The documentation and process conversion measures necessary to comply with this revision shall be completed by 24 February 2005.

INCH POUND

MIL-PRF-19500/356H
24 November 2004
SUPERSEDING
MIL-PRF-19500/356G
5 September 2003

PERFORMANCE SPECIFICATION SHEET

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, JANS, JANHC, AND JANKC

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

* The requirements for acquiring the product described herein shall consist of this specification sheet and MIL-PRF-19500.

1. SCOPE

1.1 Scope. This specification covers the performance requirements for silicon, voltage regulator diodes. Four 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 (axial leaded), 2 (surface mount), and 3 (die).

* 1.3 Maximum ratings. Maximum ratings are as shown in maximum test ratings herein (see 3.10) and as follows:

P_T at T_L = +65°C L = .375 inch (9.53 mm)	P_T at T_L = +25°C L = .375 inch (9.53 mm)	P_T at T_{EC} = +125°C	T_J and T_{STG}	Barometric pressure reduced (high altitude operation)
1N4954 through 1N4996	1N5968, 1N5969, 1N6632 through 1N6637	1N4954US through 1N4996US N5968US, 1N5969US, 1N6632US through 1N6637US	1N4954 through 1N4996 1N5968, 1N5969, 1N6632 through 1N6637 including US suffix	1N4954 through 1N4996 1N5968, 1N5969, 1N6632 through 1N6637 including US suffix
5 W (1)	5 W (2)	5 W (3)	-65°C to +175°C	8 mHg

(1) Derate: See figure 4 herein.
(2) Derate: See figure 5 herein.
(3) Derate: See figures 5, 6 and 7 herein.

* Comments, suggestions, or questions on this document should be addressed to Defense Supply Center, Columbus, ATTN: DSCC-VAC, P.O. Box 3990, Columbus, OH 43218-3990, or emailed to Semiconductor@dscc.dla.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at http://assist.daps.dla.mil..

* 1.4 Primary electrical characteristics. Primary electrical characteristics are as shown in maximum test ratings herein (see 3.10) and as follows:

$R_{\theta JL}$ = 22°C/W (max) L = .375 inch (9.53 mm)	$R_{\theta JL}$ = 30°C/W (max) L = .375 inch (9.53 mm)	$R_{\theta JEC}$ = 7°C/W (max) L = 0 inch	$R_{\theta JEC}$ = 10°C/W (max) L = 0 inch
1N4954 through 1N4996	1N5968, 1N5969, 1N6632 through 1N6637	1N4954US through 1N4996US	1N5968US, 1N5969US, 1N6632US through 1N6637US

2. APPLICABLE DOCUMENTS

* 2.1 General. The documents listed in this section are specified in sections 3, 4, or 5 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 of documents cited in sections 3, 4, or 5 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 cited in the solicitation or contract.

* DEPARTMENT OF DEFENSE SPECIFICATIONS

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

* DEPARTMENT OF DEFENSE STANDARDS

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

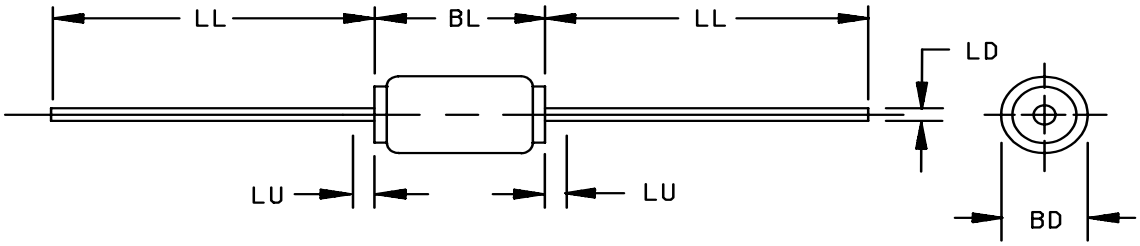
* (Copies of these documents are available online at http://assist.daps.dla.mil or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

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 General. The individual item requirements shall be as specified in MIL-PRF-19500 and as modified herein.

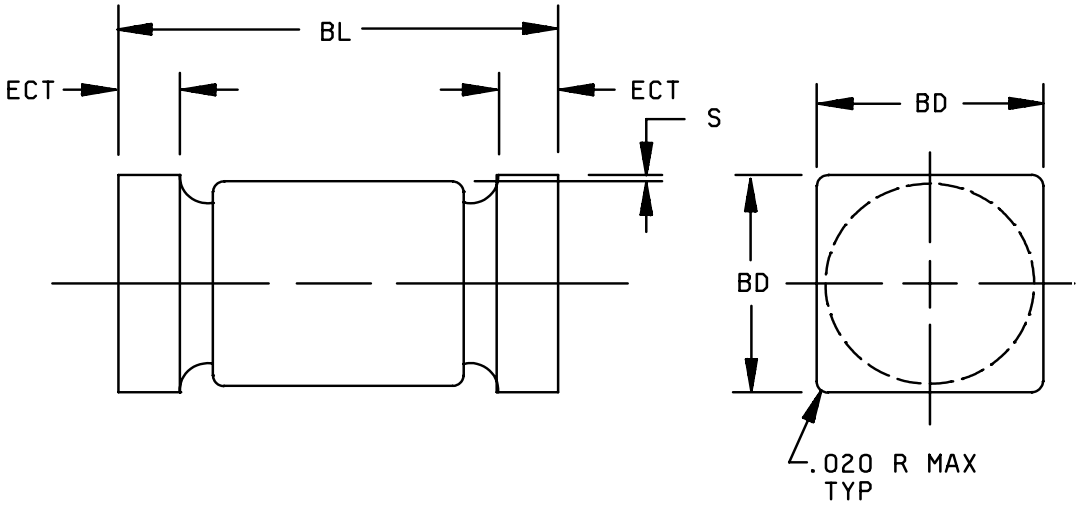
3.2 Qualification. Devices furnished under this specification shall be products that are manufactured by a manufacturer authorized by the qualifying activity for listing on the applicable qualified manufacturer's list (QML) before contract award (see 4.2 and 6.3).



Dimensions					
Ltr	Inches		Millimeters		Notes
	Min	Max	Min	Max	
BL	.130	.300	3.30	7.62	
BD	.090	.145	2.29	3.68	3
LL	1.00	1.300	25.40	33.02	
LU		.050		1.27	4
LD	.037	.043	0.94	1.09	

NOTES:
1. Dimensions are in inches.
2. Millimeters are given for general information only.
3. Dimensions BD shall be measured at the largest diameter.
4. Dimension LU defines region of uncontrolled diameter.
5. In accordance with ASME Y14.5M, diameters are equivalent to ϕx symbology..

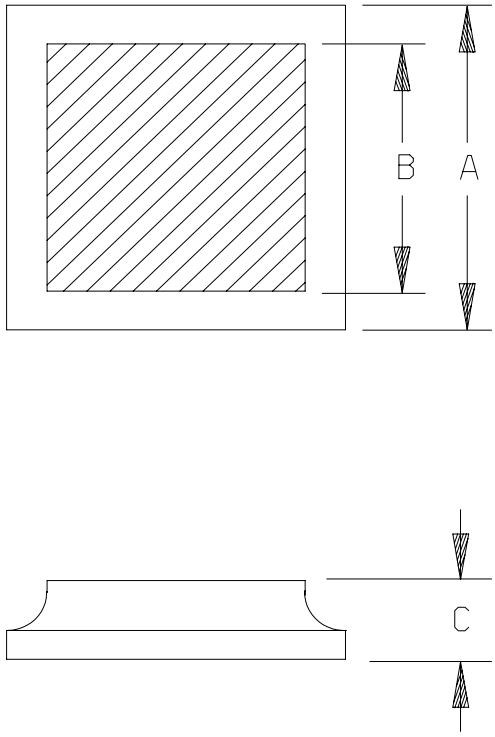
* FIGURE 1. Physical dimensions, non-surface mount devices.



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. Millimeters are given for general information only.
3. In accordance with ASME Y14.5M, diameters are equivalent to ϕx symbology.

* FIGURE 2. Physical dimensions (surface mount devices (US)) (D5B).



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. Millimeters 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.
6. In accordance with ASME Y14.5M, diameters are equivalent to ϕx symbology.

* FIGURE 3. Physical dimensions JANHCC and JANKCC (die).

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

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

3.4 Interface and physical dimensions. Interface and physical dimensions shall be as specified in MIL-PRF-19500, and on figures 1, 2, and 3 herein.

3.4.1 Construction. All devices shall be metallugically bonded, double plug construction, thermally matched, and noncavity in accordance with the requirements of MIL-PRF-19500. "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 $V_Z \leq 6.8$ V dc. Diodes with $V_Z \leq 6.8$ V dc may utilize category I, II, or category III metallurgical bonds (see MIL-PRF-19500).

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 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 3.8 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. 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, 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 table I, subgroup 2 at the tightened tolerances. Tighter tolerances for mounting clip temperature shall be maintained for reference purpose to establish correlation. For C and D tolerance levels, T_A = +25°C ±2°C at .375 inch (9.53 mm) from body for leaded devices, or zero inches for surface mount devices or equivalent.

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

3.9 Electrical test requirements. The electrical test requirements shall be the subgroups specified in table I herein.

3.10 Maximum test ratings. Test ratings for the devices specified herein shall be as shown in table IV.

3.11 Workmanship. Semiconductor devices shall be processed in such a manner as to be uniform in quality and shall be free from other defects that will affect life, serviceability, or appearance.

4. VERIFICATION

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 4.4, and tables I, II, III, and IV).

4.2 Qualification inspection. Qualification inspection shall be in accordance with MIL-PRF-19500 and as specified herein.

4.2.1 Group E qualification. Group E qualification shall be performed herein for qualification or requalification only. In case qualification was awarded to a prior revision of the associated specification that did not request the performance of table II tests, the tests specified in table II herein that were not performed in the prior revision shall be performed on the first inspection lot to this revision to maintain qualification.

4.2.2 JANHC and JANKC qualification. JANHC and JANKC qualification inspection shall be in accordance with MIL-PRF-19500, and the specification sheet.

* 4.3 Screening (JANS, JANTX, and JANTXV levels only). Screening shall be in accordance with 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	JANTX and JANTXV levels
1a 1b	Required Required	Not Required Required (JANTXV only)
2	Optional	Optional
3a 3b (1) 3c	Required Not applicable Thermal impedance see 4.3.1	Required Not applicable Thermal impedance see 4.3.1
4	Not applicable	Not applicable
5	Not applicable	Not applicable
6	Not applicable	Not applicable
7a 7b	Not applicable Optional	Not applicable Optional
8	Required	Not required
9	I_{R1} and V_Z	Not applicable
10	100 percent	Not applicable
11	I_{R1} and V_Z $\Delta I_{R1} \leq \pm 100$ percent of initial reading or 250 nA dc, whichever is greater. $\Delta V_Z \leq \pm 2.5$ percent of initial reading.	I_{R1} and V_Z
12	Required, see 4.3.2	Required, see 4.3.2
(2) 13	Required, Subgroups 2 and 3 of table I herein; ΔI_{R1} (max) $\leq \pm 100$ percent of initial reading or 250 nA, whichever is greater; $\Delta V_Z \leq \pm 2.5$ percent of initial reading. Scope display see 4.5.7.	Required, Subgroups 2 of table I herein; ΔI_{R1} (max) $\leq \pm$ 100 percent of initial reading or 25 percent of column 12 of table IV (1N6632 - 1N4964); 250 nA (1N4965 - 1N4996), whichever is greater, $\Delta V_Z \leq \pm 2.5$ percent of initial reading.
14a (3) 14b	Not applicable Required	Not applicable Required
15	Required	Not required
16	Required	Not required

(1) This test shall be performed anytime after screen 3.
(2) Thermal impedance not applicable, if already performed 100 percent.
(3) For clear glass diodes, the hermetic seal (gross leak) may be performed at any time after temperature cycling.

4.3.1 Thermal impedance ($Z_{\theta JX}$ measurements). The $Z_{\theta JX}$ measurements shall be performed in accordance with method 3101 of MIL-STD-750. The $Z_{\theta JX}$ limit shall be developed by the supplier using statistical methods and it shall not exceed the Group A limit herein.

a. I_H forward heating current. . . . . 5 A minimum to 20 A maximum.

b. t_H heating time . . . . . 10 ms.

c. I_M measurement current. . . . . 1 mA minimum, 10 mA maximum.

d. t_{MD} measurement delay time. . . . . 100 μs maximum.

4.3.2 Power burn-in conditions. Power burn-in conditions are as follows: Method 1038 of MIL-STD-750, the test current I_Z shall be adjusted to produce a junction temperature of +125°C minimum and $I_{Z(min)}$ shall be ≥ 25 percent of column 8 (I_{ZM}) of table IV, see 4.5.6. Use method 3100 to measure T_J. See 4.5.6.

* 4.3.3 Screening (JANHC and JANKC). Screening of JANHC and JANKC die shall be in accordance with MIL-PRF-19500, “Discrete Semiconductor Die/Chip Lot Acceptance”. Burn-in duration for the JANKC level follows JANS requirements, the JANHC follows JANTX requirements.

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

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

4.4.2 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.

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

Subgroup	Method	Conditions
B3	1056	0 to +100°C, 25 cycles, c = 0, n = 22.
	1051	-55 to +175°C, 100 cycles.
B4	1037	I_Z = 40 percent of column 8 of table IV.
B5	1027	Apply $I_{Z(min)} \geq$ 40 percent of column 8 of table IV. Temporary leads may be added for surface mount devices.
		Option 1: T_A = +100°C (maximum); T_J = +275°C (minimum), t = 96 hours. n = 22, c = 0.
		Option 2: T_A = +30°C (maximum); T_J +200°C (minimum); t = 1,000 hours, n = 45, c = 0.
		Option 3: T_A = +30°C (maximum); T_J +225°C (minimum); t = 216 hours n = 45, c = 0.

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

Subgroup	Method	Conditions
B2	1056	0 to +100°C, 10 cycles, c = 0, n = 22.
	1051	-55 to +175°C, 25 cycles.
B3	1027	The test current I_Z shall be adjusted to produce a junction temperature of +150°C minimum and $I_{Z(min)} \geq$ 25 percent of column 8 (I_Z)of table IV. Temporary leaded samples from the same lot may be used in lieu of the US suffix sample life test.
B5		Not applicable.

4.4.3 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.

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

Subgroup	Method	Conditions
C2	1056	0°C to +100°C, 15 cycles, n = 22 c = 0.
C2	1051	-55°C to +175°C, 25 cycles, n = 22 c = 0.
C2	2036	Tension - test condition A; 8 lbs; t = 15 s ±3 s. Lead fatigue - Test condition E. NOTE: Not applicable to US versions.
C5	3101 or 4081	See 4.5.5.
C6	1026	The test current I_Z shall be adjusted to produce a junction temperature of +150°C minimum and $I_{Z(min)} \geq 25$ percent of column 8 (I_Z)of table IV. Temporary leaded samples from the same lot may be used in lieu of the US suffix sample life test.
C7		Not applicable.
C8	4071	I_Z = column 5 of table IV, T_1 = +25°C ±5°C, T_2 = +125°C ±5°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 4.5.4).

* 4.4.4 Group E inspection. Group E inspection shall be conducted in accordance with the conditions specified for subgroup testing in appendix E, table IX of MIL-PRF-19500 and as specified herein. Electrical measurements (end-points) shall be as specified in table III.

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

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

4.5.1 Pulse measurements. Conditions for pulse measurements shall be as specified in section 4 of MIL-STD-750.

4.5.2 Regulator voltage (V_Z). Regulator voltage shall be measured in accordance with method 4022 of MIL-STD-750, 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°C ±3°C. For tight tolerance C and D suffix devices, see 3.7.

4.5.3 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 4.5.1. 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°C, +8°C, -2°C. No forced air across the device shall be permitted. US suffix devices shall be mounted with the end caps maintained at +25°C, +8°C, -2°C. For JANHC and JANKC, the die shall be stabilized at +25°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.

4.5.4 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.

* 4.5.5 Thermal resistance. Thermal resistance (not applicable to JANHC and JANKC devices) shall be measured in accordance with method 3101 or 4081 of MIL-STD-750. Read and record data in accordance with 4.4.1 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:

a. I_H = 2.0 A dc minimum.

b. t_H = thermal equilibrium.

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

d. t_{MD} = 100 μs maximum.

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 8).
LS = 0 inches (end cap mount) for US suffix devices.

4.5.6 Free-air burn-in Deliberate heat sinking, baffles to create an oven, or forced air-cooling is prohibited unless otherwise approved by the qualifying activity. The use of a current limiting or ballast resistors is permitted provided that each DUT still sees the full P_t (minimum) and that the minimum applied voltage, where applicable, is maintained throughout the burn-in period.

* 4.5.7 Scope display evaluation. Scope display evaluation shall be sharp and stable in accordance with method 4023 of MIL-STD-750. Scope display in table I, subgroup 4 shall be performed on a scope. The reverse current (I_{BR}) over the knee shall be 500 μA peak. Scope display may be performed on ATE (automatic test equipment) for screening only, with the approval of the qualifying activity.

4.5.7.1 Scope display option. At the suppliers option, 100 percent scope display evaluation may be discontinued after three consecutive lots are 100 percent tested with zero failures. Any group A failure shall require 100 percent scope display to be reinvoked.

4.5.8 Surge current (I_{ZSM}). The peak currents specified in column 10 of table III shall be applied in the reverse direction and shall be superimposed on the current (I_Z = column 5 of table III) a total of five surges at 1 minute intervals. Each individual surge shall be at one-half square wave pulse of 8.3 millisecond duration or an equivalent sine wave with the same effective (rms) current.

* TABLE I. Group A inspection.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
Subgroup 1						
Visual and mechanical inspection	2071					
Subgroup 2						
Thermal impedance 2/	3101	See 4.3.1	$Z_{\theta JX}$			°C/W
1N4954 through 1N4996					1.8	
1N5968, 1N5969					3.0	
1N6632 through 1N6637					3.0	
Forward voltage	4011	I_F = 1 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	µA dc
Regulator voltage (pulsed) (see 4.5.1 and 4.5.2).	4022	I_Z = column 5 of table IV; 0.2 ms ≤ t_p ≤ 300 ms.	V_Z	Column 3 of table IV	Column 4 of table IV	V dc
Subgroup 3						
High temperature operation:		T_A = +150°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	µA dc
Subgroup 4						
Small-signal reverse Breakdown impedance	4051	I_Z = column 5 of table IV I_{sig} = 10 percent of I_Z.	Z_Z		Column 6 of table IV	ohms
Knee impedance	4051	I_{ZK} =column 15 of table IV I_{sig} = 10 percent of I_{ZK}.	Z_{ZK}		Column 7 of table IV	ohms
Scope display	4023	See 4.5.7.				

See footnotes at end of table.

TABLE I. Group A inspection - Continued.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
Subgroup 5						
Not applicable						
Subgroup 6						
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 and 2.				
Subgroup 7						
Voltage regulation (see 4.5.3)		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 4.5.4)	4071	JANS level only I_Z = column 5 of table IV T_1 = +25°C ±5°C; T_2 = +120°C ≤ T_2 ≤ +130°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.

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

* Inspection 1/ 2/	MIL-STD-750		Sample plan
	Method	Conditions	
* Subgroup 1			22 devices, c = 0
Thermal shock	1056	20 cycles, condition D except low temperature shall be achieved using liquid nitrogen (-195°C). Do a visual for cracked glass.	
Temp cycling	1051	-65°C to +175°C, 500 cycles.	
Electrical measurements		See table III, steps 1, 2, 3, 4, 5, 6, and 7.	
Subgroup 2			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.	
Electrical measurements		See table III, steps 1, 2, 3, 4, 5, and 6.	
Subgroup 4			N/A
Thermal impedance curves		Each supplier shall submit their (typical) max design thermal impedance curves. In addition, the optimal test conditions and $Z_{\theta JX}$ limit shall be provided to the qualifying activity in the qualification report. See figures 4, 5, 6, and 7.	
Subgroup 5			22 devices, c = 0
Barometric pressure (reduced)	1001	V_R = column 11 of table IV, (1N4990 - 1N4996 only) pressure = 8 mm Hg.	
Subgroup 6			
Not applicable			

See footnotes at end of table.

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

* Inspection 1/ 2/	MIL-STD-750		Sample plan
	Method	Conditions	
Subgroup 8 Not applicable * Subgroup 9 Resistance to glass cracking	1057	Step stress to destruction by increased cycles or up to a maximum of 25 cycles.	n = 45

1/ Unless otherwise specified, for sampling plan, see MIL-PRF-19500.
2/ A separate sample may be pulled for each test.

* TABLE III. Groups A, B, C, and E electrical measurements. 1/ 2/ 3/ 4/

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	μA dc
2.	Regulator voltage (see 4.5.2)	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	ohms
4.	Knee impedance	4051	I_{ZK} = column 15 of table IV	Z_{ZK}		Column 7 of table IV	ohms
5.	Forward voltage	4011	I_F = 1.0 A dc, pulsed	V_F		1.5	V dc
6.	Forward voltage	4011	I_F = 1.0 A dc, pulsed	ΔV_F 5/		≤ 50 mV dc change from previous measured value.	
7.	Thermal impedance	3101	See 4.3.1	$Z_{\theta JX}$			°C/W

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, 5, 6, and 7.
   b. Subgroup 4, see table III herein, steps 1, 2, 3, 4, 5, 6, and 7.
   c. Subgroup 5, see table III herein, steps 1, 2, 3, 4, 5, 6, and 7.

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 1, 2, 3, and 7.
   b. Subgroup 3, see table III herein, steps 1, 2, 3, and 7.
   c. Subgroup 6, see table III herein, steps 1, 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, 5, 6, and 7 (JANS) and 1, 2, 3, and 7 for (JAN, JANTX, and JANTXV).
   b. Subgroup 6, see table III herein, steps 1, 2, 3, 4, 5, 6, and 7 (JANS) and steps 1, 2, 3, and 7 (JAN, JANTX, and JANTXV).

4/ The electrical measurements for appendix E, table IX of MIL-PRF-19500 are as follows:
   a. Subgroup 1, see table III herein, steps 1, 2, 3, 4, 5, 6, and 7.
   b. Subgroup 2, see table III herein, steps 1, 2, 3, 4, 5, 6, and 7.

5/ Devices which exceed the table I limits, for this test, shall not be accepted.

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

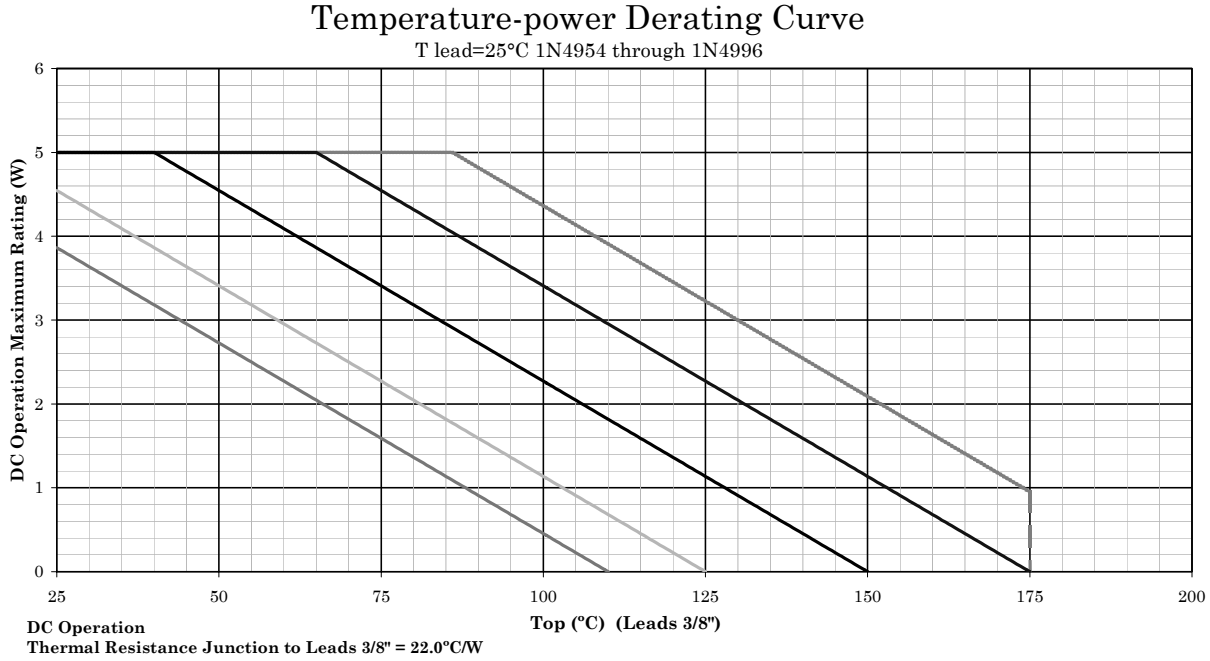
Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7	Col 8	Col 9	Col 10	Col 11	Col 12	Col 13	Col 14	Col 15
Device type	V_Z Nom	V_Z Min 1/ 2/	V_Z Max 1/ 2/	I_Z test Current T_A = +25°C	Z_Z Imped-ance	Z_K Knee imped-ance	I_Z Max dc current T_A = +25°C	V_Z(reg) voltage regula-tion 3/	I_{ZSM} T_A = +25°C 4/	V_R Rev-erse Volt-age	I_R Reverse current dc I_{R1}	α_{VZ} Temper-ature coeffi-cient 5/	I_{ZK} Test current	I_R Reverse current dc T_A = +150°C I_{R2}
	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	.9	20.0	1.0	300	-.075	2,500	5.0
1N6633	3.6	3.42	3.78	350	2.5	500	1,320	.8	18.7	1.0	250	-.070	1,000	5.0
1N6634	3.9	3.71	4.09	320	2	500	1,220	.75	17.6	1.0	175	-.060	500	5.0
1N6635	4.3	4.09	4.51	290	2	500	1,100	.7	16.4	1.0	25	-.050	500	5.0
1N6636	4.7	4.47	4.93	260	2	450	1,010	.6	15.3	1.0	20	±.025	500	5.0
1N6637	5.1	4.85	5.35	240	1.5	400	930	.5	14.4	1.0	5	±.030	500	5.0
1N5968	5.6	5.32	5.88	220	1	400	865	.4	20	4.28	5,000	.040	15,00	5.0
1N5969	6.2	5.89	6.51	220	1	1,000	765	.5	20	4.74	1,000	.040	0	1.0
1N4954	6.8	6.46	7.14	175	1	1,000	700	.7	29.3	5.2	150	.05	4,000	1.0
1N4955	7.5	7.13	7.87	175	1.5	800	630	.7	26.4	5.7	100	.06	750	1.0
1N4956	8.2	7.79	8.61	150	1.5	600	580	.7	24	6.2	50	.06	500 300	1.0
1N4957	9.1	8.65	9.55	150	2	400	520	.7	22	6.9	25	.06	200	1.0
1N4958	10.0	9.50	10.50	125	2	125	475	.8	20	7.6	25	.07	200	1.0
1N4959	11.0	10.45	11.55	125	2.5	130	430	.8	19	8.4	10	.07	150	1.0
1N4960	12.0	11.40	12.60	100	2.5	140	395	.8	18	9.1	10	.07	150	1.0
1N4961	13.0	12.35	13.65	100	3	145	365	.9	16	9.9	10	.08	150	1.0
1N4962	15	14.25	15.75	75	3.5	150	315	1.0	12	11.4	5.0	.08	100	1.0
1N4963	16	15.20	16.80	75	3.5	155	294	1.1	10	12.2	5.0	.08	100	1.0
1N4964	18	17.10	18.90	65	4.0	160	264	1.2	9.0	13.7	5.0	.085	100	1.0
1N4965	20	19.00	21.00	65	4.5	165	237	1.5	8.0	15.2	2.0	.085	100	1.0
1N4966	22	20.90	23.10	50	5.0	170	216	1.8	7.0	16.7	2.0	.085	100	1.0
1N4967	24	22.8	25.2	50	5	175	198	2.0	6.5	18.2	2.0	.09	100	1.0
1N4968	27	25.7	28.3	50	6	180	176	2.0	6.0	20.6	2.0	.09	100	1.0
1N4969	30	28.5	31.5	40	8	190	158	2.5	5.5	22.8	2.0	.09	100	1.0
1N4970	33	31.4	34.6	40	10	200	144	2.8	5.0	25.1	2.0	.095	100	1.0
1N4971	36	34.2	37.8	30	11	220	132	3.0	4.5	27.4	2.0	.095	100	1.0
1N4972	39	37.1	40.9	30	14	230	122	3.0	4.0	29.7	2.0	.095	100	1.0
1N4973	43	40.9	45.1	30	20	240	110	3.3	3.5	32.7	2.0	.095	100	1.0
1N4974	47	44.7	49.3	25	25	250	100	3.5	3.2	35.8	2.0	.095	100	1.0
1N4975	51	48.5	53.5	25	27	270	92	4.0	3.0	38.8	2.0	.095	100	1.0
1N4976	56	53.2	58.8	20	35	320	84	4.4	2.8	42.6	2.0	.095	100	1.0
1N4977	62	58.9	65.1	20	42	400	76	5.0	2.5	47.1	2.0	.100	100	1.0
1N4978	68	64.6	71.4	20	50	500	70	5.5	2.2	51.7	2.0	.100	100	1.0
1N4979	75	71.3	78.7	20	55	620	63	6.0	2.0	56	2.0	.100	100	1.0
1N4980	82	77.9	86.1	15	80	720	58	6.6	1.8	62.2	2.0	.100	100	1.0
1N4981	91	86.5	95.5	15	90	760	52.5	7.5	1.6	69.2	2.0	.100	100	1.0

See footnotes at end of table.

* 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
Device type	V_Z Nom	V_Z Min 1/ 2/	V_Z Max 1/ 2/	I_Z test Current T_A = +25°C	Z_Z Imped-ance	Z_K Knee imped-ance	I_Z Max dc current T_A = +25°C	V_Z(reg) voltage regula-tion 3/ 4/	I_{ZSM} T_A = +25°C 5/	V_R Rev-erse Volt-age	I_R Reverse current dc I_{R1}	α_{VZ} Temper-ature coeffi-cient 6/	I_{ZK} Test current	I_R Reverse current dc T_A = +150°C I_{R2}
	V	V	V	mA	Ω	Ω	mA	V	A	V	µA	%/°C	µA	mA
1N4982	100	95.0	105	12	110	800	47.5	8.0	1.4	76.0	2.0	.100	100	1.0
1N4983	110	104.5	115.5	12	125	1,000	43	9.0	1.2	83.6	2.0	.100	100	1.0
1N4984	120	114.0	126.0	10	170	1,150	39.5	10	1.0	91.2	2.0	.100	100	1.0
1N4985	130	123.5	136.5	10	190	1,250	36.6	11	.8	98.8	2.0	.105	100	1.0
1N4986	150	142.5	157.5	8	330	1,500	31.6	13	.75	114.0	2.0	.105	100	1.0
1N4987	160	152	168	8	350	1,650	29.4	14	.70	121.6	2.0	.105	100	1.0
1N4988	180	171	189	5	450	1,750	26.4	16	.60	136.8	2.0	.110	100	1.0
1N4989	200	190	210	5	500	1,850	23.6	18	.50	152.0	2.0	.110	100	1.0
1N4990	220	209	231	5	550	2,000	21.6	19	.50	167.0	2.0	.115	100	1.0
1N4991	240	228	252	5	650	2,050	19.8	22	.40	182.0	2.0	.115	100	1.0
1N4992	270	257	283	5	800	2,100	17.5	25	.35	206	2.0	.120	100	1.0
1N4993	300	285	315	4	950	2,150	15.6	28	.30	228	2.0	.120	100	1.0
1N4994	330	314	346	4	1,175	2,200	14.4	32	.25	251	2.0	.120	100	1.0
1N4995	360	342	378	3	1,400	2,300	13.0	35	.22	274	2.0	.120	100	1.0
1N4996	390	371	409	3	1,800	2,500	12.0	40	.20	297	2.0	.120	100	1.0

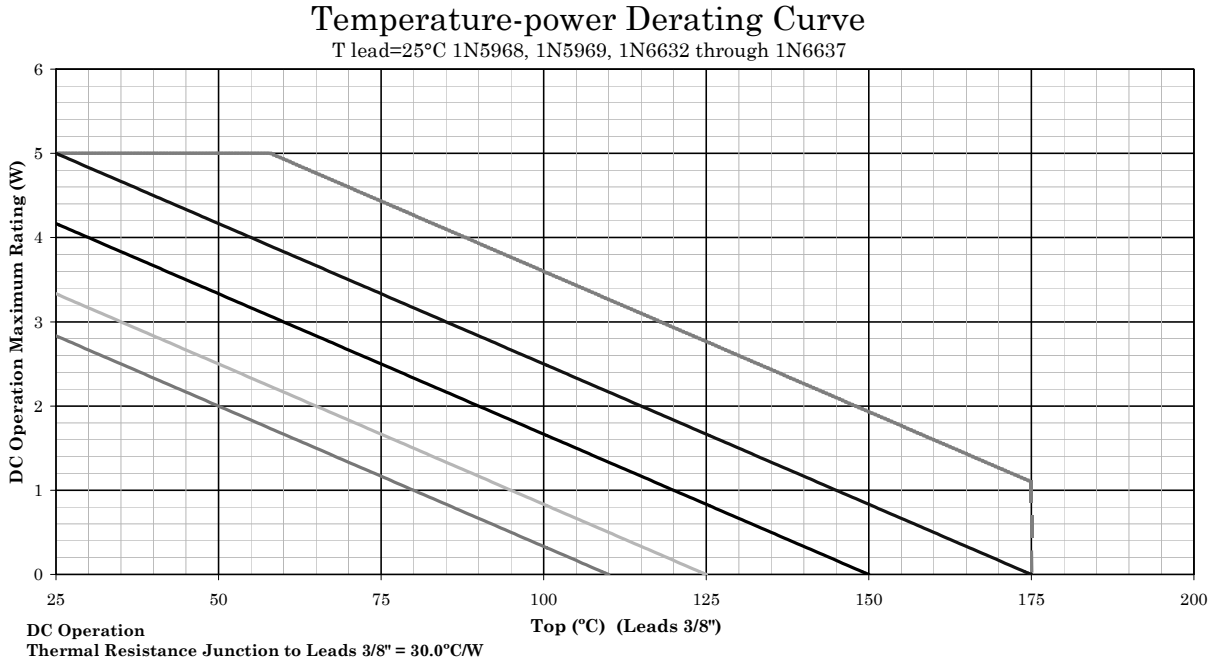
1/ Unless otherwise specified, ratings apply to all case outlines.
2/ Voltage tolerance devices (examples: 1N6632 is ±5 percent, 1N6632C is ±2 percent, and 1N6632D is ±1 percent tolerance).
3/ Min/max shown only for ±5 percent tolerance.
4/ See 4.5.3.
5/ See 4.5.8.
6/ See 4.5.4.



NOTES:

1. Top curve is thermal runaway loci and cannot be used as a derate design curve since it exceeds the maximum ratings for this part. Operating under this curve using these mounting conditions assures device will not have a thermal runaway. This is the true inverse of the worst case thermal resistance value extrapolated out to the thermal runaway point.
2. Derate design curve constrained by the maximum junction temperatures and current rating specified. (See 1.3 herein.)
3. Derate design curve chosen at $T_J \leq 150°C$, where the maximum temperature of electrical test is performed.
4. Derate design curve chosen at $T_J \leq 125°C$, and 110°C to show power rating where most users want to limit T_J in their application.

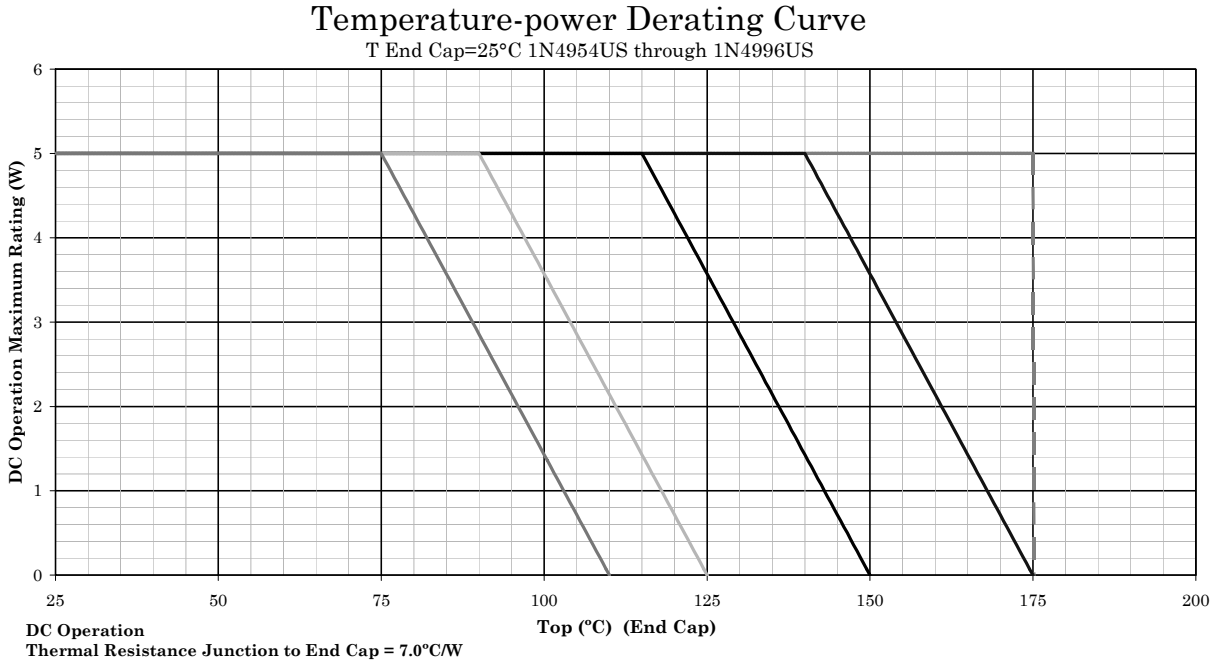
* FIGURE 4. Temperature/power derating curve.



NOTES:

1. Top curve is thermal runaway loci and cannot be used as a derate design curve since it exceeds the maximum ratings for this part. Operating under this curve using these mounting conditions assures device will not have a thermal runaway. This is the true inverse of the worst case thermal resistance value extrapolated out to the thermal runaway point.
2. Derate design curve constrained by the maximum junction temperatures and current rating specified. (See 1.3 herein.)
3. Derate design curve chosen at $T_J \leq 150°C$, where the maximum temperature of electrical test is performed.
4. Derate design curve chosen at $T_J \leq 125°C$, and 110°C to show power rating where most users want to limit T_J in their application.

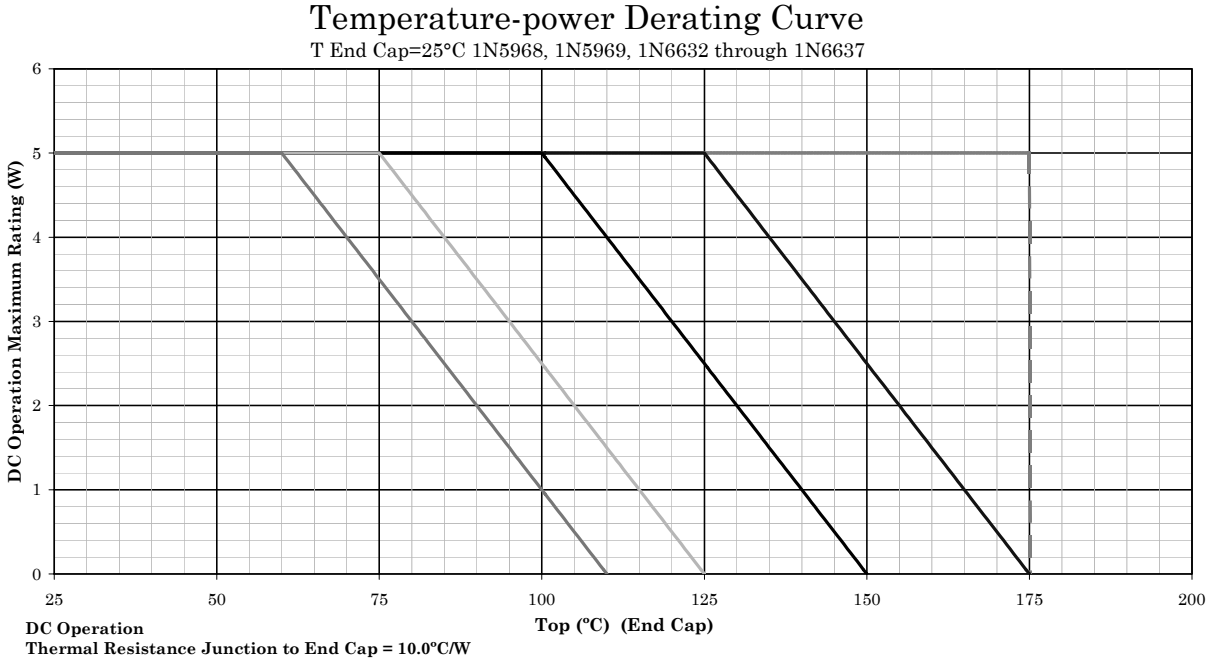
* FIGURE 5. Temperature/power derating curve.



NOTES:

1. Top curve is thermal runaway loci and cannot be used as a derate design curve since it exceeds the maximum ratings for this part. Operating under this curve using these mounting conditions assures device will not have a thermal runaway. This is the true inverse of the worst case thermal resistance value extrapolated out to the thermal runaway point.
2. Derate design curve constrained by the maximum junction temperatures and current rating specified. (See 1.3 herein.)
3. Derate design curve chosen at $T_J \leq 150°C$, where the maximum temperature of electrical test is performed.
4. Derate design curve chosen at $T_J \leq 125°C$, and 110°C to show power rating where most users want to limit T_J in their application.

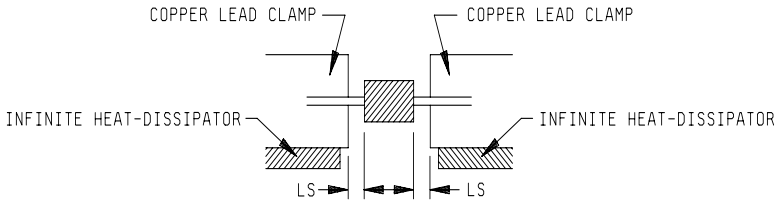
* FIGURE 6. Temperature/power derating curve.



NOTES:

1. Top curve is thermal runaway loci and cannot be used as a derate design curve since it exceeds the maximum ratings for this part. Operating under this curve using these mounting conditions assures device will not have a thermal runaway. This is the true inverse of the worst case thermal resistance value extrapolated out to the thermal runaway point.
2. Derate design curve constrained by the maximum junction temperatures and current rating specified. (See 1.3 herein.)
3. Derate design curve chosen at $T_J \leq 150°C$, where the maximum temperature of electrical test is performed.
4. Derate design curve chosen at $T_J \leq 125°C$, and 110°C to show power rating where most users want to limit T_J in their application.

* FIGURE 7. Temperature/power derating curve.



* FIGURE 8. Mounting arrangement.

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 materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the Military Service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

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

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

* 6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number, and date of this specification.

b. Packaging requirements (see 5.1).

c. Lead finish (see 3.4.2).

d. 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 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, P.O. Box 3990, Columbus, OH 43218-3990 or e-mail vqe.chief@dla.mil.

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 QML.

JANHC and JANKC ordering information	
PIN	Manufacturer
	43611
1N4954 through 1N4996	JANHCA1N4954 through JANHCA1N4996
1N4954 through 1N4996	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. The margins of this specification are marked with asterisks to indicate where changes from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

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

Review activities:
Army - AR, AV, MI, SM
Navy - AS
Air Force - 19, 99

Preparing activity:
DLA - CC

(Project 5961-2875)

* NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at http://assist.daps.dla.mil.