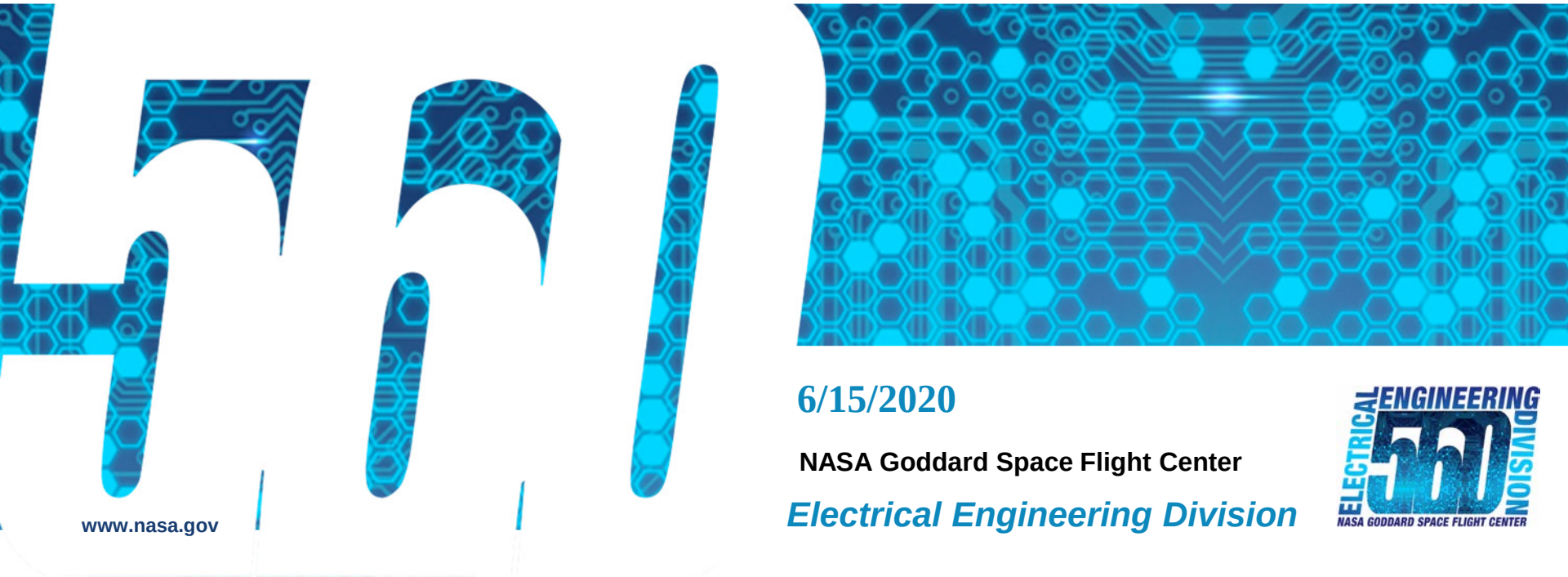
National Aeronautics and Space Administration

Update: NASA Testing & Derating Document

Noman A. Siddiqi (Jacobs, Sr. Parts Engineer) noman.a.siddiqi@nasa.gov
Chris Green (NASA GSFC Code 562, Associate Branch Head) christopher.m.green-1@nasa.gov
Bruce Meinhold (SSAI, ESES lll Group Manager/SME, Parts, Packaging, Assembly Technologies)



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NASA Goddard Space Flight Center

Electrical Engineering Division

www.nasa.gov

NASA-STD-8739.11: Instructions for EEE Parts Selection, Screening, Qualification, and Derating

- Objectives
  - Standardize center parts documents including EEE-INST-002, into an Agency wide NASA-STD-8739.11
  - Include inputs from all NASA centers and EEE Parts Engineers
  - Incorporate new commodity sections and revise existing commodity sections.
  - Update general descriptions for all commodity sections to include key commodity concerns.
  - Standardize screening and lot acceptance table formats for all commodity sections.
  - Update guidance for Level 3 and Class D missions to match NASA risk posture.

Relation to NASA-STD-8739.10: Electrical, Electronic, and Electromechanical (EEE) Parts Assurance Standard

Grade	*Part Class Summary*	*Level of In-process Controls and Screening*	NASA Risk Posture	NASA 8739.11 Part Testing Levels	Application
1	*Space quality class qualified parts or equivalent.*	*Highest*	Highest	Level 1	Space flight.
2	*Full Military quality class qualified parts or equivalent*	*High*	High	Level 1 and 2	Space flight or Critical ground support equipment.
3	*Low military quality class parts and Vendor Hi-Rel or equivalent. Screened automotive grade EEE parts.*	*Medium*	Low to Medium	Level 1, 2 and 3	Space flight experiments, Critical ground support equipment
4	*"Commercial" quality class parts. Qualification data at manufacturer's discretion. No government process monitors incorporated during manufacturing.*	*Variable*	Low to None	Level 1, 2, 3 and 4	Noncritical space flight, Critical and Noncritical ground support equipment.

NASA-STD-8739.11 Section Format

- Each Commodity Section is Formatted as:

  Introduction:
  - Brief description of the commodity.
  - General guidelines and important usage factors for the commodity.

  Tables
  - Table 1 - Overall requirements for each level
  - Table 2 - Screening (100%)
  - Table 3 - Lot Acceptance Testing (LAT), (sample)
  - Table 4 - Derating Criteria

M5 Table 1 Plastic Encapsulated Microcircuits Requirements

Table 1. PLASTIC ENCAPSULATED MICROCIRCUIT REQUIREMENTS 1/

Quality Level	Monolithic Microcircuit Type	Specification	Use as Is	Screening	LAT	DPA
Level 1	SCD **2/**	SCD		X	X	X
Level 2	QML Class N	MIL-PRF-38535				X
	Automotive, Commercial, SCD **2/**	AEC-Q100, VICD, SCD		X	X	X
Level 3	QML Class N	MIL-PRF-38535				X
	Automotive, Commercial, SCD **2/**	AEC-Q100, VICD, SCD		X		X
Level 4	QML Class N	MIL-PRF-38535	X			
	Automotive, Commercial, SCD **2/**	AEC-Q100, VICD, SCD	X			

Notes:

1/ The character "X" designates a requirement. The character "R" designates a recommendation.

2/ SCD shall be generated to the program-specific Parts Procurement Plan that specifies screening and qualification testing.

M5 Table 2 Screening

Table 2. PLASTIC ENCAPSULATED MICROCIRCUIT SCREENING 1/ 4/

Test	Test Sequence	Test Methods, Conditions, and Requirements	Level 1 SCD	Level 2 SCD, Automotive, Commercial	Level 3 SCD, Automotive, Commercial
1	Wafer Lot Acceptance	MIL-STD-883, Methods 5010 Appendix II and 5007	X		
2	Nondestructive Bond Pull	MIL-STD-883, Method 2023, 2% PDA	X		
3	Internal Visual	MIL-STD-883, Method 2010	X Cond. A		
4	Temperature Cycling	MIL-STD-883, 1010, Condition B, 10 Cycles min.	X	X	
5	External Visual	MIL-STD-883, 2009 (3 to 10X)	X	R	
6	PIND **2/**	MIL-STD-883, 1010, Condition A	X	X	
7	Serialization		X	X	
8	Radiographic	MIL STD 883 Method 2012, Two Views	X		
9	Burn-in **3/**	MIL-STD-883, 1015, Condition D.	X 240 hr. @125°C	X 160 hr. @125°C	R 96 hr. @125°C
10	Final Electrical Measurements at +25°C, Min. and Max. Operating Temp.	Per applicable device procurement specification	X	X	R
11	Maximum Percent Defective Allowable (PDA)		≤ 5%	≤ 10%	
12	External Visual	MIL-STD-883, 2009 (3 to 10X)	X	X	R

Notes:

1/ The character "X" designates a requirement. The character "R" designates a recommendation.

2/ PIND required for cavity PEM microcircuits only.

3/ Limit burn-in temperature to below the maximum junction temperature (Tj) as specified by the manufacturer.

4/ Plug cavity microcircuits vent holes before environmental testing.

M5 Table 3 Lot Acceptance Tests

Table 3. PLASTIC ENCAPSULATED MICROCIRCUIT LOT ACCEPTANCE TESTS 1/

Inspection Test	Test Methods, Conditions, and Requirements	Quantity (Accept Number)	
		Level 1	Level 2
Group 1			
Visual Inspection and Serialization	MIL-STD-883, Method 2009 (3X to 10X)	77	44
Group 2			
Preconditioning Moisture Soak **2/**	JESD22- Moisture Sensitivity Level soak shall be in accordance with IPC/JEDEC J-STD-020.	X	X
Reflow		X	
Radiography	MIL-STD-883, Method 2012, Two Views	X	X
Electrical Measurements	Measure and record parameters at 25 °C, min. and max. rated temperatures per device specification.	45 (0)	22 (0)
Life Testing **3/**	MIL-STD-883, Method 1005, Test Condition D, HTOL, 125 °C, 1,000 hours minimum Measure and record parameters at 25 °C, min. and max. rated temperatures per device specification.	45 (0)	22 (0)

M5 Table 3 Lot Acceptance Tests (continued)

Inspection Test	Test Methods, Conditions, and Requirements	Quantity (Accept Number)	
		Level 1	Level 2
Group 3			
Baseline C-SAM	PEM-INST-001, Para. 5.3.3	22 (0)	12 (0)
Temperature Cycling	MIL-STD-883, Method 1010, Condition B; 100 cycles. Measure and record parameters at 25 °C, min. and max. rated temperatures per device specification.	22(0)	12(0)
C-SAM	PEM-INST-001, Para. 5.3.3	22(0)	12(0)
Group 4			
Biased HAST	JESD22-A110, with continuous bias, 96 hours, +130 °C, 85% RH.	10 (0)	10 (0)
Final Electrical Measurements	Measure and record parameters at 25 °C, min. and max. rated temperatures per device specification.		

Notes:

1/ The character "X" designates a requirement.

2/ Preconditioning Moisture Soak: For space applications, bake-out of PEMs before soldering is required for moisture sensitivity level (MSL) 1 and 2 parts. MSL 3 parts not allowed for space application.

3/ Life test: The junction temperature should not exceed the absolute maximum rated junction temperature for the part. If 125 °C ambient causes the maximum rated junction temperature to be exceeded the ambient temperature should be decreased appropriately

Applicable Standards for Test Methods

JEDEC Standards:

JESD22-A113:	Preconditioning of non-hermetic surface mount devices prior to reliability testing.
JESD22-A110:	Highly accelerated temperature and humidity stress test (HAST).
IPC/JEDEC J-STD-020:	Moisture/Reflow Sensitivity Classification for Non-hermetic Solid State Surface mount Devices.

M5 Table 4 Derating

Table 4. PLASTIC ENCAPSULATED MICROCIRCUIT DERATING REQUIREMENTS

Derating of PEM microcircuits is accomplished by multiplying the stress parameter by the appropriate derating factor specified below.

	Derating Factor	
Stress Parameter	**Digital**	**Linear**
Maximum Supply Voltage 1/	0.9	0.8
Maximum Input Voltage	Do not exceed 100% of derated supply voltage	Do not exceed 100% of derated supply voltage
Power Dissipation	0.8	0.75
Maximum Specified Operating Junction Temperature	Tj = +110 °C or 40 °C below the manufacturer's maximum junction temperature rating, whichever is lower.	
Maximum Output Current	0.8	0.7
Maximum Operating Frequency	0.8	0.7

Notes:

1/ For low-voltage (<= 5 V) devices, use manufacturer's recommended operating conditions as the derated limit.

NASA-STD-8739.11 Review process

- NASA-STD-8739.11 Document has 26 Commodity Sections.
  - Possibility to add more Commodity Sections.
- Each Commodity Section prepared by NASA GSFC Code 562.
- NASA Review team formed that include all NASA Centers
- Each NASA Center has Lead Representative.
- NASA Center Lead Representative bring their commodity experts as a part of review team.
- Established Bi-Weekly Telecom with all NASA Centers Lead Representatives to Discuss each Commodity Section.
- NASA Review team given two weeks to review Each Commodity Section.

NASA Centers Review Team

- Representatives of following NASA Centers are part of the telecom:

NASA Centers	
ARC	Ames Research Center
GRC	Glenn Research Center
GSFC	Goddard Space Flight Center
JPL	Jet Propulsion Lab.
JSC	Johnson Space Center
KSC	Kennedy Space Center
LARC	Langley Research Center
MSFC	Marshall Space Flight Center

NASA-STD-8739.11 Commodity Sections

Part Category	Document Section
General Instructions for All Part Categories	1
Capacitors (including BME)	C1 + C2
Connectors and Contacts	C3
Crystals	C4
Crystal Oscillators	C5
Detectors	D1
Fiber Optics and Passive Components (Fiber, Cables, Connectors, and Assemblies)	F1
Filters	F2
Fuses	F3
Heaters	H1
Magnetics	M1
Microcircuits, Hybrid Hermetic	M2
Microcircuits, Monolithic	M3

Part Category	Document Section
Microcircuits, Monolithic Plastic Encapsulated	M5
Microwave and RF Devices	M6
Microcircuits, Hybrid Non-Hermetic	M7
Motors	M8
Optoelectronic Devices	O1
Laser Devices	O2
Printed Circuit Boards	P1
Relays, Electromagnetic	R1
Resistors	R2
Semiconductor Devices, Discrete	S1
Semiconductor Devices, Plastic Encapsulated	S2
Switches	S3
Temperature Sensors and RTD	T1
Wire and Cable	W1

Completed sections are highlighted in Green.

NASA-STD-8739.11 Schedule

- Review Process:
  - 17 Sections Completed — June, 2020
  - Completion of Remaining Sections — November, 2020
  - Compile all sections to NASA-STD format — Winter, 2020
  - NASA-STD-8739.11 Review and Publication — 2021

- External Reviews: Several draft sections available for external review, Seeking feedback on currently drafted sections from external NASA partners in EEE Parts Community.

Summary

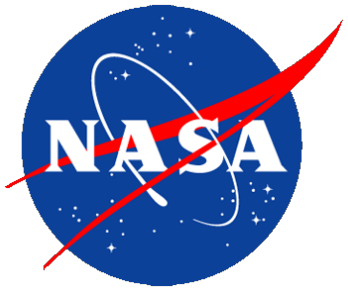
- Development of remaining commodity sections is in process.
- Internal review will be performed with commodity experts.
- Getting inputs for new commodities to be added to NASA-STD-8739.11 document.

- Special thanks all NASA Center Representatives who participate at bi-weekly Commodity Sections Reviews and provided very useful comments and recommendations.

Technical Reference Documents

– NASA-STD-8739.10	Electrical, Electronic, and Electromechanical (EEE) Parts Assurance Standard
– EEE-INST-002	Instructions for EEE Parts Selection, Screening, Qualification and Derating
– PEM-INST-001	Instructions for Plastic Encapsulated Microcircuit (PEM) Selection, Screening, Qualification
– MSFC-STD-3012	EEE Parts Management and Control for MSFC Space Flight Hardware
– JPL D-20348	JPL Institutional Parts Program Requirements
– JSC SSQ 25001	Electrical, Electronic, and Electromechanical (EEE) Parts Upgrade Screening and Qualification Requirements
– TOR documents	Technical Requirements for Electronic Parts, Materials, and Processes Used in Space Vehicles
– SMC-S-010 (2013)	AFSC Space and Missile System Center Standard: Technical Requirements for Electronic Parts, Material, and Processes Used in Space Vehicles
– ESCC 20100	Requirements for Qualification of Standard Electronic Components for Space Application
– AEC, IPC, JEDEC, ASTM	Commercial specifications.

Q&A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