revisions of MIL-STD-750 method 2052 for diodes and transistors, MIL-STD-883 method 2020 for hybrids, microcircuits, and non-electromechanical relays, as appropriate. The following exceptions shall apply: 1) the marking ink is red (reject), and 2) the lot acceptance criteria shall allow unlimited resubmits and the percent defective allowable does not apply , unless otherwise specified for a particular part. All PIND rejects shall be removed from the lot and designated with one red ink dot. If PIND testing is destructive, it shall be omitted.

4.3.3.2 Radiographic (X-Ray) Inspection - All cavity devices and solid construction (noncavity) axial lead diodes (standard and nonstandard) shall undergo X-ray inspection (two orthogonal views), or equivalent, per Method 2012 of MIL-STD-883 (for Microcircuits and crystal oscillators) or Method 2076 of MIL-STD-750 (for Semiconductors). This requirement may be met in the part manufacturer's processing, in third party laboratory testing, or by the procuring activity.

4.3.3.2.1 In-house X-Ray – EEE parts shall be examined in accordance with the latest revision of MIL-STD-883 method 2012 for microcircuits and hybrids, with MIL-STD-750 method 2076 for diodes and transistors, and with MSFC-STD-355 for all other EEE devices. The following exceptions shall be allowed: 1) the number of views is one, 2) the parts are not serialized on the film, and 3) the marking ink is red (reject) and green (accept). Parts that pass radiographic inspection are designated with a green ink dot. All radiographic rejects shall be removed from the lot and designated with two red ink dots. Parts that fail radiographic examination shall be restricted to non-flight applications**.**

4.3.4 Receiving Inspection – Receiving inspection by the procuring activity shall verify procurement from a qualified source and compliance with the controlling specifications. This may be accomplished by review of certifications.

4.4 **Application Requirements**

4.4.1 Derating – Parts shall be derated in the application in accordance with MSFC-STD-3012. The data shall document the results of EEE parts application and stress analysis. The data shall be submitted for MSFC review.

4.4.2 Ionizing Radiation – In accordance with MSFC-STD-3012, EEE parts shall be acceptable for use in the projected radiation environment identified in project documentation. Consideration shall be given to both total dose and single event effects.

4.4.3 Thermal Vacuum Bake - Connectors and backshells shall be thermal vacuum baked in accordance with MSFC-SPEC-548 or equivalent before being installed on cables, unless the applicable part specification negates the need for bake out. All cables shall be baked in accordance with MSFC-SPEC-684 or equivalent.

4.4.4 Hazard Avoidance – Parts shall comply with the hazard avoidance requirements of MSFC-STD-3012 and the additional requirements of NSTS 1700.7.

4.5 **Configuration Control Requirements** – The MSFC EEE Parts Engineering organization shall review and approve all EEE parts selections. At each subcontract level, the procuring activity shall review and approve all subtier EEE parts selections.

4.5.1 Parts Selection - Maximum use shall be made of Grade 1 standard parts, in the design, modification, and fabrication of the flight equipment. The parts, selection, and screening shall conform to the requirements and guidelines contained in Table V. Parts selection shall be accomplished in the order indicated. A lower ranked selection shall not be used if a higher ranked selection can be obtained. Commercial quality assurance level parts shall not be used in a Grade 1 application. The program objective shall be to minimize part types, utilize standard part types to the maximum extent possible, and assure that appropriate minimum quality levels are maintained.

4.5.2 Nonstandard Parts - Nonstandard parts may be used in accordance with MSFC-STD-3012 when there is no standard part with a performance capability to satisfy the application requirements or a standard part is not available. The minimum screening requirements shall be in accordance with MSFC-STD-3012 requirements for Grade 1 parts. Nonstandard parts shall be selected in the order of preference specified in MSFC-STD-3012 for Grade 1 parts. In addition, first consideration shall be given to the inherent capability of the parts to withstand the space, terrestrial, and mission environments to which the parts will be subjected.

4.6 **Parts Related Data Requirements**

4.6.1 Nonstandard Parts Approval Request (NSPAR) – When nonstandard parts are utilized (reference 4.5.1 and 4.5.2), nonstandard part approval requests shall be in accordance with MSFC-STD-3012 and contractual data requirements. A NSPAR form (MSFC Form 4346, or equivalent) shall be submitted to the procuring activity, and to each higher tier procuring activity, for each nonstandard part used in flight components. The NSPAR shall be reviewed and approved before it is submitted to the next higher tier procuring activity. An explanation of the rationale for use, and copies of applicable part specifications and part drawings (excluding military, NASA, and industry standards) shall be included. Copies of applicable Vendor Item Control Drawings (VICDs) shall be included. Note the VICD was formerly called a Specification Control Drawing (SCD).

4.6.1.1 In-house NSPAR Exception – NSPAR forms shall not be required for MSFC in-house design. Instead, nonstandard part approval shall be determined during coordination between MSFC designers and MSFC EEE Parts Engineering, and approval status shall be documented on the applicable As-Designed EEE Parts List.

4.6.2 As-Designed EEE Parts List – As-Designed EEE Parts Lists shall be prepared and submitted in accordance with MSFC-STD-3012 and applicable contractual data requirements. Submittals shall include an electronic copy in a format which is acceptable to the procuring activity. As-Designed EEE Parts Lists shall account for parts within all subassemblies, including subcontracted or procured subassemblies. The As-Designed EEE Parts List for an assembly may note the submittal and approval status of a subassembly's As-Designed EEE Parts List rather than individually list the parts for the subassembly. For the As-Designed Parts List the following identification and status information shall be provided as a minimum.

Identifying part number for the end item in which the EEE part will be used.

Applicable EEE part type (from 1.2 above).

Part number that will appear in the using assembly's parts list as the unique identification of the EEE part.

Specification or drawing in which the detail characteristics of the EEE part are identified.

A common, or manufacturer's, number identifying the basic function of the EEE part.

End Item	Part Type	EEE P/N	EEE Spec	Generic P/N	Qual Method	Qual Status	Nonstandard Approval	Manufacturer	Quantity

Method for determining the EEE part's qualification (such as test or QPL).

Status of qualification activities for the EEE part (pending, complete, QML, etc.).

Status for approval of nonstandard EEE part by the procuring activity (N/A, approval date, etc.).

Identification of qualified manufacturer(s) of the EEE part (QML, QPL, or CAGE code preferred).

Estimated quantity, if available, that will be used per end item.

4.6.2.1 In-house As-Designed EEE Parts Lists – As-Designed EEE Parts Lists for MSFC in-house design, shall be prepared in accordance with 4.6.2 above by the design activity and submitted to project management for approval.

4.6.3 As-Built EEE Parts List – As-Built EEE Parts Lists shall be submitted in accordance with MSFC-STD-3012 and applicable contractual data requirements. Submittals shall include an electronic copy in a format which is acceptable to the procuring activity. As-Built EEE Parts Lists must account for parts within all subassemblies, including subcontracted or procured subassemblies, unless excepted by specific project agreement. For the As-Built EEE Parts List the following identification and traceabilty information shall be provided as a minimum.

Identifying part number for the end item using the EEE part.

Serial number of the end item using the EEE part.

Identifying part number of the assembly which calls out the installation of the EEE part.

Serial number of the using assembly.

Applicable EEE part type (from 1.2 above).

End Item	E.I. S/N	Using Assy	Assy S/N	EEE Type	EEE P/N	Ref Des	Mfg	LDC	EEE S/N

Part number that appears in the using assembly's parts list as the EEE part identification.

Reference designation that indentifies the EEE part's circuit location (i.e. R1, C1, etc.).

Precise identification of the manufacturer of the installed EEE part (CAGE code preferred).

Identifying code for lot identification of the installed EEE part (usually Lot Date Code).

Serial number of the installed EEE part, if applicable.

4.6.3.1 In-house As-Built EEE Parts Lists – As-Built EEE Parts Lists for MSFC in-house manufacturing, shall be prepared in accordance with 4.6.3 above by the manufacturing activity and submitted to project management.

4.6.4 Government Industry Data Exchange Program (GIDEP) – GIDEP participation shall be in accordance with MSFC-STD-3012 and contractual data requirements.

4.6.5 ALERT – ALERT preparation and assessment shall be in accordance with MSFC-STD-3012 and contractual data requirements. An ALERT and Failure Analysis Program shall be established and implemented. ALERT's distributed by GIDEP and reissued by MSFC as "FULL ALERT's" shall be evaluated for impact and corrective actions, and responses shall be provided to MSFC by a systematic approach.

4.6.5.1 In-house ALERT – MSFC in-house ALERT activities shall be in accordance with MPG 1280.5.

4.6.6 Traceability – Traceability shall be provided in accordance with MSFC-STD-3012.

4.6.7 Quality Assurance Data – Results of destructive physical analyses, materials review boards, failure review boards, and parts problems reported from the field shall be documented and submitted for MSFC review.

4.6.8 Specifications and Control Drawings – EEE parts shall be defined and controlled by military/industry standard specifications and/or by control drawings. A part control drawing, such as a VICD, shall be used to document the performance and quality assurance characteristics required for the part where there is no military/industry standard that fully documents the requirements. The activity procuring parts shall be responsible for preparation of part control drawings.

4.6.8.1 In-house Control Drawings – Preparation of part control drawings, such as VICDs, for MSFC in-house initiated parts procurements, shall be the responsibility of the design activity, with support from EEE Parts Engineering.

4.7 **Lifetime Parts Availability Requirements** – Where feasible, the projects shall procure a quantity of a part (at least 20% over actual requirement) to support equipment maintenance, planned future builds, and potential future builds where any of the following applies: (1) the part is a commercial part rather than a military or NASA standard part, (2) the applicable military or NASA standard is identified as "not for new design," or equivalent, (3) the same part may not be available for future procurement within the life of the design, or (4) the minimum buy for the part exceeds or very nearly equals the lifetime requirement for the design.

4.8 **Manufacturing and Handling Requirements**

4.8.1 Electrostatic Discharge (ESD) Control – ESD control shall be in accordance with MIL-STD-1686, or equivalent. The ESD measures shall be documented and implemented during all manufacturing phases such as receiving inspections, assembly, testing, repair, storage, and shipping of all items designated as ESD sensitive. Engineering documentation shall incorporate the ESD requirements of MIL-STD-1686 for handling ESD sensitive electronic parts and assemblies.

4.8.1.1 In-house ESD – ESD control within MSFC shall be in accordance with MSFC-RQMT-2918.

4.8.2 Environmental Control – Environmental controls such as temperature, humidity, and particulate contamination shall be identified for parts handling, packaging, and storage.

4.8.3 Retest – Parts for which 3 years has transpired since screening shall be tested electrically, to the extent practical, before use.

4.8.3.1 In-house Retest – Parts intended for use within MSFC shall be retested according to requirements agreed to by the affected engineering, quality, and test organizations.

4.8.4 Allowance for Testing Fallout – An allowance should be made for test fallout quantities in accordance with MSFC-STD-3012. Where practical, it is recommended that parts be ordered from a single lot date code to reduce the number of parts needed for destructive qualification testing.

4.8.5 Manufacturing Process Compatibility – Parts shall be compatible with manufacturing processes in accordance with MSFC-STD-3012. Use of plastic encapsulated microcircuits (PEMs) shall require prior approval addressing handling, storage, and installation procedures.

4.8.5.1 In-house Manufacturing Compatibility – Solder dipped, or equivalent, lead finishes are preferred for MSFC in-house use and shall be specified where this is an option. Surface mount or through-hole packages, or a combination of both, are acceptable for in-house use.

4.8.6 Suspect Parts – Use of parts affected by ALERTs and problem advisories shall be in accordance with MSFC-STD-3012.

4.9 **Off-The-Shelf (OTS) Assemblies** - The using design organization shall be responsible for assuring that OTS hardware and design are in compliance with the OTS requirements of MSFC-STD-3012.

4.10 **Ground Support Equipment (GSE)/Avionics Interface** - Connectors that physically mate with flight hardware shall be of the same physical configuration.

APPENDIX B

ELECTRICAL, ELECTRONIC, AND ELECTROMECHANICAL

(EEE) PARTS PLAN FOR GRADE 2 PARTS

1.0 **SCOPE** – This plan implements requirements set forth in MSFC-STD-3012 for Grade 2 parts. Requirements are specified for EEE parts activities from the equipment design and development phase through use and maintenance of the system and equipment. Some special requirements, applicable only to MSFC, are included for MSFC in-house activities. Requirements herein are intended to apply only to flight hardware, except that a requirement is levied on ground equipment connectors that mate with flight connectors.

1.1 **General** – Special requirements not covered by or not in conformance with the requirements of this publication shall be detailed in engineering documentation which shall take precedence over appropriate portions of this publication when approved in writing by MSFC prior to use.

1.2 **Applicability** - This plan applies to the following EEE part types (Federal Stock Codes shown in parenthesis). Part types not listed are not subject to the controls herein.

Capacitors (5910)	Fiber optic devices (6030)	Relays (5945)
Circuit breakers (5925)	Fiber optic interconnect (6060)	Resistors (5905)
Connectors (5935)	Filters (5915)	Switches (5930)
Crystal oscillators (5955)	Fuses (5920)	Thermistors (5950)
Diodes (5961)	Hybrid microcircuits (5962)	Transistors (5961)
Fiber optic cables (6030)	Magnetics (5950)	Wire and Cable (6145)
	Monolithic microcircuits (5962)	

2.0 **APPLICABLE DOCUMENTS** –

2.2 **General**- The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issue in effect on the date of invitation for bids or request for proposal shall apply.

MIL-STD-1686	Electrostatic Discharge Control Program For Protection Of Electrical and Electronic Parts, Assemblies And Equipment (Excluding Electrically Initiated Explosive Devices)
MIL-STD-750	Test Methods For Semiconductor Devices
MIL-STD-883	Test Methods And Procedures For Microelectronics
MPG 1280.5	GIDEP ALERTS Specification For
MSFC-RQMT-2918	Requirements For Electrostatic Discharge Control
MSFC-SPEC-548	Specification For Vacuum Baking Electrical Connectors For Spacelab Payloads

MSFC-SPEC-684	Specification For Vacuum Baking Electrical Cables For Spacelab Payloads
MSFC-STD-3012	EEE Parts Management And Control For MSFC Space Flight Hardware
MSFC-STD-355	George C. Marshall Flight Center National Aeronautics And Space Administration Standard Radiographic Inspections Of Electronic Parts
NSTS 1700.7	Safety Policy and Requirements For Payloads Using the Space Transportation System

3.0 **DEFINITIONS AND ACRONYMS** – Definitions and acronyms are in accordance with MSFC-STD-3012.

4.0 **REQUIREMENTS**

4.1 **General** – This plan, or MSFC approved equivalent requirements, shall be applied to each subcontract tier for applicable equipment. The requirements of MSFC-STD-3012 for Grade 2 parts and the implementation requirements herein shall be met.

4.1.1 Focal Point Organization – The organization serving as the focal point in matters pertaining to this plan shall be MSFC's EEE Parts Engineering.

4.2 **Part Qualification** – Qualification at the piece part level shall meet the requirements of MSFC-STD-3012. Where guidance is not provided within MSFC-STD-3012 for qualification of nonstandard parts, the qualification shall be equivalent to the requirements imposed on similar standard parts, or shall otherwise satisfactorily demonstrate that the part has an MSFC approved margin of safety beyond the demands of the equipment in which it will be used.

4.3 **Quality Assurance Requirements** – Quality assurance shall comply with the requirements of MSFC-STD-3012 and the following.

4.3.1 Procurement Sources – A part shall be procured only from qualified manufacturers or their authorized distributors.

4.3.2 Quality Conformance Inspection (QCI) –The QCI provisions of applicable military standards shall be sufficient for parts listed in military or NASA QPLs or QMLs.

4.3.2.1 Destructive Physical Analysis (DPA) - All microcircuits, semiconductors (except noncavity diodes), and crystal oscillators, when not procured from a Military QPL/QML, shall be subjected to DPA on a sample basis from each lot. JANTX semiconductors shall also be subjected to DPA on a sample basis from each lot. The DPA shall be in accordance with MIL-STD-883, Method 5009, MIL-STD-750, Method 2101 or 2102 as appropriate, or to an approved equivalent method. This requirement may be met in the part manufacturer's processing, in third party laboratory testing, or by the procuring activity.

4.3.2.2 In-house DPA – Microcircuits: DPA radiography is required. Die shear testing is not required when radiographic means are used to verify die attachment. DPA electrical testing and internal water vapor content testing are not required. Quality Class B, or equivalent, shall apply where requirements are differentiated by quality class.

4.3.3 Screening – Screening requirements shall be as listed in Table VI of MSFC-STD-3012 and as follows.

4.3.3.1 Particle Impact Noise Detection (PIND) – All internal cavity devices of appropriate construction shall be PIND tested, or equivalent, per Method 2020 of MIL-STD-883 (for Microcircuits and crystal oscillators), Method 2052 of MIL-STD-750 (for Semiconductors), or manufacturer's recommendations (for relays). This requirement may be met in the part manufacturer's processing, in third party laboratory testing, or by the procuring activity.

4.3.3.1.1 In-house PIND - Cavity devices shall be tested in accordance with the latest revisions of MIL-STD-750 method 2052 for diodes and transistors, MIL-STD-883 method 2020 for hybrids, microcircuits, and non-electromechanical relays, as appropriate. The following exceptions shall apply: 1) the marking ink is red (reject), and 2) the lot acceptance criteria shall allow unlimited resubmits and the percent defective allowable does not apply, unless otherwise specified for a particular part. All PIND rejects shall be removed from the lot and designated with one red ink dot. If PIND testing is destructive, it shall be omitted.

4.3.3.2 Radiographic (X-Ray) Inspection - All cavity devices and solid construction (noncavity) axial lead diodes (standard and nonstandard) shall undergo X-ray inspection (two orthogonal views), or equivalent, per Method 2012 of MIL-STD-883 (for Microcircuits and crystal oscillators) or Method 2076 of MIL-STD-750 (for Semiconductors). This requirement may be met in the part manufacturer's processing, in third party laboratory testing, or by the procuring activity.

4.3.3.2.1 In-house X-Ray – EEE parts shall be examined in accordance with the latest revision of MIL-STD-883 method 2012 for microcircuits and hybrids, with MIL-STD-750 method 2076 for diodes and transistors, and with MSFC-STD-355 for all other EEE devices. The following exceptions shall be allowed: 1) the number of views is one, 2) the parts are not serialized on the film, and 3) the marking ink is red (reject) and green (accept). Parts that pass radiographic inspection are designated with a green ink dot. All radiographic rejects shall be removed from the lot and designated with two red ink dots. Parts that fail radiographic examination shall be restricted to non-flight applications**.**

4.3.4 Receiving Inspection – Receiving inspection by the procuring activity shall verify procurement from a qualified source and compliance with the controlling specifications. This may be accomplished by review of certifications.

4.4 **Application Requirements** –

4.4.1 Derating – Parts shall be derated in the application in accordance with MSFC-STD-3012. The data shall document the results of EEE parts application and stress analysis. The data shall be submitted for MSFC review.

4.4.2 Ionizing Radiation –In accordance with MSFC-STD-3012, parts shall be acceptable for use in the projected radiation environment identified in project documentation. Consideration shall be given to both total dose and single event effects.

4.4.3 Thermal Vacuum Bake - Connectors and backshells shall be thermal vacuum baked in accordance with MSFC-SPEC-548 or equivalent before being installed on cables, unless the

applicable part specification negates the need for bake out. All cables shall be baked in accordance with MSFC-SPEC-684 or equivalent.

4.4.4 Hazard Avoidance – Parts shall comply with the hazard avoidance requirements of MSFC-STD-3012 and the additional requirements of NSTS 1700.7.

4.5 **Configuration Control Requirements** – The MSFC EEE Parts Engineering organization shall review and approve all EEE parts selections. At each subcontract level, the procuring activity shall review and approve all subtier EEE parts selections.

4.5.1 Parts Selection - Maximum use shall be made of Grade 2 standard parts, in the design, modification, and fabrication of the flight equipment. The parts, selection, and screening shall conform to the requirements and guidelines contained in Table VI. Parts selection shall be accomplished in the order indicated. A lower ranked selection shall not be used if a higher ranked selection can be obtained. The program objective shall be to minimize part types, utilize standard part types to the maximum extent possible, and assure that appropriate minimum quality levels are maintained.

4.5.2 Nonstandard Parts - Nonstandard parts may be used in accordance with MSFC-STD-3012 when there is no standard part with a performance capability to satisfy the application requirements or a standard part is not available. The minimum screening requirements shall be in accordance with MSFC-SPEC-3012 requirements for Grade 2 parts. Nonstandard parts shall be selected in the order of preference specified in MSFC-STD-3012 for Grade 2 parts. In addition, first consideration shall be given to the inherent capability of the parts to withstand the space, terrestrial, and mission environments to which the parts will be subjected.

4.6 **Parts Related Data Requirements** –

4.6.1 Nonstandard Parts Approval Request (NSPAR) – When nonstandard parts are utilized (reference 4.5.1 and 4.5.2), nonstandard part approval requests shall be in accordance with MSFC-STD-3012 and contractual data requirements. A NSPAR form (MSFC Form 4346, or equivalent) shall be submitted to the procuring activity, and to each higher tier procuring activity, for each nonstandard part used in flight components. The NSPAR shall be reviewed and approved before it is submitted to the next higher tier procuring activity. An explanation of the rationale for use, and copies of applicable part specifications and part drawings (excluding military, NASA, and industry standards) shall be included. Copies of applicable Vendor Item Control Drawings (VICDs) shall be included. Note that the VICD was formerly called a Specification Control Drawing (SCD).

4.6.1.1 In-house NSPAR Exception – NSPAR forms shall not be required for MSFC in-house design. Instead, nonstandard part approval shall be determined during coordination between MSFC designers and MSFC EEE Parts Engineering, and approval status shall be documented on the applicable As-Designed EEE Parts List.

4.6.2 As-Designed EEE Parts List – As-Designed EEE Parts Lists shall be prepared and submitted in accordance with MSFC-STD-3012 and applicable contractual data requirements. Submittals shall include an electronic copy in a format which is acceptable to the procuring activity. As-Designed EEE Parts Lists shall account for parts within all subassemblies, including subcontracted or procured subassemblies. The As-Designed EEE Parts List for an assembly may note the submittal and approval status of a subassembly's As-Designed EEE Parts List rather

than individually list the parts for the subassembly. For the As-Designed EEE Parts List the following identification and status information shall be provided as a minimum.

Identifying part number for the end item in which the EEE part will be used.

Applicable EEE part type (from 1.2 above).

Part number that will appear in the using assembly's parts list as the unique identification of the EEE part.

Specification or drawing in which the detail characteristics of the EEE part are identified.

A common, or manufacturer's, number identifying the basic function of the EEE part.

End Item	Part Type	EEE P/N	EEE Spec	Generic P/N	Qual Method	Qual Status	Nonstandard Approval	Manufacturer	Quantity

Method for determining the EEE part's qualification (such as test or QPL).

Status of qualification activities for the EEE part (pending, complete, QML, etc.).

Status for approval of nonstandard EEE part by the procuring activity (N/A, approval date, etc.).

Identification of qualified manufacturer(s) of the EEE part (QML, QPL, or CAGE code preferred).

Estimated quantity, if available, that will be used per end item.

4.6.2.1 In-house As-Designed EEE Parts Lists – As-Designed EEE Parts Lists for MSFC in-house design, shall be prepared in accordance with 4.6.2 above by the design activity and submitted to project management for approval.

4.6.3 As-Built EEE Parts List – As-Built EEE Parts Lists shall be submitted in accordance with MSFC-STD-3012 and applicable contractual data requirements. Submittals shall include an electronic copy in a format which is acceptable to the procuring activity. As-Built EEE Parts Lists must account for parts within all subassemblies, including subcontracted or procured subassemblies, unless excepted by specific project agreement. For the As-Built EEE Parts List the following identification and traceabilty information shall be provided as a minimum.

Identifying part number for the end item using the EEE part.

Serial number of the end item using the EEE part.

Identifying part number of the assembly which calls out the installation of the EEE part.

Serial number of the using assembly.

Applicable EEE part type (from 1.2 above).

End Item	E.I. S/N	Using Assy	Assy S/N	EEE Type	EEE P/N	Ref Des	Mfg	LDC	EEE S/N

Part number that appears in the using assembly's parts list as the EEE part identification.

Reference designation that indentifies the EEE part's circuit location (i.e. R1, C1, etc.).

Precise identification of the manufacturer of the installed EEE part (CAGE code preferred).

Identifying code for lot identification of the installed EEE part (usually Lot Date Code).

Serial number of the installed EEE part, if applicable.

4.6.3.1 In-house As-Built EEE Parts Lists – As-Built EEE Parts Lists for MSFC in-house manufacturing, shall be prepared in accordance with 4.6.3 above by the manufacturing activity and submitted to project management.

4.6.4 Government Industry Data Exchange Program (GIDEP) – GIDEP participation shall be in accordance with MSFC-STD-3012 and contractual data requirements.

4.6.5 ALERT – ALERT preparation and assessment shall be in accordance with MSFC-STD-3012 and contractual data requirements. An ALERT and Failure Analysis Program shall be established and implemented. ALERTs distributed by GIDEP and reissued by MSFC as "FULL ALERTs" shall be evaluated for impact and corrective actions, and responses shall be provided to MSFC by a systematic approach.

4.6.5.1 In-house ALERT – MSFC in-house ALERT activities shall be in accordance with MPG 1280.5.

4.6.6 Traceability – Traceability shall be provided in accordance with MSFC-STD-3012.

4.6.7 Quality Assurance Data – Results of destructive physical analyses, materials review boards, failure review boards, and parts problems reported from the field shall be documented and submitted for MSFC review.

4.6.8 Specifications and Control Drawings – EEE parts shall be defined and controlled by military/industry standard specifications and/or by control drawings. A part control drawing, such as a VICD, shall be used to document the performance and quality assurance characteristics required for the part where there is no military/industry standard that fully documents the requirements. The activity procuring parts shall be responsible for preparation of part control drawings. Published vendor data sheet and catalog data may be relied on as a substitute for a part control drawing where all of the following apply: (1) a military/industry standard specification does not exist and can not be readily obtained, (2) the vendor data adequately defines the performance and quality assurance provisions for the part, and (3) the part and/or manufacturer has a good record of use within the aerospace industry.

4.6.8.1 In-house Control Drawings – Preparation of part control drawings, such as VICDs, for MSFC in-house initiated parts procurements, shall be the responsibility of the design activity, with support from EEE Parts Engineering.

4.7 **Lifetime Parts Availability Requirements** – Where feasible, the projects shall procure a quantity of a part (at least 20% over actual requirement) to support equipment maintenance, planned future builds, and potential future builds where any of the following applies: (1) the part is a commercial part rather than a military or NASA standard part, (2) the applicable military or NASA standard is identified as "not for new design," or equivalent, (3) the same part may not be available for future procurement within the life of the design, or (4) the minimum buy for the part exceeds or very nearly equals the life time requirement for the design.

4.8 **Manufacturing and Handling Requirements**

4.8.1 Electrostatic Discharge (ESD) Control – ESD control shall be in accordance with MIL-STD-1686, or equivalent. The ESD measures shall be documented and implemented during all manufacturing phases such as receiving inspections, assembly, testing, repair, storage, and shipping of all items designated as ESD sensitive. Engineering documentation shall incorporate the ESD requirements of MIL-STD-1686 for handling ESD sensitive electronic parts and assemblies.

4.8.1.1 In-house ESD – ESD control within MSFC shall be in accordance with MSFC-RQMT-2918.

4.8.2 Environmental Control – Environmental controls such as temperature, humidity, and particulate contamination shall be identified for parts handling, packaging, and storage.

4.8.3 Retest – Parts for which 3 years has transpired since screening shall be tested electrically, to the extent practical, before use.

4.8.3.1 In-house Retest – Parts intended for use within MSFC shall be retested according to requirements agreed to by affected engineering, quality, and test organizations.

4.8.4 Allowance for Testing Fallout – An allowance should be made for test fallout quantities in accordance with MSFC-STD-3012. It is recommended that, where practical, parts be ordered from a single lot date code to reduce the number of parts needed for destructive qualification testing.

4.8.5 Manufacturing Process Compatibility – Parts shall be compatible with manufacturing processes in accordance with MSFC-STD-3012. Use of plastic encapsulated microcircuits (PEMs) shall require prior approval addressing handling, storage, and installation procedures.

4.8.5.1 In-house Manufacturing Compatibility – Solder dipped, or equivalent, lead finishes are preferred for MSFC in-house use and shall be specified where this is an option. Surface mount or through-hole packages, or a combination of both, are acceptable for in-house use.

4.8.6 Suspect Parts – Use of parts affected by ALERTs and problem advisories shall be in accordance with MSFC-STD-3012.

4.9 **Off-The-Shelf (OTS) Assemblies** - The using design organization shall be responsible for assuring that OTS hardware and design are in compliance with the OTS requirements of MSFC-STD-3012.

4.10 **Ground Support Equipment (GSE)/Avionics Interface** - Connectors that physically mate with flight hardware shall be of the same physical configuration.

APPENDIX C

ELECTRICAL, ELECTRONIC, AND ELECTROMECHANICAL (EEE) PARTS PLAN FOR GRADE 3 PARTS

1.0 **SCOPE** – This plan implements requirements set forth in MSFC-STD-3012 for Grade 3 parts. Requirements are specified for EEE parts activities from the equipment design and development phase through use and maintenance of the system and equipment. Some special requirements, applicable only to MSFC, are included for MSFC in-house activities. Requirements herein are intended to apply only to flight hardware, except that a requirement is levied on ground equipment connectors that mate with flight connectors.

1.1 **General** – Special requirements not covered by or not in conformance with the requirements of this publication shall be detailed in engineering documentation which shall take precedence over appropriate portions of this publication when approved in writing by MSFC prior to use.

1.2 **Applicability** - This plan applies to the following EEE part types (Federal Stock Codes shown in parenthesis). Part types not listed are not subject to the controls herein.

Capacitors (5910)
Circuit breakers (5925)
Connectors (5935)
Crystal oscillators (5955)
Diodes (5961)
Fiber optic cables (6030)
Fiber optic devices (6030)
Fiber optic interconnect (6060)
Filters (5915)
Fuses (5920)
Hybrid microcircuits (5962)
Magnetics (5950)
Monolithic microcircuits (5962)
Relays (5945)
Resistors (5905)
Switches (5930)
Thermistors (5950)
Transistors (5961)
Wire and Cable (6145)

2.0 **APPLICABLE DOCUMENTS** –

2.1 **General**-The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issue in effect on the date of invitation for bids or request for proposal shall apply.

MIL-STD-1686	Electrostatic Discharge Control Program For Protection Of Electrical and Electronic Parts, Assemblies And Equipment (Excluding Electrically Initiated Explosive Devices)
MIL-STD-750	Test Methods For Semiconductor Devices
MIL-STD-883	Test Methods And Procedures For Microelectronics
MPG 1280.5	GIDEP ALERTS Specification For
MSFC-RQMT-2918	Requirements For Electrostatic Discharge Control
MSFC-SPEC-548	Specification For Vacuum Baking Electrical Connectors For Spacelab Payloads

MSFC-SPEC-684	Specification For Vacuum Baking Electrical Cables For Spacelab Payloads
MSFC-STD-3012	EEE Parts Management And Control For MSFC Space Flight Hardware
MSFC-STD-355	George C. Marshall Flight Center National Aeronautics And Space Administration Standard Radiographic Inspections Of Electronic Parts
NSTS 1700.7	Safety Policy and Requirements For Payloads Using the Space Transportation System

3.0 **DEFINITIONS AND ACRONYMS** – Definitions and acronyms are in accordance with MSFC-STD-3012.

4.0 **REQUIREMENTS**

4.1 **General** – This plan, or MSFC approved equivalent requirements, shall be applied to each subcontract tier for applicable equipment. The requirements of MSFC-STD-3012 for Grade 3 parts and the implementation requirements herein shall be met.

4.1.1 Focal Point Organization – The organization serving as the focal point in matters pertaining to this plan shall be MSFC's EEE Parts Engineering.

4.2 **Part Qualification** – Qualification at the piece part level shall meet the requirements of MSFC-STD-3012. Where guidance is not provided within MSFC-STD-3012 for qualification of nonstandard parts, the qualification shall be equivalent to the requirements imposed on similar standard parts, or shall otherwise satisfactorily demonstrate that the part has an MSFC approved margin of safety beyond the demands of the equipment in which it will be used.

4.3 **Quality Assurance Requirements** – Quality assurance shall comply with the requirements of MSFC-STD-3012 and the following.

4.3.1 Procurement Sources – A part shall be procured only from qualified manufacturers or their authorized distributors.

4.3.2 Quality Conformance Inspection (QCI) –The QCI provisions of applicable military standards shall be sufficient for parts listed in military or NASA QPLs or QMLs.

4.3.2.1 Destructive Physical Analysis (DPA) - All microcircuits, semiconductors (except noncavity diodes), and crystal oscillators, when not procured from a Military QPL/QML or as a vendor "Hi Rel" product, shall be subjected to DPA on a sample basis from each lot. The DPA shall be in accordance with MIL-STD-883, Method 5009, MIL-STD-750, Method 2101, or 2102 as appropriate, or to an approved equivalent method, This requirement may be met in the part manufacturer's processing, in third party laboratory testing, or by the procuring activity.

4.3.2.2 In-house DPA – Microcircuits: DPA radiography is required. Die shear testing is not required when radiographic means are used to verify die attachment. DPA electrical testing and internal water vapor content testing are not required. Quality Class B, or equivalent, shall apply where requirements are differentiated by quality class.

4.3.3 Screening – Screening requirements shall be as listed in Table VII in MSFC-STD-3012 and as follows.

4.3.3.1 Particle Impact Noise Detection (PIND) – It is strongly recommended that all internal cavity devices of appropriate construction be PIND tested, or equivalent, per Method 2020 of MIL-STD-883 (for Microcircuits and crystal oscillators), Method 2052 of MIL-STD-750 (for Semiconductors), or manufacturer's recommendations (for relays). This may be accomplished in the part manufacturer's processing, in third party laboratory testing, or by the procuring activity.

4.3.3.1.1 In-house PIND – It is recommended that cavity devices be tested in accordance with the latest revisions of MIL-STD-750 method 2052 for diodes and transistors, MIL-STD-883 method 2020 for hybrids, microcircuits, and non-electromechanical relays, as appropriate. The following exceptions shall apply: 1) the marking ink is red (reject), and 2) the lot acceptance criteria shall allow unlimited resubmits and the percent defective allowable does not apply, unless otherwise specified for a particular part. All PIND rejects shall be removed from the lot and designated with one red ink dot. If PIND testing is destructive, it shall be omitted.

4.3.3.2 Radiographic (X-Ray) Inspection – It is strongly recommended that all cavity devices and solid construction (noncavity) axial lead diodes (standard and nonstandard) shall undergo X-ray inspection (two orthogonal views), or equivalent, per Method 2012 of MIL-STD-883 (for Microcircuits and crystal oscillators) or Method 2076 of MIL-STD-750 (for Semiconductors). This may be accomplished in the part manufacturer's processing, in third party laboratory testing, or by the procuring activity.

4.3.3.2.1 In-house X-Ray – EEE parts shall be examined in accordance with the latest revision of MIL-STD-883 method 2012 for microcircuits and hybrids, with MIL-STD-750 method 2076 for diodes and transistors, and with MSFC-STD-355 for all other EEE devices. The following exceptions shall be allowed: 1) the number of views is one, 2) the parts are not serialized on the film, and 3) the marking ink is red (reject) and green (accept). Parts that pass radiographic inspection are designated with a green ink dot. All radiographic rejects shall be removed from the lot and designated with two red ink dots. Parts that fail radiographic examination shall be restricted to non-flight applications**.**

4.3.4 Receiving Inspection – Receiving inspection by the procuring activity shall verify procurement from a qualified source and compliance with the controlling specifications. This may be accomplished by review of certifications.

4.4 **Application Requirements** –

4.4.1 Derating – Parts shall be derated in the application in accordance with MSFC-STD-3012. The data shall document the results of EEE parts application and stress analysis. The data shall be submitted for MSFC review.

4.4.2 Ionizing Radiation – In accordance with MSFC-STD-3012, parts shall be acceptable for use in the projected radiation environment identified in project documentation. Consideration shall be given to both total dose and single event effects.

4.4.3 Thermal Vacuum Bake - Connectors and backshells shall be thermal vacuum baked in accordance with MSFC-SPEC-548 or equivalent before being installed on cables, unless the

applicable part specification negates the need for bake out. All cables shall be baked in accordance with MSFC-SPEC-684 or equivalent.

4.4.4 Hazard Avoidance – Parts shall comply with the hazard avoidance requirements of MSFC-STD-3012 and the additional requirements of NSTS 1700.7.

4.5 **Configuration Control Requirements** – The MSFC EEE Parts Engineering organization shall review and approve all EEE parts selections. At each subcontract level, the procuring activity shall review and approve all subtier EEE parts selections.

4.5.1 Parts Selection - Maximum use shall be made of Grade 3 standard parts, in the design, modification, and fabrication of the flight equipment. The parts, selection, and screening shall conform to the requirements and guidelines contained in Table VII. Parts selection shall be accomplished in the order indicated. A lower ranked selection shall not be used if a higher ranked selection can be obtained. The program objective shall be to minimize part types, utilize standard part types to the maximum extent possible, and assure that appropriate minimum quality levels are maintained.

4.5.2 Nonstandard Parts - Nonstandard parts may be used in accordance with MSFC-STD-3012 when there is no standard part with a performance capability to satisfy the application requirements or a standard part is not available. The screening requirements shall be in accordance with MSFC-SPEC-3012 requirements for Grade 3 parts. Nonstandard parts shall be selected in the order of preference specified in MSFC-STD-3012, Table VII, for Grade 3 parts. In addition, first consideration shall be given to the inherent capability of the parts to withstand the space, terrestrial, and mission environments to which the parts will be subjected.

4.6 **Parts Related Data Requirements** –

4.6.1 Nonstandard Parts Approval Request (NSPAR) – When nonstandard parts are utilized (reference 4.5.1 and 4.5.2.) nonstandard part approval requests shall be in accordance with MSFC-STD-3012 and contractual data requirements. A NSPAR form (MSFC Form 4346, or equivalent) shall be submitted to the procuring activity, and to each higher tier procuring activity, for each nonstandard part used in flight components. The NSPAR shall be reviewed and approved before it is submitted to the next higher tier procuring activity. An explanation of the rationale for use, and copies of applicable part specifications and part drawings (excluding military, NASA, and industry standards) shall be included. Copies of applicable Vendor Item Control Drawings (VICD) shall be included. Note that the VICD was formerly called a Specification Control Drawing (SCD).

4.6.1.1 In-house NSPAR Exception – NSPAR forms shall not be required for MSFC in-house design. Instead, nonstandard part approval shall be determined during coordination between MSFC designers and MSFC EEE Parts Engineering, and approval status shall be documented on the applicable As-Designed EEE Parts List.

4.6.2 As-Designed EEE Parts List – As-Designed EEE Parts Lists shall be prepared and submitted in accordance with MSFC-STD-3012 and applicable contractual data requirements. Submittals shall include an electronic copy in a format which is acceptable to the procuring activity. As-Designed EEE Parts Lists shall account for parts within all subassemblies, including subcontracted or procured subassemblies. The As-Designed EEE Parts List for an assembly may note the submittal and approval status of a subassembly's As-Designed EEE Parts List rather

than individually list the parts for the subassembly. For the As-Designed EEE Parst List the following identification and status information shall be provided as a minimum.

Identifying part number for the end item in which the EEE part will be used.

Applicable EEE part type (from 1.2 above).

Part number that will appear in the using assembly's parts list as the unique identification of the EEE part.

Specification or drawing in which the detail characteristics of the EEE part are identified.

A common, or manufacturer's, number identifying the basic function of the EEE part.

End Item	Part Type	EEE P/N	EEE Spec	Generic P/N	Qual Method	Qual Status	Nonstandard Approval	Manufacturer	Quantity

Method for determining the EEE part's qualification (such as test or QPL).

Status of qualification activities for the EEE part (pending, complete, QML, etc.).

Status for approval of nonstandard EEE part by the procuring activity (N/A, approval date, etc.).

Identification of qualified manufacturer(s) of the EEE part (QML, QPL, or CAGE code preferred).

Estimated quantity, if available, that will be used per end item.

4.6.2.1 In-house As-Designed EEE Parts Lists – As-Designed EEE Parts Lists for MSFC in-house design, shall be prepared in accordance with 4.5.2 above by the design activity and submitted to project management for approval.

4.6.3 As-Built EEE Parts List – As-Built EEE Parts Lists shall be submitted in accordance with MSFC-STD-3012 and applicable contractual data requirements. Submittals shall include an electronic copy in a format which is acceptable to the procuring activity. As-Built EEE Parts Lists must account for parts within all subassemblies, including subcontracted or procured subassemblies, unless excepted by specific project agreement. For the As-Built EEE Parts List the following identification and traceability information shall be provided as a minimum.

Identifying part number for the end item using the EEE part.

Serial number of the end item using the EEE part.

Identifying part number of the assembly which calls out the installation of the EEE part.

Serial number of the using assembly.

Applicable EEE part type (from 1.2 above).

End Item	E.I. S/N	Using Assy	Assy S/N	EEE Type	EEE P/N	Ref Des	Mfg	LDC	EEE S/N

Part number that appears in the using assembly's parts list as the EEE part identification.

Reference designation that identifies the EEE part's circuit location (i.e. R1, C1, etc.).

Precise identification of the manufacturer of the installed EEE part (CAGE code preferred).

Identifying code for lot identification of the installed EEE part (usually Lot Date Code).

Serial number of the installed EEE part, if applicable.

4.6.3.1 In-house As-Built EEE Parts Lists – As-Built EEE Parts Lists for MSFC in-house manufacturing, shall be prepared in accordance with 4.5.3 above by the manufacturing activity and submitted to project management.

4.6.4 Government Industry Data Exchange Program (GIDEP) – GIDEP participation shall be in accordance with MSFC-STD-3012 and contractual data requirements.

4.6.5 ALERT – ALERT preparation and assessment shall be in accordance with MSFC-STD-3012 and contractual data requirements. An ALERT and Failure Analysis Program shall be established and implemented. ALERTs distributed by GIDEP and reissued by MSFC as "FULL ALERTs" shall be evaluated for impact and corrective actions, and responses shall be provided to MSFC by a systematic approach.

4.6.5.1 In-house ALERT – MSFC in-house ALERT activities shall be in accordance with MPG 1280.5.

4.6.6 Traceability – Traceability shall be provided in accordance with MSFC-STD-3012.

4.6.7 Quality Assurance Data – Results of destructive physical analyses, materials review boards, failure review boards, and parts problems reported from the field shall be documented and available for MSFC review.

4.6.8 Specifications and Control Drawings – EEE parts shall be defined and controlled by military/industry standard specifications and/or by control drawings. A part control drawing, such as a VICD, or a published vendor data sheet and catalog data may be used to document the performance and quality assurance characteristics required for the part where there is no military/industry standard that fully documents the requirements. The activity procuring parts shall be responsible for preparation of part control drawings.

4.6.8.1 In-house Control Drawings – Preparation of part control drawings, such as VICDs, for MSFC in-house initiated parts procurements, shall be the responsibility of the design activity, with support from EEE Parts Engineering.

4.7 **Lifetime Parts Availability Requirements** – Where feasible, the projects shall procure a quantity of a part (at least 20% over actual requirement) to support equipment maintenance, planned future builds, and potential future builds where any of the following applies: (1) the part is a commercial part rather than a military or NASA standard part, (2) the applicable military or NASA standard is identified as "not for new design," or equivalent, (3) the same part may not be available for future procurement within the life of the design, or (4) the minimum buy for the part exceeds or very nearly equals the life time requirement for the design.

4.8 **Manufacturing and Handling Requirements**

4.8.1 Electrostatic Discharge (ESD) Control – ESD control shall be in accordance with MIL-STD-1686, or equivalent. The ESD measures shall be documented and implemented during all manufacturing phases such as receiving inspections, assembly, testing, repair, storage, and shipping of all items designated as ESD sensitive. Engineering documentation shall incorporate the ESD requirements of MIL-STD-1686 for handling ESD sensitive electronic parts and assemblies.

4.8.1.1 In-house ESD – ESD control within MSFC shall be in accordance with MSFC-RQMT-2918.

4.8.2 Environmental Control – Environmental controls such as temperature, humidity, and particulate contamination shall be identified for parts handling, packaging, and storage.

4.8.3 Allowance for Testing Fallout – An allowance should be made for test fallout quantities in accordance with MSFC-STD-3012. It is recommended that, where practical, parts be ordered from a single lot date code to reduce the number of parts needed for qualification.

4.8.4 Manufacturing Process Compatibility – Parts shall be compatible with manufacturing processes in accordance with MSFC-STD-3012. Use of plastic encapsulated microcircuits (PEMs) shall require prior approval addressing handling, storage, and installation procedures.

4.8.4.1 In-house Manufacturing Compatibility – Solder dipped, or equivalent, lead finishes are preferred for MSFC in-house use and shall be specified where this is an option. Surface mount or through-hole packages, or a combination of both, are acceptable for in-house use.

4.8.5 Suspect Parts – Use of parts affected by ALERTs and problem advisories shall be in accordance with MSFC-STD-3012.

4.9 **Off-The-Shelf (OTS) Assemblies** - The using design organization shall be responsible for assuring that OTS hardware and design are in compliance with the OTS requirements of MSFC-STD-3012.

4.10 **Ground Support Equipment (GSE)/Avionics Interface** - Connectors that physically mate with flight hardware shall be of the same physical configuration.

APPENDIX D
ELECTRICAL, ELECTRONIC, AND ELECTROMECHANICAL
(EEE) PARTS PLAN FOR GRADE 4 PARTS

1.0 **SCOPE** – This plan implements requirements set forth in MSFC-STD-3012 for Grade 4 parts. Requirements are specified for EEE parts activities from the equipment design and development phase through use and maintenance of the system and equipment. Some special requirements, applicable only to MSFC, are included for MSFC in-house activities. Requirements herein are intended to apply only to flight hardware, except that a requirement is levied on ground equipment connectors that mate with flight connectors.

1.1 **General** – Special requirements not covered by or not in conformance with the requirements of this publication shall be detailed in engineering documentation which shall take precedence over appropriate portions of this publication when approved in writing by MSFC prior to use.

1.2 Applicability – This plan applies to the following EEE part types (Federal Stock Codes shown in parenthesis). Part types not listed are not subject to the controls herein.

Capacitors (5910)	Fiber optic devices (6030)	Relays (5945)
Circuit breakers (5925)	Fiber optic interconnect (6060)	Resistors (5905)
Connectors (5935)	Filters (5915)	Switches (5930)
Crystal oscillators (5955)	Fuses (5920)	Thermistors (5950)
Diodes (5961)	Hybrid microcircuits (5962)	Transistors (5961)
Fiber optic cables (6030)	Magnetics (5950)	Wire and Cable (6145)
	Monolithic microcircuits (5962)	

2.0 **APPLICABLE DOCUMENTS**

2.1 **General** – The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issue in effect on the date of invitation for bids or requests for proposal shall apply.

MIL-STD-1686	Electrostatic Discharge Control Program For Protection Of Electrical and Electronic Parts, Assemblies And Equipment (Excluding Electrically Initiated Explosive Devices)
MPG 1280.5	GIDEP ALERTS Specification For
MSFC-RQMT-2918	Requirements For Electrostatic Discharge Control
MSFC-SPEC-548	Specification For Vacuum Baking Electrical Connectors For Spacelab Payloads
MSFC-SPEC-684	Specification For Vacuum Baking Electrical Cables For Spacelab Payloads
MSFC-STD-3012	EEE Parts Management And Control For MSFC Space Flight Hardware

NSTS 1700.7 Safety Policy and Requirements For Payloads Using the Space Transportation System

3.0 **DEFINITIONS AND ACRONYMS** – Definitions and acronyms are in accordance with MSFC-STD-3012.

4.0 **REQUIREMENTS**

4.1 **General** – This plan, or MSFC approved equivalent requirements, shall be applied to each subcontract tier for applicable equipment. The requirements of MSFC-STD-3012 for Grade 4 parts and the implementation requirements herein shall be met.

4.1.1 Focal Point Organization – The organization serving as the focal point in matters pertaining to this plan shall be MSFC's EEE Parts Engineering.

4.2 **Part Qualification** – In accordance with MSFC-STD-3012 qualification at the piece part level is not required. However, since commercial parts receive no screening and offer no notification of changes to design or processes it is recommended that qualified parts be used when the schedule and funding will allow it.

4.3 **Quality Assurance Requirements** – Quality assurance requirements shall comply with the requirements for Grade 4 parts of MSFC-STD-3012.

4.4 **Application Requirements** –

4.4.1 Derating –It is strongly recommended that parts be derated in the application in accordance with MSFC-STD-3012.

4.4.2 Ionizing Radiation – Where feasible in accordance with MSFC-STD-3012,parts should be acceptable for use in the projected radiation environment identified in project documentation. Consideration should be given to both total dose and single event effects. It should be noted that certain parts may not perform to specification in a radiation environment.

4.4.3 Thermal Vacuum Bake - Connectors and backshells shall be thermal vacuum baked in accordance with MSFC-SPEC-548 or equivalent before being installed on cables, unless the applicable part specification negates the need for bake out. All cables shall be baked in accordance with MSFC-SPEC-684 or equivalent.

4.4.4 Hazard Avoidance – Parts shall comply with the hazard avoidance requirements of MSFC-STD-3012 and the additional requirements of NSTS 1700.7.

4.5 **Configuration Control Requirements** – The MSFC EEE Parts Engineering organization shall be available to assist in the selection of EEE parts. No formal approval of the EEE parts is required.

4.5.1 Parts Selection - The parts, selection, and screening shall conform to the requirements and guidelines contained in Table VIII of MSFC-STD-3012.

4.5.2 Nonstandard Parts -There are no nonstandard parts. All parts are considered standard.

4.6 **Parts Related Data Requirements** –

4.6.1 As-Designed EEE Parts List – An As-Designed EEE Parts Lists shall be prepared in accordance with MSFC-STD-3012 in an electronic format. This parts list will enable the project to evaluate the impact of GIDEP ALERTs and also contribute to a flight history database for future use of commercial parts. The following identification and status information shall be provided as a minimum.

Identifying part number for the end item in which the EEE part will be used.

Applicable EEE part type (from 1.2 above).

Part number that will appear in the using assembly's parts list as the unique identification of the EEE part.

Specification or drawing in which the detail characteristics of the EEE part are identified.

A common, or manufacturer's, number identifying the basic function of the EEE part.

End Item	Part Type	EEE P/N	EEE Spec	Generic P/N	Manufacturer	Quantity

Identification of manufacturer(s) of the EEE part (QML, QPL, or CAGE code preferred).

Estimated quantity, if available, that will be used per end item.

4.6.1.1 In-house As-Designed EEE Parts Lists – An As-Designed EEE Parts Lists for MSFC in-house design shall be prepared in accordance with 4.6.2 above by the design activity and submitted to project management for approval.

4.6.2 As-Built EEE Parts List – An As-Built EEE Parts Lists shall be submitted in accordance with MSFC-STD-3012. The following identification and traceabilty information shall be provided as a minimum.

Identifying part number for the end item using the EEE part.

Serial number of the end item using the EEE part.

Identifying part number of the assembly which calls out the installation of the EEE part.

Serial number of the using assembly.

Applicable EEE part type (from 1.2 above).

End Item	E.I. S/N	Using Assy	Assy S/N	EEE Type	EEE P/N	Ref Des	Mfg

Part number that appears in the using assembly's parts list as the EEE part identification.

Reference designation that indentifies the EEE part's circuit location (i.e. R1, C1, etc.).

Precise identification of the manufacturer of the installed EEE part (CAGE code preferred).

4.6.2.1 In-house As-Built EEE Parts Lists – An As-Built EEE Parts Lists for MSFC in-house manufacturing shall be prepared in accordance with 4.6.3.above by the manufacturing activity and submitted to project management.

4.6.3 Government Industry Data Exchange Program (GIDEP) – GIDEP participation shall be in accordance with MSFC-STD-3012 and contractual data requirements.

4.6.4 ALERT – ALERT preparation and assessment shall be in accordance with MSFC-STD-3012 and contractual data requirements. An ALERT and Failure Analysis Program shall be established and implemented. ALERTs distributed by GIDEP and reissued by MSFC as "FULL ALERTs" shall be evaluated for impact and corrective actions, and responses provided to MSFC by a systematic approach.

4.6.4.1 In-house ALERT – MSFC in-house ALERT activities shall be in accordance with MPG 1280.5.

4.6.5 Traceability – Traceability shall be provided in accordance with MSFC-STD-3012.

4.6.6 Quality Assurance Data -Results of destructive physical analyses, materials review boards, and failure review boards, parts problems reported from the field shall be documented and available for MSFC review.

4.6.7 Specifications and Control Drawings – EEE parts shall be defined and controlled by military/industry standard specifications, by control drawings or by vendor data sheets. A part control drawing, such as a VICD, may be used to document the performance and quality assurance characteristics required for the part where there is no military/industry standard that fully documents the requirements. The activity procuring parts is responsible for preparation of part control drawings. Published vendor data sheets, purchase order data, and catalog data may substitute for a part control drawing.

4.6.7.1 In-house Control Drawings – Preparation of part control drawings for MSFC in-house initiated parts procurements, shall be the responsibility of the design activity, with support from EEE Parts Engineering.

4.7 **Lifetime Parts Availability Requirements** – Where feasible, the projects shall procure a quantity of a part (at least 20% over actual requirement) to support equipment maintenance, planned future builds, and potential future builds where any of the following applies: (1) the part is a commercial part rather than a military or NASA standard part, (2) the applicable military or NASA standard is identified as "not for new design," or equivalent, (3) there is other reason to indicate that the same part may not be available for future procurement within the life of the design, or (4) the minimum buy for the part exceeds or very nearly equals the life time requirement for the design.

4.8 **Manufacturing and Handling Requirements**

4.8.1 Electrostatic Discharge (ESD) Control – ESD control shall be in accordance with MIL-STD-1686, or equivalent. The ESD measures shall be documented and implemented during all manufacturing phases such as receiving inspections, assembly, testing, repair, storage, and shipping of all items designated as ESD sensitive. Engineering documentation shall incorporate the ESD requirements of MIL-STD-1686 for handling ESD sensitive electronic parts and assemblies.

4.8.1.1 In-house ESD – ESD control within MSFC shall be in accordance with MSFC-RQMT-2918.

4.8.2 Environmental Control – Environmental controls such as temperature, humidity, and particulate contamination shall identified for parts handling, packaging, and storage.

4.8.3 Manufacturing Process Compatibility – Parts shall be compatible with manufacturing processes in accordance with MSFC-STD-3012.

4.8.5.1 In-house Manufacturing Compatibility – Solder dipped, or equivalent, lead finishes are preferred for MSFC in-house use and shall be specified where this is an option. Surface mount or through-hole packages, or a combination of both, are acceptable for in-house use.

4.8.4 Suspect Parts – Use of parts affected by ALERTs and problem advisories shall be in accordance with MSFC-STD-3012.

4.9 **Off-The-Shelf (OTS) Assemblies** - The design organization using OTS assemblies shall be responsible for assuring that OTS hardware is suitable for the application.

4.10 **Ground Support Equipment (GSE)/Avionics Interface** - Connectors that physically mate with flight hardware shall be of the same physical configuration.

MSFC DOCUMENTATION REPOSITORY - DOCUMENT INPUT RECORD

I. GENERAL INFORMATION

1. APPROVED PROJECT:	2. DOCUMENT/ DRAWING NUMBER:	3. CONTROL NUMBER:	4. RELEASE DATE:	5. SUBMITTAL DATE:
Multi-program projects	MSFC-STD-3012		12/07/1999	10/09/2002

6. DOCUMENT/DRAWING TITLE:
EEE Parts Management and Control for MSFC Spaceflight Hardware

7. REPORT TYPE:
MSFC Standard

8. CONTRACT NUMBER / PERFORMING ACTIVITY:	9. DRD NUMBER:	10. DPD / DRL / IDRD NUMBER:

11. DISPOSITION AUTHORITY (Check One):	12. SUBMITTAL AUTHORITY:	13. RELEASING AUTHORITY:
☒ Official Record - NRRS 8/12/A ☐ Reference Copy - NRRS 8/5/A/3 (destroy when no longer needed)	Charles L. Gamble, Jr./ED16	Terry S. Roberts 10/10/02

14. SPECIAL INSTRUCTIONS:
Document will be available on the Electronic Master List.

Irene Taylor /ED10 CER

15. CONTRACTOR/SUBMITTING ORGANIZATION, ADDRESS AND PHONE NUMBER:	16. ORIGINATING NASA CENTER:
ED16 Charles L. Gamble, Jr. (256) 544-3353	MSFC
	17. OFFICE OF PRIMARY RESPONSIBILITY: ED16

18. PROGRAMMATIC CODE (5 DIGITS):	19. NUMBER OF PAGES: 99

II. ENGINEERING DRAWINGS

20. REVISION:	21. ENGINEERING ORDER:	22. PARTS LIST:	23. CCBD:

III. REPORTS, SPECIFICATIONS, ETC.

24. REVISION:	25. CHANGE:	26. VOLUME:	27. BOOK:	28. PART:	29. SECTION:

30. ISSUE:	31. ANNEX:	32. SCN:	33. DCN:	34. AMENDMENT:

35. APPENDIX:	36. ADDENDUM:	37. CCBD:	38. CODE ID:	39. IRN:

IV. EXPORT AND DISTRIBUTION RESTRICTIONS

- ☐ Privacy Act (see MWI 1382.1)
- ☐ Proprietary (see MPD 2210.1)
- ☐ Patent (see MPG 2220.1)
- ☐ ITAR (see MPG 2220.1)
- ☐ EAR (see MPG 2220.1)
- ☐ Other ACI (see NPG 1620.1 and MPG 1600.1) _____
- ☒ No statutory or institutional restrictions applicable -- material may be electronically distributed to user in the NASA domain

V. ORIGINATING ORGANIZATION APPROVAL

40. ORG. CODE:	41. PHONE NUMBER:	42. NAME:	43. SIGNATURE/DATE:
ED16	(256) 544-3353	Charles L. Gamble, Jr.	Charles L. Gamble Jr. 10/10/02

VI. TO BE COMPLETED BY MSFC DOCUMENTATION REPOSITORY

44. RECEIVED BY:	45. DATE RECEIVED:	46. WORK ORDER:
Tammy Wise	10-15-03	