

The documentation and process conversion measures necessary to comply with this revision shall be completed by 10 November 1999.

INCH POUND

MIL-PRF-19500/356F
10 August 1999
SUPERSEDING
MIL-S-19500/356E
11 November 1996

PERFORMANCE SPECIFICATION

SEMICONDUCTOR DEVICE, DIODE, SILICON, VOLTAGE REGULATOR
TYPES 1N4954 THROUGH 1N4996, 1N5968, 1N5969, AND 1N6632 THROUGH 1N6637,
1N4954US THROUGH 1N4996US, 1N5968US, 1N5969US, AND 1N6632US THROUGH 1N6637US,
AND C AND D TOLERANCE SUFFIX DEVICES
JAN, JANTX, JANTXV, JANJ, JANS, JANHC, AND JANKC

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the performance requirements for silicon, voltage regulator diodes. Five levels of product assurance are provided for each encapsulated device type as specified in MIL-PRF-19500, and two levels of product assurance for each unencapsulated device type die.

1.2 Physical dimensions. See figures 1, 2, 3, 4, and 5.

1.3 Maximum ratings. Maximum ratings are as shown in columns 8 and 10 of table IV herein, and as follows:

$P_T = 5 \text{ W}$ at $T_L = +65^\circ\text{C}$, $L = .375 \text{ inch (9.53 mm)}$, derate $45 \text{ mW}/^\circ\text{C}$ above $T_L = +65^\circ\text{C}$ (1N4954 through 1N4996). 1/
 $P_T = 5 \text{ W}$ at $T_L = +25^\circ\text{C}$, $L = .375 \text{ inch (9.53 mm)}$, derate $33 \text{ mW}/^\circ\text{C}$ above $T_L = +25^\circ\text{C}$ (1N5968, 1N5969, 1N6632 through 1N6637). 1/

$P_T = 5 \text{ W}$ at $T_{EC} = +125^\circ\text{C}$, derate $100 \text{ mW}/^\circ\text{C}$ above $T_{EC} = +125^\circ\text{C}$ for US suffix devices.

$-55^\circ\text{C} < T_{op} < +175^\circ\text{C}$ (ambient); $-65^\circ\text{C} < T_{STG} < +175^\circ\text{C}$ (ambient).

Barometric pressure reduced (high altitude operation): 8 mm Hg.

1.4 Primary electrical characteristics. Primary electrical characteristics are as shown in columns 2, 12, and 14 of table IV herein, and as follows:

$R_{\theta JL} = 22^\circ\text{C}/\text{W}$ (max) at $L = .375 \text{ inch (9.53 mm)}$ (1N4954 through 1N4996). 1/
 $R_{\theta JL} = 30^\circ\text{C}/\text{W}$ (max) at $L = .375 \text{ inch (9.53 mm)}$ (1N5968, 1N5969, 1N6632 through 1N6637). 1/

$R_{\theta JEC} = 7^\circ\text{C}/\text{W}$ (max) (surface mount) (1N4954 through 1N4996).

$R_{\theta JEC} = 10^\circ\text{C}/\text{W}$ (max) (surface mount) (1N5968, 1N5969, 1N6632 through 1N6637).

1/ Does not apply to surface mount devices.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Defense Supply Center Columbus, ATTN: DSCC-VAT, 3990 East Broad Street, Columbus, OH 43216-5000, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements in documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document 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, cited in the solicitation (see 6.2).

SPECIFICATION

DEPARTMENT OF DEFENSE

MIL-PRF-19500 - Semiconductor Devices, General Specification for.

STANDARD

MILITARY

MIL-STD-750 - Test Methods for Semiconductor Devices.

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, 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 Qualification. Devices furnished under this specification shall be products that are authorized by the qualifying activity for listing on the applicable qualified products list before contract award (see 4.2 and 6.3).

3.2 Associated detail specification. The individual item requirements shall be in accordance with MIL-PRF-19500 and as specified herein.

3.3 Abbreviations, symbols, and definitions. The abbreviations, symbols, and definitions used herein shall be as specified in MIL-PRF-19500, and as follows.

3.3.1 Symbols.

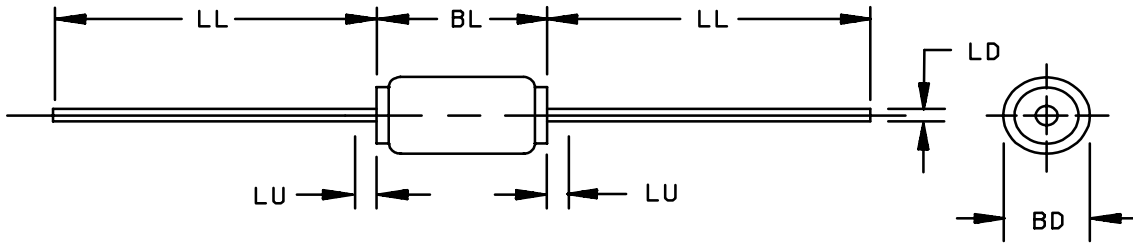
C suffix	±2 percent voltage tolerance.
D suffix	±1 percent voltage tolerance.
T _{EC}	Temperature, end cap.
US suffix	Unleaded or surface mounted devices (square end caps).
JANHC	High reliability product assurance level for unencapsulated devices.
JANKC.....	Space reliability product assurance level for unencapsulated devices.

3.4 Design, construction, and physical dimensions. The design, construction, and physical dimensions for the purpose of interchangeability shall be as specified in on figures 1, 2, 3, and 4 herein.

3.4.1 Construction. Shall be in accordance with MIL-PRF-19500, A.3.15.1, A.3.15.2, A.3.15.3, A.3.15.6, A.3.15.7, A.3.15.8 and this document. "US" version devices shall be structurally identical to the axial leaded type except for lead attachment.

3.4.1.1 Diodes with V_Z ≥ 6.8 V dc. Diodes with V_Z ≥ 6.8 V dc shall utilize category I metallurgical bonds (see MIL-PRF-19500).

3.4.1.2 Diodes with V_Z < 6.8 V dc. Diodes with V_Z < 6.8 V dc may utilize category I, II, or category III metallurgical bonds (see MIL-PRF-19500).

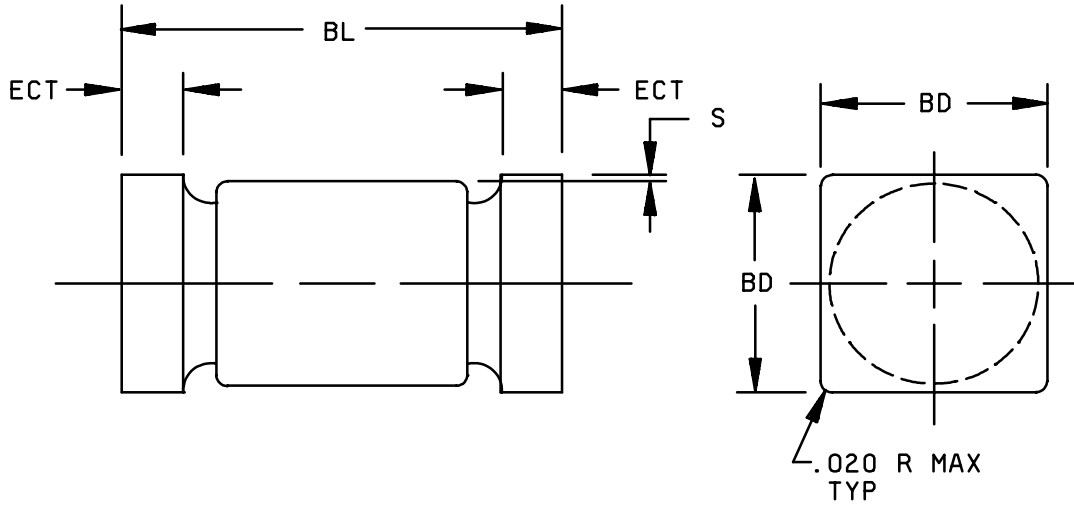


Dimensions					
Ltr	Inches		Millimeters		Notes
	Min	Max			
BL	.130	.300	3.30	4.95	
BD	.090	.145	2.92	4.70	
LL	1.00	1.300	25.40	33.02	
LU		.050		1.27	4
LD	.037	.043	0.94	1.89	3

NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Dimensions BD shall be measured at the largest diameter.
4. Dimension LU defines region of uncontrolled diameter.

FIGURE 1. Physical dimensions, non-surface mount devices.



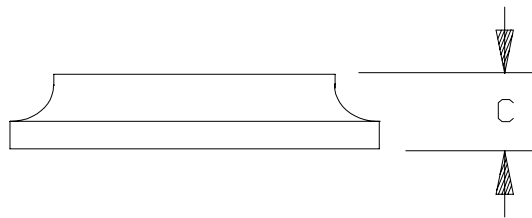
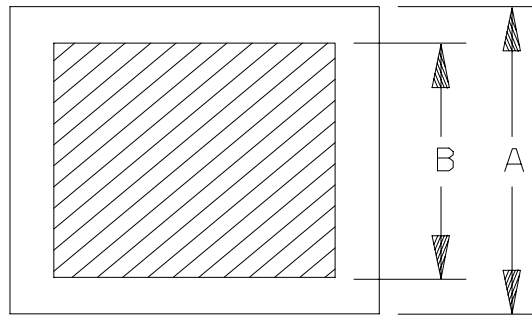
Dimensions				
Ltr	Inches		Millimeters	
	Min	Max	Min	Max
BL	.200	.225	5.08	5.72
ECT	.019	.028	0.48	0.71
S	.003	---	0.08	---
BD	.137	.148	3.48	3.76

NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only.

FIGURE 2. Physical dimensions (surface mount devices).

MIL-PRF-19500/356F



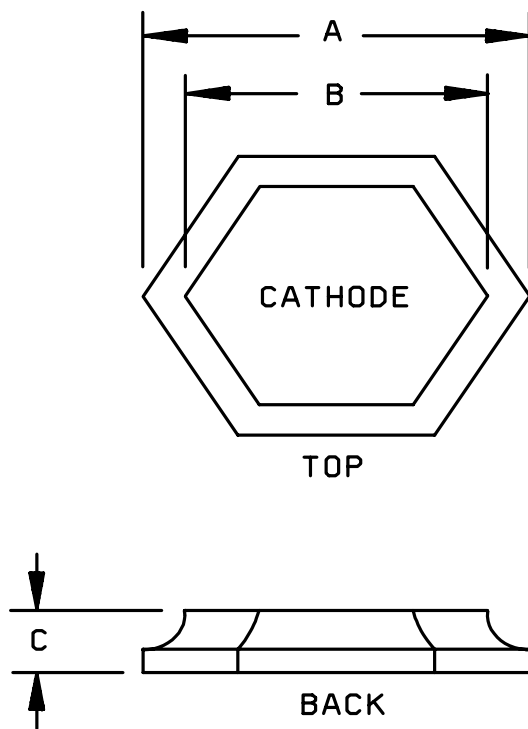
A version

Ltr	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
A	.059 sq	.072 sq	1.50 sq	1.83 sq
B	.056 sq	.065 sq	1.42 sq	1.65 sq
C	.006	.012	0.15	0.30

NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Metallization: Top (cathode) - Silver.
Back (anode) - Silver.
(See 3.4.3)

FIGURE 3. Physical dimensions JANHCA and JANKCA (die).



B Version

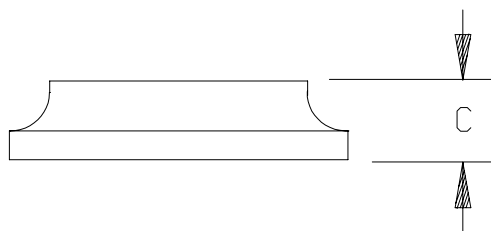
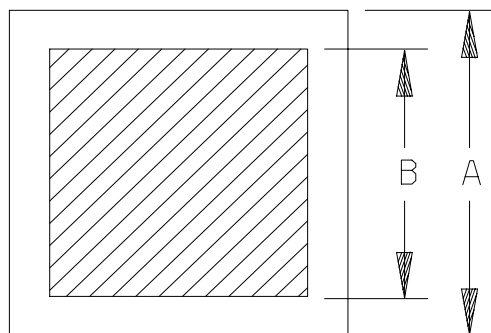
Type	Inches		Millimeters	
	Min	Max	Min	Max
A	.085	.102	2.16	2.59
B	.072	.091	1.83	2.31
C	.007	.012	0.18	0.30

NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Metallization: Top (cathode) - Aluminum.
Back (anode) - Gold.
See 3.4.3.

FIGURE 4. Physical dimensions JANHCB and JANKCB (die).

MIL-PRF-19500/356F



C version

Type	Inches		Millimeters	
	Min	Max	Min	Max
A	.062 sq	.064 sq	1.57 sq	1.63 sq
B	.052 sq	.056 sq	1.32 sq	1.42 sq
C	.007	.012	0.18	0.30

NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Metallization: Top - AL.
Back - AU.
(See 3.4.3)
4. Backside is Anode on 1N4954 through 1N4996.
5. Backside is Cathode on 1N5968, 1N5969, AND 1N6632 THROUGH 1N6637.

FIGURE 5. Physical dimensions JANHCC and JANKCC (die).

3.4.2 Lead finish. Lead finish shall be solderable in accordance with MIL-PRF-19500, MIL-STD-750, and herein. Where a choice of lead finish is desired, it shall be specified in the acquisition document (see 6.2).

3.4.3 JANHC and JANKC metallization. Metallization on JANHC and JANKC is optional and may be specified on the purchase order.

3.5 Marking. Devices shall be marked as specified in MIL-PRF-19500.

3.5.1 Marking for US suffix devices. For US suffix devices only, all marking (except see 3.6 below) may be omitted from the body, but shall be retained on the initial container.

3.5.2 Marking for JANHC and JANKC die. Marking of JANHC and JANKC die shall be in accordance with MIL-PRF-19500.

3.6 Polarity. The polarity of all types shall be indicated with a contrasting color band to denote the cathode end or the use of other techniques considered commercial practice. Alternatively, for US suffix devices, a minimum of three contrasting color dots spaced around the periphery on the cathode end may be used.

3.6.1 Polarity of JANHC and JANKC devices. Polarity marking is not required on JANHC or JANKC devices. All marking shall be retained on the initial container.

3.7 Selection of tight tolerance devices. The C and D suffix devices shall be selected from JAN, JANTX, JANTXV, JANJ or JANS devices which have successfully completed all applicable screening, and groups A, B, and C testing as ± 5 percent tolerance devices. All sublots of C and D suffix devices shall pass group A, subgroup 2 at the tightened tolerances.

3.8 Electrical performance characteristics. Unless otherwise specified herein, the electrical performance characteristics are as specified in 1.3, 1.4 and table I.

3.9 Electrical test requirements. The electrical test requirements shall be the subgroups specified in 4.4.2, 4.4.3 and table I.

3.10 Qualification. Devices furnished under this specification shall be products that are authorized by the qualifying activity for listing on the applicable qualified products list before contract award (see 4.2 and 6.3).

4. QUALITY ASSURANCE PROVISIONS

4.1 Classification of inspection. The inspection requirements specified herein are classified as follows:

- a. Qualification inspection (see 4.2).
- b. Screening (see 4.3).
- c. Conformance inspection (see 4.5).

4.2 Qualification inspection. Qualification inspection shall be in accordance with MIL-PRF-19500.

4.2.1 JANJ devices. For JANJ level, 3.3.1 through 3.3.1.3 of MIL-PRF-19500 shall apply, except as modified herein. Supplier imposed requirements as well as alternate screens, procedures, and/or controls shall be documented in the QM plan and must be submitted to the Qualifying Activity for approval. When alternate screens procedures, and/or controls are used in lieu of the JANJ screens herein equivalency shall be proven and documented in the QM Plan. Radiation characterization may be submitted in the QM plan at the option of the manufacturer, however, paragraph 3.3.1.1 of MIL-PRF-19500 is not required. Die lot controls and rework requirements shall be in accordance with MIL-PRF-19500 paragraphs 3.13 and D.3.13.2.1 for JANS level. Lot formation and conformance inspection requirements for JANJ shall be those used for JANTXV devices as a minimum

MIL-PRF-19500/356F

4.3 Screening (all levels). Screening shall be in accordance with appendix E table IV of MIL-PRF-19500, and as specified herein. The following measurements shall be made in accordance with table I herein. Devices that exceed the limits of table I herein shall not be acceptable.

Screen (see table IV of MIL-PRF-19500)	Measurements		
	JANS Level	JANJ	JANTX and JANTXV Levels
1a	Required	Not Required	Not Required
1b	Required	Required	Required (JANTXV only)
2	Not Required	Not Required	Not Required
3a	Required	Required	Required
3b	Not Applicable	Not Applicable	Not Applicable
3c	Thermal impedance, see 4.6.2	Thermal impedance, see 4.6.2	Thermal impedance, see 4.6.2
4	Not Applicable	Not Applicable	Not Applicable
5	Not Applicable	Not Applicable	Not Applicable
6	Not Applicable	Not Applicable	Not Applicable
7	Hermetic seal, gross leak	Hermetic seal, gross leak	Hermetic seal, gross leak
8	Required	Not Required	Not Required
9	I _{R1} and V _Z	Not applicable	Not applicable
10	Not Applicable	Not Applicable	Not Applicable
11	I _{R1} and V _Z ΔI _{R1} ≤ ±100 percent of initial reading or 250 nA dc, whichever is greater. ΔV _Z ≤ ±2.5 percent of initial reading.	I _{R1} and V _Z	I _{R1} and V _Z
12	Required	Required T = 240 hours	Required
	See 4.4	See 4.4	See 4.4
13 <u>2/</u> <u>3/</u>	Required	Required	Required
	Subgroups 2 and 3 of table I herein; ΔI _{R1} (max) ≤ ±100 percent of initial reading or 250 nA, whichever is greater; ΔV _Z ≤ ±2.5 percent of initial reading.	Subgroups 2 and 3 of table I herein; ΔI _{R1} (max) ≤ ±100 percent of initial reading or 250 nA, whichever is greater; ΔV _Z ≤ ±2.5 percent of initial reading.	Subgroups 2 of table I herein; ΔI _{R1} (max) ≤ ±100 percent of initial reading or 250 nA, whichever is greater; ΔV _Z ≤ ±2.5 percent of initial reading.
14a	Not Applicable	Not Applicable	Not Applicable
14b	Optional <u>1/</u>	Optional <u>1/</u>	Optional <u>1/</u>
15	Required	Not Required	Not Required
16	Required	Required	Not Required
17	Not Required	Required Subgroup 2 of table I herein Verify polarity	Not Required

1/ This test shall be performed anytime after screen 3.

2/ Thermal impedance not applicable, if already performed 100%.

$$\text{Leaded devices: } T_J = [P_T \times R_{\Theta_{JL}}] + T_L \quad \text{"US" devices } T_J = [P_T \times R_{\Theta_{J \text{ endcap}}}] + T_{\text{endcap}}$$

4.3.1 Screening (JANHC and JANKC). Screening of JANHC and JANKC die shall be in accordance with MIL-PRF-19500, appendix G.

4.4 Power burn-in conditions. Power burn-in conditions are as follows:

$I_z \geq 25$ percent of column 8 ($I_{z(M)}$) of table IV.

The test current (I_z) shall be adjusted to achieve a junction temperature of $T_J = +175^\circ\text{C} +25^\circ\text{C}, -30^\circ\text{C}$. The diode shall be suspended in a free air ambient temperature equal to or greater than $+25^\circ\text{C}$ and equal to or less than $+100^\circ\text{C}$. The mounting clips for leaded devices shall be a minimum of .375 inch (9.53 mm) from the device body; for "US" suffix devices, the mounting clips shall contact the endcaps with $T_A = +125^\circ\text{C}$ maximum.

4.5 Conformance inspection. Conformance inspection shall be in accordance with MIL-PRF-19500 and as specified herein.

4.5.1 Group A inspection. Group A inspection shall be conducted in accordance with appendix E, table V, MIL-PRF-19500, and table I herein. End-point electrical measurements shall be in accordance with the applicable steps of table III herein.

4.5.2 Group B inspection. Group B inspection shall be conducted in accordance with the conditions specified for subgroup testing in appendix E, table VIa (JANS) and table VIb (JAN, JANTX and JANTXV) of MIL-PRF-19500, and as follows. Electrical measurements (end-points) and delta requirements shall be in accordance with the applicable steps of table III herein.

4.5.2.1 Group B inspection, table VIa (JANS) of MIL-PRF-19500.

Subgroup	Method	Conditions
B4	1037	$I_z = 40$ percent of column 8 of table IV; $L = .375$ inch (9.53 mm), $t_{on} = t_{off} = 3$ minutes minimum for 2,000 cycles. No heat sink or forced air cooling on the devices shall be permitted. Leaded samples from the same lot may be used in lieu of the U suffix sample life test.
B5	1027	$I_z = 40$ percent of column 8 of table IV for 96 hours. $T_A = +125^\circ\text{C}$ or adjusted as required, to give an average lot $T_J = +275^\circ\text{C}$. (frequency of test is per wafer lot) or. $I_z = 40$ percent of column 8 of table IV for 1000 hours. $T_J = 175^\circ\text{C}$ (min). $T_A = 30^\circ\text{C} \pm 5^\circ\text{C}$ (frequency is per inspection lot). Leaded samples from the same lot may be used in lieu of the U suffix sample life test.
B6	4081 or 3101	$R_{\theta JEC} = 7^\circ\text{C}/\text{W}$ (surface mount), $R_{\theta JL} = 22^\circ\text{C}/\text{W}$ (max) at $L = .375$ inch (9.53 mm); reference temperature (T_R) point at $L = .375$ inch (9.53 mm); $L = 0$ (surface mount devices); $+25^\circ\text{C} < T_A < +35^\circ\text{C}$. (See 4.6.6).

4.5.2.2 Group B inspection, table VIb (JAN, JANTX and JANTXV) of MIL-PRF-19500.

Subgroup	Method	Conditions
B2	4066	$I_{zSM} =$ column 10 of table IV, 5 surges, 1 per minute, 1/120 second duration superimposed on $I_z =$ column 5 of table IV (mounting conditions to be as specified in MIL-STD-750, method 1026).
B3	1027	Leaded samples from the same lot may be substituted for "US" devices (see paragraph 4.4).

4.5.3 Group C inspection. Group C inspection shall be conducted in accordance with the conditions specified for subgroup testing in appendix E, table VII of MIL-PRF-19500, and as follows. Electrical measurements (end-points) and delta requirements shall be in accordance with the applicable steps of table III herein.

4.5.3.1 Group C inspection, table VII of MIL-PRF-19500.

Subgroup	Method	Conditions
C2	2036	Test condition A, $t = 15 \pm 3s$, 8 pounds. Test condition E. Terminal strength not applicable to "US" suffix devices.
C6	1026	Leaded samples from the same lot may be substituted for "US" suffix devices (see paragraph 4.4).
C7	4071	$I_z =$ column 5 of table IV, $T_1 = +25^\circ C \pm 5^\circ C$, $T_2 = +125^\circ C \pm 5^\circ C$; symbol is αV_z . The sample plan for subgroup 7 is 22 devices, $c = 0$. The maximum limits are column 14 of table IV (See 4.5.5).

4.5.1 Group E inspection. Group E inspection shall be conducted in accordance with appendix E, table IX of MIL-PRF-19500 and table II herein.

4.5.2 JANHC and JANKC devices. Qualification for JANHC and JANKC devices shall be as specified in appendix H of MIL-PRF-19500.

4.6 Methods of inspection. Methods of inspection shall be as specified in the appropriate tables and as follows.

4.6.1 Pulse measurements. Unless otherwise specified herein, conditions for pulse measurements shall be as specified in section 4 of MIL-STD-750.

4.6.2 Thermal impedance ($Z_{\theta JX}$ measurements). The $Z_{\theta JX}$ measurements shall be performed in accordance with MIL-STD-750, method 3101. Read and record data ($Z_{\theta JX}$) shall be supplied to the qualifying activity on one lot (random sample of 500 devices minimum). Twenty-two of these samples shall be serialized and they shall be provided to the qualifying activity for test correlation prior to implementation date on this specification or prior to shipments as applicable.

- a. I_M measurement current. 1 mA minimum, 10 mA maximum.
- b. I_H forward heating current. 5 A minimum to 20 A maximum.
- c. t_H heating time 10 ms.
- d. t_{MD} measurement delay time. 100 μs maximum.

4.6.3 Regulator voltage (V_z). Regulator voltage shall be measured in accordance with MIL-STD-750, method 4022, except that the test shall be performed by the pulse method with $t_p = 0.2$ ms to 300 ms. The thermal equilibrium requirement does not apply. For JANHC and JANKC, this measurement shall be made with the chip resting on a metal heat sink maintained at $+25^\circ C \pm 3^\circ C$. For tight tolerance "C" and "D" suffix devices, see 3.7.

4.6.4 Voltage regulation (V_z (reg)). The breakdown voltage shall be measured at $I_z = 10$ percent of column 8 of table IV and at $I_z = 50$ percent of column 8 of table IV. The difference between these voltages shall then be determined and shall not exceed column 9 of table IV. The voltage measurement at $I_z = 10$ percent of column 8 of table IV shall be a pulse measurement in accordance with 4.6.1. The measurement at $I_z = 50$ percent of column 8 of table IV shall be made after current has been applied for 30 ± 3 seconds. For this time interval, the device shall be suspended in free air by its leads with mounting clips with inside edge .375 inch (9.53 mm) from the body, and the point of connection shall be maintained at a temperature of $+25^\circ C$, $+8^\circ C$, $-2^\circ C$. No forced air across the device shall be permitted. US suffix devices shall be mounted with the end caps maintained at $+25^\circ C$, $+8^\circ C$, $-2^\circ C$. For JANHC and JANKC, the die shall be stabilized at $+25^\circ C$ and the test shall be performed utilizing pulse conditions. The ΔV_z measurement may be performed after a shorter time interval following application of the test current if correlation can be established to the satisfaction of the Government.

4.6.5 Temperature coefficient of regulator voltage (αV_z). The device shall be temperature stabilized with current applied prior to reading regulator voltage at the specified ambient temperature.

4.6.6 Thermal resistance. Thermal resistance (not applicable to JANHC and JANKC devices) shall be measured in accordance with MIL-STD-750, method 3101 or 4081. Read and record data in accordance with group E herein and shall be included in the qualification report. Forced moving air or draft shall not be permitted across the device during test. The maximum limit for $R_{\theta JL}$ or $R_{\theta JEC}$ under these conditions shall be specified in 1.4. The following conditions shall apply:

$I_H = 2.0$ A dc minimum.

$I_M = 1$ mA minimum, 10 mA maximum.

$t_{MD} = 100$ μ s maximum.

$t_H =$ thermal equilibrium.

The devices shall be allowed to reach thermal equilibrium at current I_H before the measurement shall be made.

Lead spacing: $LS = .375$ inch (9.53 mm) for leaded devices (see figure 4).
 $LS = 0$ inches (end cap mount) for US suffix devices.

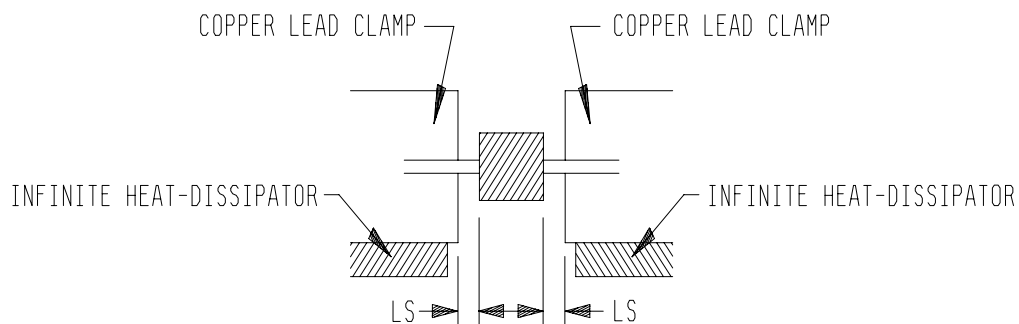


FIGURE 4. Mounting arrangement.

TABLE I. Group A inspection.

Inspection 1/ 	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 1</u>						
Visual and mechanical inspection	2071					
<u>Subgroup 2</u>						
Thermal impedance 2/ 1N4954 through 1N4996 1N5968, 1N5969 1N6632 through 1N6637	3101	See 4.6.2	$Z_{\theta JX}$		1.8 3.0 3.0	$^{\circ}\text{C/W}$
Forward voltage	4011	$I_F = 1 \text{ A dc}$	V_F		1.5	V dc
Reverse current	4016	DC method; $V_R =$ column 11 of table IV	I_{R1}		Column 12 of table IV	$\mu\text{A dc}$
Regulator voltage (pulsed) (see 4.6.1 and 4.6.3)	4022	$I_Z =$ column 5 of table IV; $0.2 \text{ ms} \leq t_p \leq 300 \text{ ms}$	V_Z	Column 3 of table IV	Column 4 of table IV	V dc
<u>Subgroup 3</u>						
High temperature operation:		$T_A = +150^{\circ}\text{C}$				
Reverse current	4016	DC method; $V_R =$ column 11 of table IV; pulsed (see 4.5.1)	I_{R2}		Column 14 of table IV	$\mu\text{A dc}$
<u>Subgroup 4</u>						
Small-signal reverse breakdown impedance	4051	$I_Z =$ column 5 of table IV $I_{\text{sig}} = 10 \text{ percent of } I_Z$	Z_Z		Column 6 of table IV	Ω
Knee impedance	4051	$I_{ZK} =$ column 16 of table IV $I_{\text{sig}} = 10 \text{ percent of } I_{ZK}$	Z_{ZK}		Column 7 of table IV	Ω
<u>Subgroup 5</u>						
(Not applicable)						

See footnotes at end of table.

TABLE I. Group A inspection - Continued.

Inspection <u>1/</u>	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 6</u>		JANS level only				
Surge current	4066	I_{ZSM} = column 10 of table IV; 5 surges, 1 per minute, 1/120 second duration superimposed on I_Z = column 5 of table IV	I_{ZSM}			
End-point electrical measurements		See table III, steps 1, 4 and 5				
<u>Subgroup 7</u>						
Voltage regulation (see 4.6.4)		I_Z = 10 percent to 50 percent of column 8 of table IV	V_Z (reg)		Column 9 of table IV	V dc
Temperature coefficient of regulator voltage (See 4.6.5)	4071	JANS level only I_Z = column 5 of table IV $T_1 = +25^\circ\text{C} \pm 5^\circ\text{C}$; $T_2 = +120^\circ\text{C} \leq T_2 \leq +130^\circ\text{C}$	$\propto V_Z$		Column 13 of table IV	%/°C

1/ For sampling plan, see MIL-PRF-19500.

2/ Not applicable to JANHC and JANKC devices.

MIL-PRF-19500/356F

TABLE II. Group E inspection (all quality levels except JANHC and JANKC) for qualification only.

Inspection ^{1/}	MIL-STD-750		Sampling plan
	Method	Conditions	
<u>Subgroup 1</u>			22 devices c = 0
Thermal shock	1056	500 cycles, condition A	
Electrical measurements		See table III, steps 1, 3, 4, and 6	
<u>Subgroup 2</u>			22 devices c = 0
Intermittent operation life	1037	I _z = 40 percent of column 8 of table IV; T _L = +95°C minimum, L = .375 inch (9.53 mm), t _{on} = t _{off} = 3 minutes minimum for 10,000 cycles. No heat sink or forced air cooling on the devices shall be permitted (see 4.3.2).	
Electrical measurements		See table III, steps 2, 3, 4, 5, and 6	
<u>Subgroup 3</u>			
Not applicable			
<u>Subgroup 4</u>			22 devices c = 0
Thermal resistance (see 4.6.6)	3101 or 4081	R _{QJL} = 22°C/W (max) at L = .375 inch (9.53 mm); R _{θJEC} = 7°C/W (surface mount); reference temperature (T _R) point at L = .375 inch (9.53 mm); L = 0 (surface mount devices); +25°C < T _R < +35°C.	
<u>Subgroup 5</u>			22 devices c = 0
Barometric pressure (reduced)	1001	V _R = column 11 of table IV, (1N4990 - 1N4996 only) pressure = 8 mm Hg	

^{1/} Unless otherwise specified, for sampling plan, see MIL-PRF-19500.

TABLE III. Groups A, B, C, and E electrical measurements. 1/ 2/ 3/

Step	Inspection	MIL-STD-750		Symbol	Limits		Unit
		Method	Conditions		Min	Max	
1	Reverse current	4016	DC method; V_R = column 11 of table IV	I_{R1}		Column 12 of table IV	μ A dc
2	Regulator voltage (see 4.6.3)	4022	I_Z = column 5 of table IV	V_Z	Column 3 of table IV	Column 4 of table IV	V dc
3	Small signal breakdown impedance 1N5968 only	4051	I_Z = column 5 of table IV, I_{sig} = 10 percent of I_Z I_{SIG} = .5 mA ac	Z_Z		Column 6 of table IV	Ω
4	Knee impedance	4051	I_{ZK} = column 16 of table IV;	Z_{ZK}		Column 7 of table IV	Ω
5	Forward voltage	4011	I_F = 1.0 A dc, pulsed	ΔV_F <u>4/</u>		≤ 50 mV dc change from previous measured value	

1/ The electrical measurements for appendix E, table VIa (JANS) of MIL-PRF-19500 are as follows:

- a. Subgroup 3, see table III herein, steps 1, 2, 3, 4, and 5.
- b. Subgroup 4, see table III herein, steps 1, 2, 3, 4, and 5.
- c. Subgroup 5, see table III herein, steps 2, 3, 4, and 5.

2/ The electrical measurements for appendix E, table VIb (JAN, JANTX, and JANTXV) of MIL-PRF-19500 are as follows:

- a. Subgroup 2, see table III herein, steps 2, and 3.
- b. Subgroup 3, see table III herein, steps 2, and 3.
- c. Subgroup 6, see table III herein, steps 2, and 3.

3/ The electrical measurements for appendix E, table VII of MIL-PRF-19500 are as follows:

- a. Subgroup 2, see table III herein, steps 1, 2, 3, 4, and 5 (JANS) and 1, 2, and 3 for (JAN, JANTX, and JANTXV).
- b. Subgroup 6, see table III herein, steps 1, 2, 3, 4, and 5 (JANS) and steps 1, 2, and 3 (JAN, JANTX, and JANTXV).

4/ Devices which exceed the group A limits, for this test, shall not be accepted.

MIL-PRF-19500/356F

TABLE IV. Test ratings for diodes, types 1N4954 through 1N4996, 1N5968, 1N5969, 1N6632 through 1N6637.

Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6	Col. 7	Col. 8	Col. 9	Col. 10	Col. 11	Col. 12	Col. 13	Col. 14	Col. 15
Type device 1/ 2/	V _Z Nom	V _Z Min 2/ 3/	V _Z Max 2/ 3/	I _Z T _A = +25°C test current	Z _Z Imped- ance	Z _K Knee Imped- ance	I _Z Max dc current T _A = +25°C	V _Z (reg) Voltage regulation	I _{ZSM} T _A = +25°C	V _R Re- verse voltage	I _{R1} Reverse current dc	αV _Z Temp. coefficient	I _{R2} Reverse current dc T _A = +150°C	I _{ZK} Test current
	V	V	V	mA	Ω	Ω	mA	V	A	V	μA	%/°C	μA	mA
1N6632	3.3	3.14	3.46	380	3	500	1,440	0.9	20.0	1.0	300	-.075	2,500	5.0
1N6633	3.6	3.42	3.78	350	2.5	500	1320	0.8	18.7	1.0	500	-.070	1000	5.0
1N6634	3.9	3.71	4.09	320	2	500	1220	0.75	17.6	1.0	175	-.060	500	5.0
1N6635	4.3	4.09	4.51	290	2	500	1,100	.70	16.4	1.0	25	-.050	500	"
1N6636	4.7	4.47	4.93	260	2	450	1,010	.60	15.3	1.0	20	±.025	500	"
1N6637	5.1	4.85	5.35	240	1.5	400	930	.50	14.4	1.0	5	±.030	500	"
1N5968	5.6	5.32	5.88	220	1	400	865	.4	20	4.28	5,000	.040	15,000	"
1N5969	6.2	5.89	6.51	220	1	1,000	765	.5	20	4.74	1,000	.040	4,000	1.0
1N4954	6.8	6.46	7.14	175	1	1,000	700	.7	40	5.2	150	.05	750	"
1N4955	7.5	7.13	7.87	175	1.5	800	630	.7	32	5.7	100	.06	500	"
1N4956	8.2	7.79	8.61	150	1.5	600	580	.7	24	6.2	50	.06	300	"
1N4957	9.1	8.65	9.55	150	2	400	520	.7	22	6.9	25	.06	200	"
1N4958	10	9.50	10.50	125	2	125	475	.8	20	7.6	25	.07	200	"
1N4959	11	10.45	11.55	125	2.5	130	430	.8	19	8.4	10	.07	150	"
1N4960	12	11.40	12.60	100	2.5	140	395	.8	18	9.1	10	.07	150	"
1N4961	13	12.35	13.65	100	3	145	365	.9	16	9.9	10	.08	150	"
1N4962	15	14.25	15.75	75	3.5	150	315	1.0	12	11.4	5.0	.08	100	"
1N4963	16	15.20	16.80	75	3.5	155	294	1.1	10	12.2	5.0	.08	"	"
1N4964	18	17.10	18.90	65	4	160	264	1.2	9.0	13.7	5.0	.085	"	"
1N4965	20	19.0	21.0	65	4.5	165	237	1.5	8.0	15.2	2	.085	"	"
1N4966	22	20.9	23.1	50	5	170	216	1.8	7.0	16.7	"	.085	"	"

See footnotes at end of table.

MIL-PRF-19500/356F

TABLE IV. Test ratings for diodes, types 1N4954 through 1N4996, 1N5968, 1N5969, 1N6632 through 1N6637 - Continued.

Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6	Col. 7	Col. 8	Col. 9	Col. 10	Col. 11	Col. 12	Col. 13	Col. 14	Col. 15
Type device 1/ 2/	V _Z Nom	V _Z Min 2/ 3/	V _Z Max 2/ 3/	I _Z T _A = +25°C test current	Z _Z Imped ance	Z _K Knee Imped- ance	I _Z Max dc current T _A = +25°C	V _Z (reg) Voltage regulation	I _{ZSM} T _A = +25°C	V _R Reverse voltage	I _{R1} Reverse current dc	αV _Z Temp. coeffi- cient	I _{R2} Reverse current dc T _A = +150°C	I _{ZK} Test current
	V	V	V	mA	Ω	Ω	mA	V	A	V	μA	%/°C	μA	mA
1N4967	24	22.8	25.2	50	5	175	198	2.0	6.5	18.2	"	.09	"	"
1N4968	27	25.7	28.3	50	6	180	176	2.0	6.0	20.6	"	.09	"	"
1N4969	30	28.5	31.5	40	8	190	158	2.5	5.5	22.8	"	.09	"	"
1N4970	33	31.4	34.6	40	10	200	144	2.8	5.0	25.1	"	.095	"	"
1N4971	36	34.2	37.8	30	11	220	132	3.0	4.5	27.4	"	"	"	"
1N4972	39	37.1	40.9	30	14	230	122	3.0	4.0	29.7	2	.095	100	1.0
1N4973	43	40.9	45.1	30	20	240	110	3.3	3.5	32.7	"	"	"	"
1N4974	47	44.7	49.3	25	25	250	100	3.5	3.2	35.8	"	"	"	"
1N4975	51	48.5	53.5	25	27	270	92	4.0	3.0	38.8	"	"	"	"
1N4976	56	53.2	58.8	20	35	320	84	4.4	2.8	42.6	"	"	"	"
1N4977	62	58.9	65.1	20	42	400	76	5.0	2.5	47.1	"	.100	"	"
1N4978	68	64.6	71.4	20	50	500	70	5.5	2.2	51.7	"	"	"	"
1N4979	75	71.3	78.7	20	55	620	63	6.0	2.0	56	"	"	"	"
1N4980	82	77.9	86.1	15	80	720	58	6.6	1.8	62.2	"	"	"	"
1N4981	91	86.5	95.5	15	90	760	52.5	7.5	1.6	69.2	"	"	"	"
1N4982	100	95.0	105	12	110	800	47.5	8.0	1.4	76.0	"	"	"	"
1N4983	110	104.5	115.5	12	125	1,000	43	9.0	1.2	83.6	"	"	"	"
1N4984	120	114	126	10	170	1,150	39.5	10	1.0	91.2	"	"	"	"
1N4985	130	123.5	136.5	10	190	1,250	36.6	11	.8	98.8	"	.105	"	"
1N4986	150	142.5	157.5	8	330	1,500	31.6	13	.75	114.0	"	.105	"	"
1N4987	160	152	168	8	350	1,650	29.4	14	.70	121.6	"	.105	"	"
1N4988	180	171	189	5	450	1,750	26.4	16	.60	136.8	"	.110	"	"
1N4989	200	190	210	"	500	1,850	23.6	18	.50	152.0	"	.110	"	"
1N4990	220	209	231	"	550	2,000	21.6	19	.50	167	"	.115	"	"

See footnotes at end of table.

MIL-PRF-19500/356F

TABLE IV. Test ratings for diodes, types 1N4954 through 1N4996, 1N5968, 1N5969, 1N6632 through 1N6637 - Continued.

Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6	Col. 7	Col. 8	Col. 9	Col. 10	Col. 11	Col. 12	Col. 13	Col. 14	Col. 15
Type device 1/ 2/	V _Z Nom	V _Z Min 2/ 3/	V _Z Max 2/ 3/	I _Z T _A = +25°C test current	Z _Z Imped- ance	Z _K Knee Imped- ance	I _Z Max dc current T _A = +25°C	V _Z (reg) Voltage regulation	I _{ZSM} T _A = +25°C	V _R Re- verse voltage	I _{R1} Reverse current dc	αV _Z Temp. coefficient	I _{R2} Reverse current dc T _A = +150°C	I _{ZK} Test current
	V	V	V	mA	Ω	Ω	mA	V	A	V	μA	%/°C	μA	mA
1N4991	240	228	252	"	650	2,050	19.8	22	.40	182	"	.115	"	"
1N4992	270	257	283	"	800	2,100	17.5	25	.35	206	"	.120	"	"
1N4993	300	285	315	4	950	2,150	15.6	28	.30	228	"	"	"	"
1N4994	330	314	346	4	1175	2,200	14.4	32	.25	251	"	"	"	"
1N4995	360	342	378	3	1400	2,300	13	35	.22	274	"	"	"	"
1N4996	390	371	409	3	1800	2,500	12	40	.20	297	"	"	"	"

1/ Unless otherwise specified, ratings apply to all case outlines.

2/ Voltage tolerance devices (examples: 1N6632 is ±5 percent, 1N6632C is ±2 percent, and 1N6632D is ±1 percent tolerance).

3/ Min/max shown only for ±5% tolerance.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of material is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Points' packaging activity within the Military Department or Defense Agency, or within the Military Departments' System Command. Packaging data retrieval is available from the managing Military Departments' or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

5.2 Marking. Unless otherwise specified (see 6.2), marking shall be in accordance with MIL-STD-129.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Notes. The notes specified in MIL-PRF-19500 are applicable to this specification.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Issue of DODISS to be cited in the solicitation.
- b. Lead finish as specified (see 3.3.1).
- c. Product assurance level and type designator.

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Manufacturers List QML-19500 whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or purchase orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from Defense Supply Center Columbus, ATTN: DSCC-VQE, 3990 East Broad Street, Columbus, OH 43216-5000.

6.4 Suppliers of JANHC and JANKC die. The qualified JANHC and JANKC suppliers with the applicable letter version (example: JANHCA1N4954) will be identified on the QPL.

JANHC and JANKC ordering information			
PIN	Manufacturer		
	12969	66891	55801
1N4954 through 1N4996	JANHCA1N4954 through JANHCA1N4996	JANHCA1N4954 through JANHCA1N4996	JANHCA1N4954 through JANHCA1N4996
1N4954 through 1N4996	JANKCA1N4954 through JANHCA1N4996	JANKCB1N4954 through JANHCB1N4996	JANKCC1N4954 through JANHCC1N4996
1N5968 and 1N5969			JANHCC1N5968 and JANHCC1N5969
1N5968 and 1N5969			JANKCC1N5968 and JANKCC1N5969
1N6632 through 1N6637			JANHCC1N6632 through JANHCC1N6637
1N6632 through 1N6637			JANKCC1N6632 -through JANKCC1N6637

6.5 Substitutability of 2 percent and 1 percent tolerance devices. Devices of tighter tolerance are a direct one way substitute for the looser tolerance devices (example: JANTX1N4954D substitutes for a JANTX1N4954).

6.6 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

CONCLUDING MATERIAL

Custodians:

Army - CR
Navy - EC
Air Force - 11
NASA - NA
DLA - CC

Preparing activity:
DLA - CC

(Project 5961-2097)

Review activities:

Army - AR, AV, MI, SM
Navy - AS
Air Force - 13, 19

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER MIL-PRF-19500/356F	2. DOCUMENT DATE (YYMMDD)
------------------------------	---	----------------------------------

3. DOCUMENT TITLE
SEMICONDUCTOR DEVICE, DIODE, SILICON, VOLTAGE REGULATOR TYPES 1N4954 THROUGH 1N4996, 1N5968, 1N5969, AND 1N6632 THROUGH 1N6637, 1N4954US THROUGH 1N4996US, 1N5968US, 1N5969US, AND 1N6632US THROUGH 1N6637US, AND C AND D TOLERANCE SUFFIX DEVICES, JAN, JANTX, JANTXV, JANJ, JANS; JANHC AND JANKC

4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)

5. REASON FOR RECOMMENDATION

6. SUBMITTER		
a. NAME (Last, First, Middle initial)	b. ORGANIZATION	
c. ADDRESS (Include Zip Code)	d. TELEPHONE (Include Area Code) Commercial DSN FAX EMAIL	7. DATE SUBMITTED (YYMMDD)

8. PREPARING ACTIVITY	
a. Point of contact: Alan Barone	b. TELEPHONE Commercial DSN FAX EMAIL 614-692-0510 850-0510 614-692-6939 alan_barone@dscclia.mil
c. ADDRESS: Defense Supply Center Columbus, ATTN: DSCC-VAT, 3990 East Broad Street, Columbus, OH 43216-5000	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Standardization Program Office (DLSC-LM) 8725 John J. Kingman Road, Suite 2533, Fort Belvoir, Virginia 22060-6221 Telephone (703) 767-6888 DSN 427-6888