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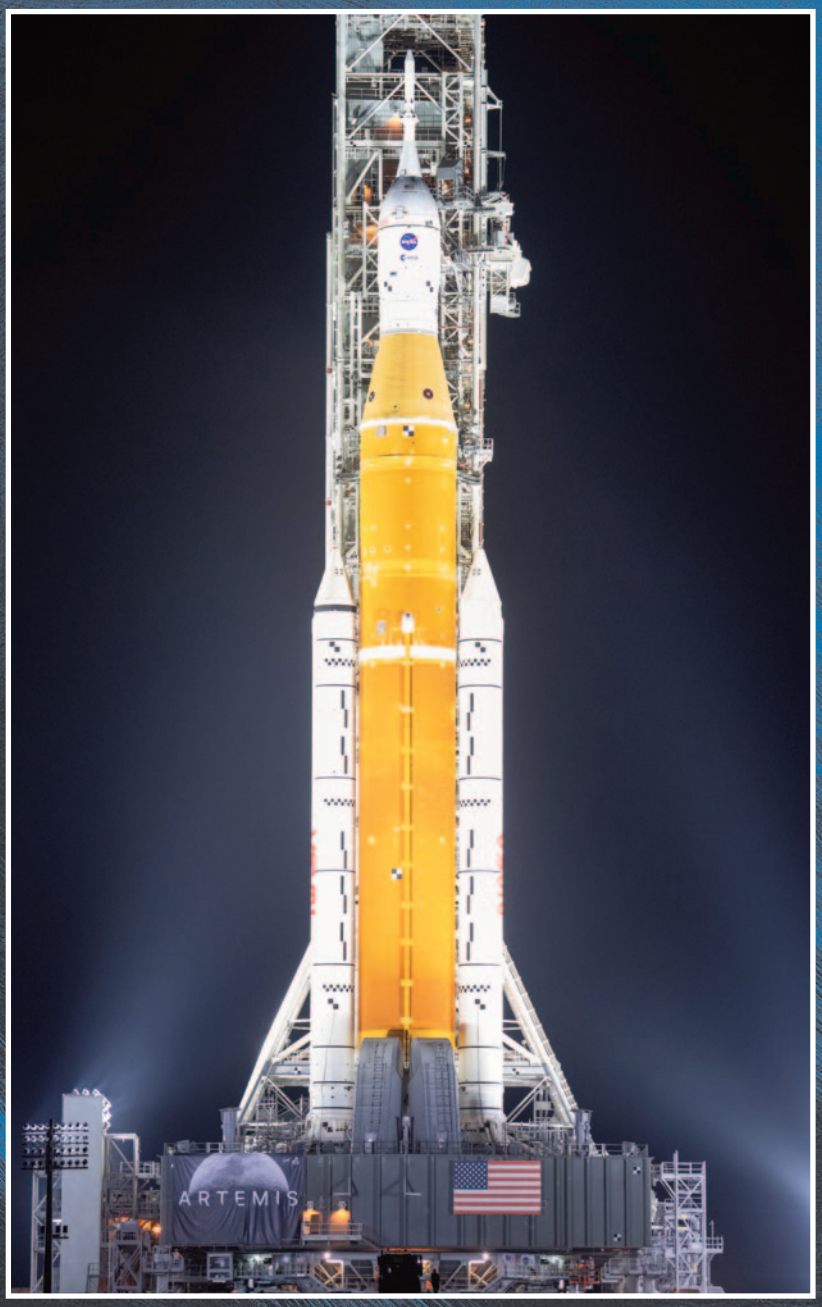

NASA S-311-P-829 REV. M SPECIFICATION

REVISIONS			
SYMBOL	DESCRIPTION	DATE	APPROVAL
-	Initial Release	07/08/2008	JS
A	Revised numbering scheme, separated electrical and mechanical, editorial changes throughout	07/14/2009	JS
B	Corrected typographical errors in PIN table, added flag note 1.	08/06/2009	JS
C	Added 1712/25V, 0805/50V, 0805/100V, deleted errant para. 4.6.6, clarified paragraph 1.2.1 testing	01/13/2010	JS
D	Added Table I values, added low inductance reverse geometry styles, reduced 25V dielectric thickness, editorial changes throughout	07/07/2010	JS
E	RN A177; Revised Table I, added new terminations, increased voltages, editorial corrections, removed Paragraph 6.4 restriction.	07/10/2012	JS
F	RN A187; Added new 10V values, added Solderability for "N" terminations, clarified moisture resistance test conditions, clarified part marking.	07/24/2013	JS

SHEET REVISION STATUS

All sheets are at the same revision

ORIGINATOR: Dennis Krus Original signature on file	DATE	FSC: 5910
APPROVED: Dennis Krus Original signature on file		SPECIFICATION CONTROL DRAWING Capacitor, Ceramic, Multilayer Chip, Space Applications
ENGINEERING APPROVAL: Thomas R. Duffy Original signature on file		
CODE 562 APPROVAL: Marcellus A. Proctor Original signature on file		
CODE 562 SUPERVISORY APPROVAL: Kusum K. Sahu Original signature on file		**S-311-P-829**

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD 20771

CAGE CODE: 25306

REVISIONS (continued)

SYMBOL	DESCRIPTION	DATE	APPROVAL
G	RN A195; Table I changes: Added new 0402 10V; increased 0402 16V values; added new 0603 10V; removed errant /6 references; reduced NPO, 50V minimum dielectric thickness (all changes in bold); added annual summary report; minor editorial changes throughout	01/21/2015	JS
H	RN A207; DF changes for X7R; Remove CSAM sample option; Clarified low capacitance designation in Paragraph 1.2; added flag note /6 to Table I and paragraph 3.7; removed flag note 3/ in Table I; added 0508, 6.3V part; modified Group B sample storage requirement in paragraph 4.6.5; 1209 length tolerance changed to 0.010"; updated calibration standards in reference documents.	1/5/2017	JS
J	RN A211; Added "A" tolerance and updated flag note 1/ in paragraph 1.2; 0306 16V part added	2/16/2017	EH
K	RN A219; Added "H" finish; Updated paragraph 1.2.3; Updated paragraph 4.6.4 requirements to reflect test differences based on termination types	8/30/2018	BM
L	RN A223, clarified tolerance flag note 1; added 1210, 1812, 1825 package sizes, updated DF for long term testing (Table 2), updated dimensions for 0402 (Figure 1) to reflect MIL-PRF-32535/2; added Mfr specific part number note to section 6.1.1; Removed obsolete calibration documents	10/05/2023	BM
M	RN A226, Clarified capacitance tolerance availability in paragraph 1.2. Added 4V rating in paragraph 1.2. Added 0201 size to paragraph 1.2 and Table 1. Added 0402 4 volt rated to Table 1. Added nondestructive internal examination to paragraph 1.2.1. Added 4 volt rated DF to Table 2. Added 0201 size to Figure 1. Corrected 0402 min spacing in Figure 1. Clarified dimensions for solder coated devices in Figure 1.	08/04/2025	BM

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1. SCOPE

1.1 Purpose. This specification defines the general requirements for high reliability, ceramic dielectric, multilayer, fixed value chip capacitors for space, missile and other high reliability applications. It defines the test and qualification parameters for extended range capacitors required by the very low power, low voltage assemblies used for flight.

1.2 Part or Identifying Number (PIN). The complete GSFC PIN for the Multilayer Chip Capacitors supplied to this specification shall be specified as follows. Allowable combinations of voltage, capacitance, dielectric type, and package size shall be described in Table I herein. Reference paragraph 6.1.1 for manufacturer internal part number details.

GSFC Identifier	Ultrasonic Examination (replaces dash character)	Size Code	Dielectric Type	Capacitance (pF)	Tolerance 1/	Voltage (Vdc)	Termination	Packaging/Marking 1/
G311P829	A = 100%	A = 0402	N = NPO	XXX Nominal capacitance value in pF: First two digits are significant and last digit specifies the number of zeros to follow. When nominal value is <10 pF, the letter "R" is used to indicate the decimal point; succeeding digit(s) are significant; e.g. 1R0 indicates 1.0°pF; R75 indicates 0.75 pF; 0R5 indicates 0.5 pF.	A = +/- 0.05pF For NPO parts <10 pF only	1 = 25V	P = PdAg alloy	1 = 7" T/R, unmarked capacitors
		B = 0403	X = X7R		B = +/- 0.10pF For NPO parts <10 pF only	2 = 50V	N = Ni-Sn/Pb Plated	2 = 7" T/R, marked capacitors
		C = 0504			C = +/- 0.25pF For NPO parts <10 pF only	3 = 100V	G = Ag-Ni-Au plated	3 = Waffle Pack, unmarked capacitors
		D = 0603			D = +/- 0.50pF For NPO parts <10 pF only	4 = 5V	H = Gold, Thick Film	4 = Waffle Pack, marked capacitors
		E = 0805			F = +/- 1% For NPO parts ≥10 pF only	5 = 10V		
		F = 1206			G =+/- 2% For NPO parts ≥10 pF only	6 = 16V		
		G = 1209			J = +/- 5% For NPO parts ≥10 pF only	7 = 6.3V		
		H = 1725			K =+/- 10% For NPO/X7R parts ≥10 pF	8 = 4V		
		J = 2225			L = +20% / -10% For NPO/X7R parts ≥10 pF			
		K = 1712						
		L = 0502						
		M = 0306						
		N = 0508						
		P = 0612						
		Q = 0912						
		R = 1812						
		S = 1210						
		T = 1825						
		U = 0201						

1/ Packages smaller than 0805/0612 cannot be selected with the marking option (2 or 4) due to physical size constraints.

1.2.1 Ultrasonic examination. Devices >0402 size, supplied to this specification, shall be subjected to ultrasonic examination in accordance with the manufacturer's standard procedures and MIL-PRF-123, except as modified herein. 100% inspection complies with the MIL-PRF-123 sample requirements. Devices <0402 size, supplied to this specification, shall be subjected to nondestructive internal examination in accordance with the manufacturer's standard procedures and MIL-PRF-32535, except as modified herein. 100% inspection complies with the MIL-PRF-32535 sample requirements. 0402 size devices may be examined using ultrasonic or the nondestructive internal examination in accordance with the manufacturer's standard procedures and MIL-PRF-123 or MIL-PRF-32535. Ultrasonic examination may be performed prior to capacitor termination (in accordance with MIL-PRF-123 or MIL-PRF-32535 requirements) or after capacitor termination, at the manufacturer's option.

1.2.2 Dielectric Type. The voltage temperature characteristic shall be referenced to the +25°C value, and shall be applicable over the entire temperature range of -55°C to +125°C. Dielectric type NPO ("N") shall be 0 ±30 ppm/°C, and dielectric type X7R ("X") shall be +15, -15 percent.

1.2.3 Termination. Devices supplied to this specification shall have a termination coating of palladium silver alloy (MIL-PRF-123, type M), or base metal barrier tin-lead solder (MIL-PRF-123, type Z) plated, or base metal barrier gold (MIL-PRF-123, type G) plated, or Thick Film Gold (MIL-PRF-32535, type H). Tin lead solder plating shall contain a minimum of 4% lead, by mass. Note that the palladium silver alloy and thick film gold termination coatings are not recommended for applications using eutectic solder attach methods; PdAg termination coating is appropriate for conductive epoxy mounting techniques only. Thick film Au termination coating is appropriate for conductive epoxy mounting. Thick film Au terminations are also appropriate for wire bonding.

1.2.4 Package/Marking. Capacitors supplied to this specification may be supplied as unmarked or marked, as designed by the marking identifier code in the GSFC PIN. Capacitors shall be unmarked, and packaged on 7" tape and reel (identifier code 1), or in waffle packs (identifier code 3). Capacitors shall be marked per the manufacturer's standard marking procedure and nomenclature (or MIL-PRF-123 nomenclature), and packaged on 7" tape and reel (identifier code 2), or in waffle packs (identifier code 4). For marked capacitors, size codes smaller than 0805 (A, B, C, D, L, M, N, and P) are not available, due to physical size constraints.

Table I. Allowable Capacitance/Voltage Combinations

Case Size	Maximum Working Voltage (Vdc)	NPO Dielectric		X7R Dielectric	
		Maximum Capacitance	Minimum Dielectric Thickness 2/	Maximum Capacitance	Minimum Dielectric Thickness 2/
0201	4 V	NA	NA	0.022 µF **5/**	0.15 mils
0201	10 V	100 pF	.25 mils	0.01 µF **5/**	0.18 mils
0402	4 V	NA	NA	0.22 µF **5/**	0.15 mils
0402	10 V	NA	NA	0.1 µF **5/**	0.25 mils
0402	16 V	NA	NA	0.01 µF	0.4 mils
0402	25 V	120 pF	0.6 mils	4700 pF	0.8 mils
0402	50 V	100 pF	0.7 mils	3900 pF	0.8 mils
0402	100 V	39 pF	1.0 mils	1200 pF	1.0 mils
0403	16 V	NA	NA	0.022 µF	0.4 mils
0403	25 V	390 pF	0.6 mils	0.015 µF	0.8 mils
0403	50 V	330 pF	0.7 mils	0.012 µF	0.8 mils
0403	100 V	68 pF	1.0 mils	2200 pF	1.0 mils
0502	6.3 V	NA	NA	0.1 µF	0.4 mils
0504	16 V	NA	NA	0.082 µF	0.4 mils
0504	25 V	1500 pF	0.6 mils	0.047 µF	0.8 mils
0504	50 V	1200 pF	0.7 mils	0.039 µF	0.8 mils
0504	100 V	180 pF	1.0 mils	6800 pF	1.0 mils
0306 4/	5V	NA	NA	0.1 µF **/5**	0.25 mils
0306 4/	16V	NA	NA	0.1 µF **/5**	0.25 mils
0306 4/	25V	NA	NA	.022 µF	0.8 mils
0603	10V	NA	NA	0.22 µF **5/**	0.3 mils
0603	16 V	NA	NA	0.1 µF **6/**	0.4 mils
0603	25 V	680 pF	0.6 mils	0.027 µF	0.8 mils
0603	50 V	560 pF	0.7 mils	0.022 µF	0.8 mils
0603	100 V	100 pF	1.0 mils	3300 pF	1.0 mils
0508 4/	6.3 V	NA	NA	0.18 uF	0.3 mils
0508 4/	10V	NA	NA	0.12 µF	0.4 mils
0508 4/	16V	NA	NA	0.1 µF	0.4 mils
0508 4/	25V	NA	NA	0.047 µF	0.8 mils
0805	10 V	NA	NA	1.0 µF **/5**	0.3 mils
0805	16 V	NA	NA	0.22 µF	0.4 mils
0805	25 V	2700 pF	0.6 mils	0.10 µF	0.8 mils
0805	50 V	2200 pF	0.7 mils	0.1 µF	0.8 mils
0805	100 V	560 pF	1.0 mils	0.022 µF	1.0 mils
0612 4/	16V	NA	NA	0.27 µF	0.4 mils
0612 4/	25V	NA	NA	0.22 µF	0.8 mils

Table I. Allowable Capacitance/Voltage Combinations

Case Size	Maximum Working Voltage (Vdc)	NPO Dielectric		X7R Dielectric	
		Maximum Capacitance	Minimum Dielectric Thickness 2/	Maximum Capacitance	Minimum Dielectric Thickness 2/
1206	10 V	NA	NA	1.8 µF /5	0.3 mils
1206	16 V	NA	NA	0.39 µF	0.4 mils
1206	25 V	6800 pF	0.6 mils	0.27 µF	0.8 mils
1206	50 V	5600 pF	0.7 mils	0.22 µF	0.8 mils
1206	100 V	1500 pF	1.0 mils	0.1 µF	1.0 mils
0912 4/	16V	NA	NA	.68 µF	0.4 mils
0912 4/	25V	NA	NA	.47 µF	0.8 mils
1209	10 V	NA	NA	2.7 µF /5	0.3 mils
1209	16 V	NA	NA	0.68 µF	0.4 mils
1209	25 V	0.010 µF	0.6 mils	0.47 µF	0.8 mils
1209	50 V	8200 pF	0.7 mils	0.39 µF	0.8 mils
1209	100 V	3900 pF	1.0 mils	0.15 µF	1.0 mils
1210	10 V	NA	NA	2.7 µF /5	0.3 mils
1210	16 V	NA	NA	0.68 µF	0.4 mils
1210	25 V	0.010 µF	0.6 mils	0.47 µF	0.8 mils
1210	50 V	8200 pF	0.7 mils	0.39 µF	0.8 mils
1210	100 V	3900 pF	1.0 mils	0.15 µF	1.0 mils
1712	16 V	NA	NA	1.2 µF	0.4 mils
1712	25 V	0.022µF	0.6 mils	1.0 µF	0.8 mils
1712	50 V	0.015 µF	0.7 mils	0.68 µF	0.8 mils
1712	100 V	6800pF	1.0 mils	0.27 µF	1.0 mils
1812	10V	NA	NA	4.7 µF /5	0.3 mils
1812	16 V	NA	NA	1.2 µF	0.4 mils
1812	25 V	0.022µF	0.6 mils	1.0 µF	0.8 mils
1812	50 V	0.015 µF	0.7 mils	0.68 µF	0.8 mils
1812	100 V	6800pF	1.0 mils	0.27 µF	1.0 mils
1725	16 V	NA	NA	3.3 µF	0.4 mils
1725	25 V	0.056 µF	0.6 mils	2.2 µF	0.8 mils
1725	50 V	0.039 µF	0.7 mils	1.8 µF	0.8 mils
1725	100 V	0.018 µF	1.0 mils	0.68 µF	1.0 mils
1825	16V	NA	NA	3.3 µF	0.4 mils
1825	25V	0.056 µF	0.6 mils	2.2 µF	0.8 mils
1825	50V	0.039 µF	0.7 mils	1.8 µF	0.8 mils
1825	100V	0.018 µF	1.0 mils	0.68 µF	1.0 mils

Table I. Allowable Capacitance/Voltage Combinations

Case Size	Maximum Working Voltage (Vdc)	NPO Dielectric		X7R Dielectric	
		Maximum Capacitance	Minimum Dielectric Thickness 2/	Maximum Capacitance	Minimum Dielectric Thickness 2/
2225	16 V	NA	NA	3.9 µF	0.4 mils
2225	25 V	.068 µF	0.6 mils	3.3 µF	0.8 mils
2225	50 V	0.056 µF	0.7 mils	2.2 µF	0.8 mils
2225	100 V	0.027 µF	1.0 mils	1.0 µF	1.0 mil

Notes:
1/ NA indicates "Not Available"
2/ Thickness measured after firing.
3/ Deleted.
4/ Values shown here are reverse geometry, low inductance style capacitors.
5/ Maximum capacitance value may have DF values up to 7.5%.
6/ Maximum capacitance value may have DF values up to 5.0%.

2. APPLICABLE DOCUMENTS

2.1 Government specifications, standards, and handbooks. The following Government specifications, standards, and handbooks form a part of this drawing to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, in effect on the date of the contract or purchase order**.**

STANDARDS

MILITARY

MIL-STD-202	Test Methods for Electronic and Electrical Components.
MIL-STD-883	Test Method Standard, Microcircuits

SPECIFICATIONS

MILITARY

MIL-PRF-123	Capacitors, Fixed, Ceramic Dielectric, (Temperature Stable and General Purpose), High Reliability, General Specification
MIL-PRF-32535	Capacitor, Chip, Fixed, Ceramic Dielectric (Temperature Stable and General Purpose), Extended Range, High Reliability and Standard Reliability.

GENERAL SPECIFICATION FOR

National Aeronautics and Space Administration (NASA)

EEE-INST-002	Instructions for EEE Parts Selection, Screening, Qualification and Derating

2.2 Non–Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the DoDISS in effect on the date of the contract or purchase order. Unless otherwise specified, the issues of documents not listed in the DoDISS are the issues of the documents in effect on the date of the contract or purchase order.

Electrical Overstress/Electrostatic Discharge Association Inc.

EOS/ESD S20.20	For the Development of an Electrostatic Discharge Control Program for Protection of Electrical and Electronic Capacitors, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices)

American National Standards Institute (ANSI)

Electronic Industries Alliance (EIA)

ANSI/EIA-469	Standard Test Method for Destructive Physical Analysis (DPA) of Ceramic Monolithic Capacitors.

2.3 Order of precedence**.** In the event of a conflict between the text of this document and the references cited herein (except for related associated specifications, specification sheets, or MS sheets), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Individual Item Requirements. Individual item requirements for capacitors supplied to this specification shall be in accordance with the requirements of MIL-PRF-123, and as specified herein. Capacitors supplied to this specification shall meet all performance requirements as specified herein, under all combinations of environmental conditions specified herein.

3.1.1 Electrodes. All capacitors supplied to this specification shall be manufactured with precious metal electrodes.

3.1.2 Pure Tin. The use of pure tin, as an underplate or final finish, is prohibited both internally and externally. Tin content of capacitor components and solder shall not exceed 96 percent, by mass. Tin shall be alloyed with a minimum of 4 percent lead, by mass.

3.2 Interface Requirements. Capacitors supplied to this specification shall meet the physical dimension requirements as specified in Figure 1, herein.

3.2.1 Dielectric thickness. Dielectric thickness is the actual measured thickness of the fired ceramic dielectric layer. Capacitors supplied to this specification shall have a minimum dielectric thickness of 0.8 mils for 50Vdc rated capacitors, or 1.0 mil for 100Vdc rated capacitors. Capacitors rated below 50Vdc shall meet the dielectric thickness requirement of 0.8 mils, unless specifically identified in Table I. Voids, or the cumulative effect of voids, shall not reduce the total dielectric thickness by more than 50 percent. Maximum dielectric constant shall be 4000 for X7R dielectric; 100 for NPO dielectric.

3.2.2 Side Margin Requirements. For capacitors rated at <25 V, side margin requirements are not specified in ANSI/EIA-469, Table 6. Capacitors supplied to this specification, and rated below 25 V, shall meet the following minimum requirement. Side margins shall be 0.015mm (0.0006"), minimum. Capacitors rated at ≥25 V shall meet the requirements of ANSI/EIA-469, Table 6.

3.2.3 End Margin Requirements. For capacitors rated at <25 V, end margin requirements are not specified in ANSI/EIA-469, Table 7. Capacitors supplied to this specification, and rated below 25 V, shall meet the following minimum requirement. End margins shall be 0.025mm (0.001"), minimum. Capacitors rated at ≥25 V shall meet the requirements of ANSI/EIA-469, Table 7.

3.2.4 Cover Plate Thickness Requirements. For capacitors rated at <25 V, cover plate thickness requirements are not specified in ANSI/EIA-469, Table 8. Capacitors supplied to this specification, and rated below 25 V, shall meet the following minimum requirement. Cover plate thickness shall be 0.025mm (0.001"), minimum. Capacitors rated at ≥25 V shall meet the requirements of ANSI/EIA-469, Table 8.

3.3 Insulation Resistance (IR @ 125°C). Capacitors shall be tested at +125°C and rated voltage in accordance with MIL-STD-202, Method 302. The minimum IR measurement shall be 10,000 Megohms or 100 Megohm-Microfarads, whichever is less.

3.4 Dielectric Withstanding Voltage (DWV). Capacitors shall be tested at two and one half times the rated voltage in accordance with MIL-STD-202, Method 301.

3.5 Insulation Resistance (IR @ 25°C). Capacitors shall be tested at +25°C and rated voltage in accordance with MIL-STD-202, Method 302. The minimum IR measurement shall be 100,000 Megohms or 1,000 Megohm-Microfarads, whichever is less.

3.6 Capacitance. Capacitors shall be tested at +25°C and 1.0 Vacrms in accordance with MIL-STD-202, Method 305.

3.7 Dissipation Factor (DF). Dissipation factor shall not exceed 0.15% for all NPO dielectric capacitors, in all voltage ranges. Dissipation factor, for X7R dielectric capacitors, shall not exceed 7.5% at the 4V, 5, 6.3, and 10 volt ratings, 5.0% at the 16 volt rating, 4.0% at the 25 volt ratings, 3.5% at the 50 volt rating, and 2.5% at the 100 volt rating. Note, in accordance with flag notes 5/ and 6/ of Table I herein, certain X7R capacitor values, in the 4V, 5V, 6.3V, and 10V ratings, may exhibit a dissipation factor exceeding 5%, up to a maximum of 7.5%.

3.8 Percent Defective Allowable (PDA). The cumulative PDA after Voltage Conditioning shall be less than 5%. Pieces rejected as out of tolerance for capacitance or visual screening will be removed from the lot, but not counted in the PDA calculation.

3.9 Visual Examination. Visual inspection, in accordance with MIL-PRF-123, Appendix B, shall be performed on 100% of the capacitors delivered to this specification.

3.10 Mechanical Examination. Mechanical inspection, in accordance with the requirements of MIL-PRF-123, shall be performed. Sample size shall be as specified in MIL-PRF-123.

4.0 QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection. Unless otherwise specified in the contract purchase order, the manufacturer of microcircuits supplied against this specification shall be responsible for the performance of all inspection requirements as specified herein. The procuring activity shall retain the right to perform any of the inspections specified herein, where such inspections are deemed necessary to assure that supplies and services conform to prescribed requirements.

4.1.1 Test Equipment and Inspection Facilities. Test and measuring equipment and inspection facilities of sufficient accuracy, quality, and quantity to permit performance of the required inspections specified herein shall be established and maintained by the manufacturer. The establishment and maintenance of a calibration system to control the accuracy of the measuring and test equipment shall be in accordance with ANSI/NCSL Z540.3-2006 (R2013) and ISO 17025:2000, or similar system approved by the procuring activity.

4.2 Design and Source Approval. Prior to qualification, the manufacturer's facility shall be subjected to survey, at the option of GSFC. Compliance with ANSI/NCSL Z540.1-1994 (R2002) and ISO 17025:2000 or equivalent is required. In addition, the history and detailed engineering of the specific (part) design shall be reviewed, as well as the documented manufacturing and quality control procedures. Only those source(s) approved in the design and source phase shall be eligible for qualification or award of contract under this specification. Source approval and design approval do not constitute part qualification or an equivalent thereof.

4.2.1 Qualification. Capacitors furnished to this specification shall be product which has been granted qualification approval by NASA/GSFC, and has been listed in the latest revision of the GSFC Qualified Products List Directory (QPLD).

4.2.1.1 QPL Status. Manufacturers supplying capacitors to this specification shall be listed on the version of QPDSIS-123 in effect on the date of purchase order or contract.

4.2.2 Requalification. Requalification shall be imposed following any change in design, manufacture, materials, or quality control procedures as reviewed and approved during qualification. Requalification shall be required if it is demonstrated that any stipulation initially presented in the manufacturer's certification no longer applies. Inspection discrepancies that are not suitably explained by failure analysis, or by other means, shall also be considered a basis for disqualification by GSFC.

4.2.3 QPLD Summary Report. Manufacturers supplying capacitors to this specification shall provide an annual product summary, to the GSFC QPLD Administrator specified in paragraph 6.2. The summary shall include the total number of lots ordered/manufactured to this specification, by size and dielectric type, with pass/fail statistics (inspection lot level).

4.3 Classification of inspections. Inspections required by this specification shall be classified as follows.

a. In Process Inspection
b. Group A Inspection
c. Group B Inspection

4.3.1 Inspection of product for delivery. Inspection of product for delivery to this specification shall consist of in-process inspection, Group A inspection, and Group B inspection.

4.3.2 Inspection lot. An inspection lot shall be defined in accordance with MIL-PRF-123, and shall consist of all capacitors of a single nominal capacitance and voltage rating of one design, from the same dielectric material batch, and processed as a single lot through all manufacturing steps on the same equipment.

4.4 In-Process Inspection. In-process inspection shall be as specified in MIL-PRF-123, Table X, and as specified herein.

4.4.1 Destructive Physical Analysis (DPA). Destructive physical analysis (pre-termination) shall be performed on each inspection lot of capacitors supplied to this specification. DPA shall be performed in accordance with the requirements of MIL-PRF-123; sample size shall be as specified in MIL-PRF-123. Analysis shall verify compliance with manufacturer's internal design requirements as well as the requirements of ANSI EIA 469.

4.5 Group A Inspection. Group A inspection shall be performed each inspection lot of capacitors supplied to this specification. Group A inspection shall consist of the following tests, performed in the order shown.

4.5.1 Thermal Shock. 100% of devices supplied to this specification shall receive thermal shock, in accordance with MIL-STD-202, Method 107, Test Condition A, except the temperature in step 3 shall be +125°C, and number of cycles shall be twenty (20), minimum.

4.5.2 Voltage Conditioning. 100% of devices supplied to this specification shall receive voltage conditioning. Voltage conditioning shall consist of applying twice the rated voltage (Maximum Working Voltage, as specified in Table I) to the capacitors at the maximum rated temperature of +125°C +4°C/-0°C, for a minimum of 168 hours and a maximum of 264 hours. Voltage conditioning may be terminated at any time during the 168 to 264 hour time interval, provided that the number of failures detected during the last 48 hours of test is less than 0.1%, or one piece. Resistors may be used in lieu of fuses specified by MIL-PRF-123.

4.5.3 Electrical Performance. After completion of voltage conditioning, all capacitors shall be subjected to the electrical inspections, as specified below. The supplier has the option of performing these electrical tests in any order except insulation resistance shall always be done after dielectric withstanding voltage.

Insulation resistance at +125°C, per paragraph 3.3. herein.
Dielectric Withstanding Voltage, per paragraph 3.4 herein.
Insulation Resistance at +25°C, per paragraph 3.5 herein.
Capacitance, per paragraph 3.6 herein.
Dissipation Factor, per paragraph 3.7 herein.

4.5.4 Percent Defective Allowable (PDA). PDA shall be calculated per paragraph 3.8 herein.

4.5.5 Visual and Mechanical Inspection. Visual inspection shall be performed on 100% of the capacitors supplied to this specification, as specified in paragraph 3.9 herein. Mechanical inspection shall be performed on a sample of the deliverable capacitors supplied to this specification, per paragraph 3.10 herein.

4.6 Group B Inspection. Group B inspection shall be performed on each inspection lot of capacitors delivered against this specification. Capacitors used for Group B inspections shall have successfully passed all Group A inspections. Group B inspection shall consist of the tests as specified in MIL-PRF-123, and as specified herein. Tests shall be performed in the order shown. Sample sizes shall be as specified below.

4.6.1 Subgroup 1 sample size. For capacitors with dielectric thickness equal to or greater than 0.8 mils (reference Table I herein), sample size shall be forty-five (45) with zero (0) rejects allowed. For capacitors with dielectric thickness less than 0.8 mils (reference Table I herein), sample size shall be one hundred, twenty-five (125) with zero (0) rejects allowed.

4.6.1.1 Thermal Shock. Capacitors shall be tested in accordance with MIL-STD-202, Method 107, Test Condition A-3, except the temperature in step 3 shall be +125°C.

4.6.1.2 Life Test. Capacitors shall be tested in accordance with MIL-STD-202, Method 108. The following details apply. Capacitors shall be subjected to twice the rated voltage (Maximum Working Voltage, as specified in Table I) at a temperature of +125°C, +4°C, -0°C. Duration shall be 1000 hours.

4.6.1.3 DF Limits During Life Test. Dissipation Factor limits during and post life test, shall be as shown in Table 2, herein.

Table 2.
Dissipation Factor Limits During and Post Life Test

Rated Voltage	Characteristic	Initial DF (%)	250 Hour DF (%)	1000 Hour DF (%)	4000 Hour DF (%)
All	NPO	0.15	0.15	0.15	0.15
4 / 5 / 6.3 / 10	X7R	7.5	7.5	10	10
16	X7R	5	5	6.5	6.5
25	X7R	4	4	5.5	5.5
50	X7R	3.5	3.5	4	4
100	X7R	2.5	2.5	3	3

4.6.2 Subgroup 2 sample size. Sample size shall be twelve (12) with zero (0) rejects allowed.

4.6.2.1 Humidity Steady State Low Voltage Test (HSSLV). Capacitors shall be tested in accordance with MIL-STD-202, Method 103, Condition A, with the exceptions and clarifications specified in MIL-PRF-123, paragraph 4.6.16.1.

4.6.3 Subgroup 3 sample size. Sample size shall be twelve (12) with zero (0) rejects allowed.

4.6.3.1 Voltage Temperature Limits. NPO capacitors shall be tested in accordance with MIL-PRF-123 BP characteristic.

4.6.3.2 Moisture Resistance Test. Moisture resistance testing is only applicable to capacitors with a package size (nominal) of 0805 (standard geometry), or 0612 (reverse geometry), and larger. Capacitors shall be tested in accordance with MIL-STD-202, Method 106, with the exceptions and clarifications specified in MIL-PRF-123, paragraph 4.6.16.2, and specified herein. Capacitors rated at less than fifty (50) volts shall be tested at the rated voltage.

4.6.4 Subgroup 4 sample size. Sample size shall be six (6) pieces. Test method shall be based on selected termination type. All twelve (12) terminations shall be tested.

4.6.4.1 Solderability. This test applies only to capacitors specified with termination “N”. Solderability inspection shall be performed in accordance with MIL-STD-202, Method 208, with the exceptions and clarifications as specified in MIL-PRF-123, paragraph 4.6.13.2.

4.6.4.2 Shear Stress. This test applies only to capacitors specified with terminations “H” or “P”. Shear stress shall be performed in accordance with MIL-PRF-32535, paragraph 4.6.10; mounting shall be in accordance with MIL-PRF-32535, paragraph 4.3.5, for termination H.

4.6.4.3 Bond Strength. This subgroup applies only to capacitors specified with termination “G”. Bond strength testing shall be performed in accordance with MIL-STD-883, Method 2011, with the exceptions and clarifications as specified in MIL-PRF-38535, paragraph 4.6.12; mounting shall be in accordance with MIL-PRF-32535, paragraph 4.3.5, for termination G.

4.6.5 Group B Samples. Capacitors used for Group B inspections shall not be delivered as flight material. Test samples, or their remains, shall be maintained at the supplier's facility for a minimum of ten (10) years.

4.6.6 Deliverable data package. Each shipment of capacitors supplied to this specification shall contain the following information as a minimum.

- Certificate of Conformance
- DPA report
- Attribute summary data for Group A and Group B inspections
- Variables data for Group B, life test and humidity steady state low voltage testing

SIZE	L 1/ (Inches)	W 1/ (Inches)	THICKNESS MAX (T) 1/ (Inches)	METALIZATION BAND (M.B.) (Inches)
0201	0.024 ± 0.003	0.012 ± 0.001	0.013	0.004 Min. Band 0.007 Min. Space
0402	0.040 + 0.006/-0.004	0.020 +0.005/-0.004	0.025	0.004 Min. Band 0.012 Min. Space
0403	0.040 ± 0.010	0.030 ± 0.010	0.030	0.004 Min. Band 0.015 Min. Space
0502	0.050 ± 0.006	0.022 ± 0.004	0.038	0.005 Min. Band; 0.020 Min. Space
0504	0.050 ± 0.010	0.040 ± 0.010	0.040	0.005 Min. Band; 0.015 Min. Space
0306	0.032 ± 0.008	0.063 ± 0.008	0.033	0.005 Min. Band; 0.010 Min. Space
0603	0.063 ± 0.006	0.032 ± 0.006	0.035	0.005 Min. Band; 0.025 Min. Space
0508	0.050 ± 0.010	0.080 ± 0.010	0.045	0.005 Min. Band; 0.020 Min. Space
0805	0.080 ± 0.010	0.050 ± 0.010	0.055	0.020 ± 0.010
0612	0.063 ± 0.010	0.126 ± 0.010	0.055	0.005 Min. Band; 0.025 Min. Space
1206	0.126 ± 0.008	0.063 ± 0.008	0.060	0.020 ± 0.010
0912	0.095 ± 0.010	0.126 ± 0.010	0.065	0.005 Min. Band; 0.025 Min. Space
1209	0.126 ± 0.010	0.095 ± 0.010	0.065	0.020 ± 0.010
1210	0.126 ± 0.010	0.098 ± 0.010	0.080	0.020 ± 0.010
1712	0.175 ± 0.013	0.125 ± 0.010	0.065	0.020 ± 0.010
1812	0.180 ± 0.015	0.125 ± 0.015	0.080	0.020 ± 0.010
1725	0.175 ± 0.013	0.250 ± 0.018	0.065	0.020 ± 0.010
1825	0.177 ± 0.013	0.250 ± 0.018	0.080	0.020 ± 0.010
2225	0.220 ± 0.015	0.250 ± 0.018	0.080	0.020 ± 0.010

1/ Dimensions and tolerances are for bare chips. For sizes 0201 through 0306 sizes with solder coated terminations, add .010 inch to the positive length (L) tolerance and .007 inch to the positive width (W) and thickness (T) tolerances. For sizes 0603 through 2225 sizes with solder coated terminations, add .020 inch to the positive length (L) tolerance and .015 inch to the positive width (W) and thickness (T) tolerances.

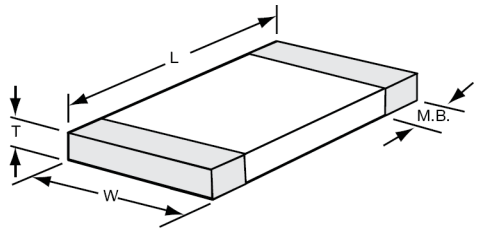

Figure 1. Mechanical Configuration.

5. PREPARATION FOR DELIVERY

5.1 Packaging Requirements. Capacitors shall be clean, dry, and packaged as per the part number designation, in an electrostatic discharge (ESD) safe package, in a secure manner that will afford adequate protection against corrosion, deterioration, and physical damage during common carrier shipment to the procuring activity. These packages shall conform to the applicable carrier rules and regulations.

5.1.1 Bulk Packaging. Bulk packaging of any capacitors supplied to this specification is not permitted.

6.0 NOTES

6.1 Ordering data. Acquisition documents shall specify the following minimum information.
a) number, title, and date of this specification
b) Goddard part number (paragraph 1.2)
c) quantity

6.1.1 Manufacturer Internal Part Numbers. Manufacturers may assign specific internal part numbers for manufacturing and production control purposes. These may differ from the GSFC PIN ordered; compliance with the requirements of this document is not impacted.

6.2 Notice. When GSFC drawings, specification, or other data are used for any purpose other than in connection with a definitely related GSFC procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; the fact that GSFC might have formulated, furnished, or in any way supplied the said drawings, specification, or other data is not to be regarded by implication or otherwise in any manner licensing the holder or any person or corporation, or conveying any right or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

Custodian: QPLD Administrator
Parts, Packaging, and Assembly Technologies Office, Code 562
Goddard Space Flight Center
8800 Greenbelt Road
Mailstop 562.0
Greenbelt, Maryland 20771

6.3 Approved Source(s) of Supply. Identification of the suggested source(s) of supply hereon is not to be construed as a guarantee of present or continued availability as a source of supply for the item.

6.4 Use and Application Information. Capacitors supplied to this specification are not compliant with MIL-PRF-123. Physical size, voltage ratings, dielectric thickness, and dielectric constant are outside of the current limits as specified by MIL-PRF-123 and the associated slash sheets. Capacitors supplied to this specification have been subjected to In-Process inspection, Group A and Group B Quality Conformance Inspection (QCI), in accordance with the requirements of this specification. Manufacturers of capacitors supplied to this specification are currently listed on the MIL-PRF-123 and MIL-PRF-32535 QPDSIS for ceramic chip capacitors.