

The documentation and process conversion measures necessary to comply with this revision shall be completed by 18 January 2008.

INCH-POUND

MIL-PRF-19500/550C
 18 October 2007
 SUPERSEDING
 MIL-PRF-19500/550B
 20 October 1998

* PERFORMANCE SPECIFICATION SHEET

SEMICONDUCTOR DEVICE, DIODE, SILICON, FAST-RECOVERY, HIGH CURRENT,
 TYPES 1N6304, 1N6305, 1N6306, AND R TYPES,
 JAN, JANTX, JANTXV, 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, high efficiency, fast recovery, switching power rectifier diodes. Three 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 figure 1 (DO-203AB) formerly DO-5 and figures 2, 3, 4, and 5 for JANHC and JANKC (die) dimensions.

* 1.3 Maximum ratings. Unless otherwise specified, $T_C = +25^\circ\text{C}$.

Types	V_R	V_{RWM}	I_O $T_C = +100^\circ\text{C}$ (1) (2)	I_{FSM} $T_C = +55^\circ\text{C}$ $t_p = 8.3 \text{ ms}$	t_{rr}	V_{FM1} $I_{FM} = 70 \text{ A (pk)}$ duty cycle $\leq 2 \text{ percent}$ $t_p = 300 \mu\text{s max}$	I_R at rated I_R	T_J and T_{STG}	$R_{\theta JC}$
	<u>V dc</u>	<u>V dc</u>	<u>A dc</u>	<u>A dc</u>	<u>ns</u>	<u>V (pk)</u>	<u>$\mu\text{A dc}$</u>	T_C	<u>$^\circ\text{C/W}$</u>
1N6304, R	50	50	70	800	50	0.975	25	-65 $^\circ\text{C}$	0.8
1N6305, R	100	100	70	800	50	0.975	25	to	0.8
1N6306, R	150	150	70	800	50	0.975	25	+175 $^\circ\text{C}$	0.8

(1) Derate linearly, 875 mA/ $^\circ\text{C}$ from $T_C = +100^\circ\text{C}$ to $+150^\circ\text{C}$, and 1,050 mA/ $^\circ\text{C}$ above $T_C > +150^\circ\text{C}$.

(2) Higher I_O , up to 1.2 times I_O is allowable provided that appropriate heat sinking or forced air cooling maintains the maximum junction temperature at or below $+175^\circ\text{C}$ as proven by the junction temperature rise time.

* 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@dsc.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>.

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/quicksearch/> or <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).

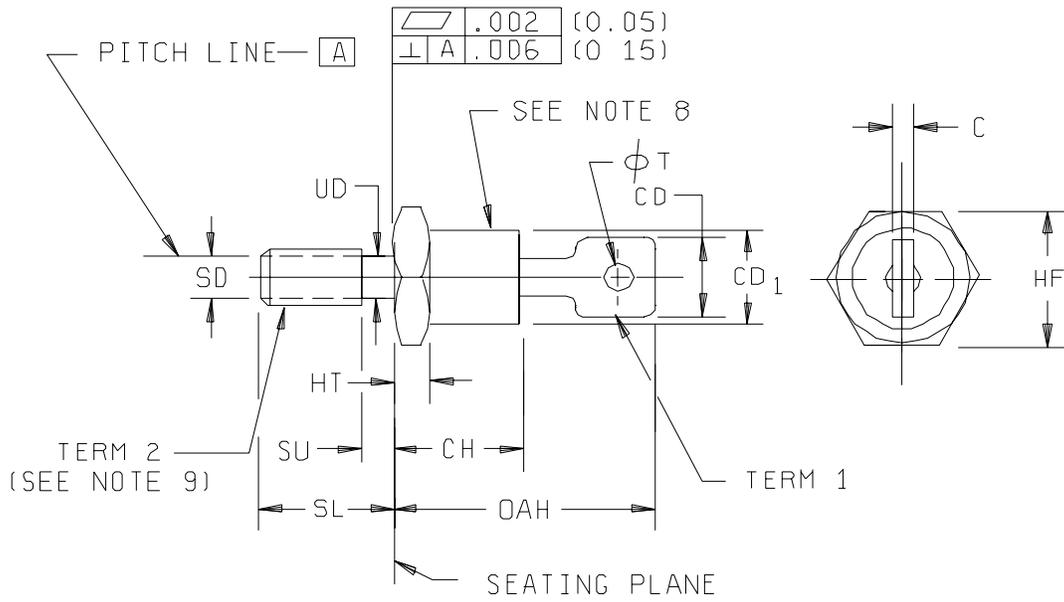
3.3 Abbreviations, symbols, and definitions. Abbreviations, symbols, and definitions used herein shall be as specified in MIL-PRF-19500.

* 3.4 Interface requirements and physical dimensions. The interface requirements and physical dimensions shall be as specified in MIL-PRF-19500, and on figures 1 (DO-203AB) and figures 2, 3, 4, and 5 for JANHC and JANKC die herein.

3.4.1 Lead material and finish. Lead material shall be copper (terminal number 1) with a steel cap on a copper stud (terminal number 2). Lead finish shall be solderable as defined in 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).

3.5 Marking. Marking shall be in accordance with MIL-PRF-19500.

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



* FIGURE 1. Physical dimensions (DO-203AB).

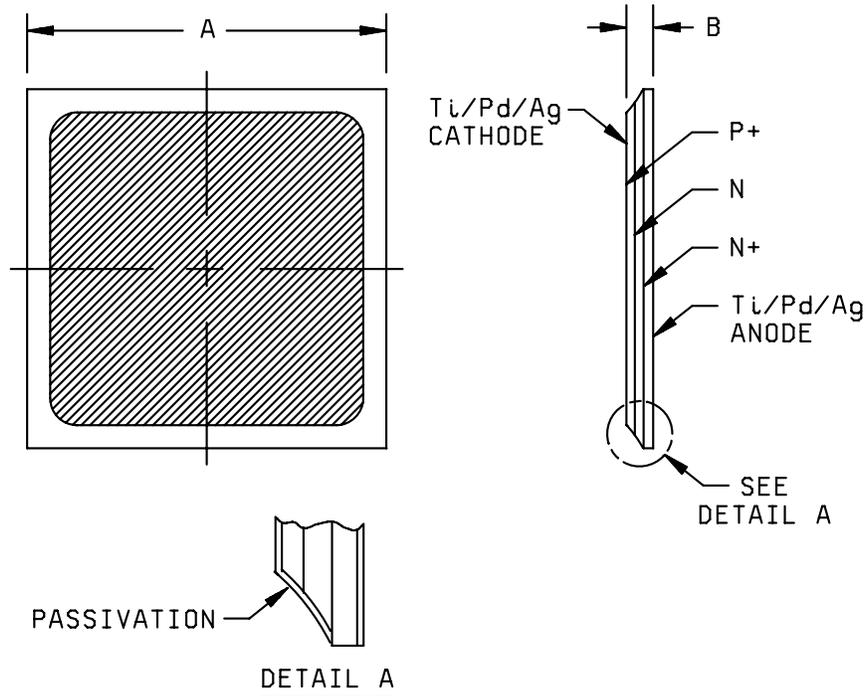
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Ltr	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
CD		.375		9.53	7
C		.080		2.03	
HF	.669	.688	16.99	17.48	
HT	.115	.200	2.92	5.08	
CH		.450		11.43	
OAH	.750	1.000	19.05	25.40	
SL	.422	.453	10.72	11.51	
SU		.090		2.29	4
CD ₁		.667		16.94	
SD					5
UD	.220	.249	5.59	6.32	
θT	.140	.175	3.56	4.45	

NOTES:

1. Dimensions are in inches.
2. Millimeter equivalents are given for information only.
3. Units must not be damaged by torque of 30 inch-pound applied to .25-28 UNF-2B nut assembled on thread.
4. Length of incomplete or undercut threads of UD.
5. Maximum pitch diameter of plated threads shall be basic pitch diameter .2268 inch (5.761 mm).
6. A chamfer or undercut on one or both ends of the hex portion is optional; minimum base diameter at seating plane .60 inch (15.2 mm).
7. The angular orientation and peripheral configuration of terminal 1 is undefined.
8. Standard types shall have cathode connected to stud. Reverse types shall have anode connected to stud.
9. Term 2 threads in accordance with FED-STD-H28.
10. In accordance with ASME Y14.5M, diameters are equivalent to ϕ x symbology.

* FIGURE 1. Physical dimensions (DO-203AB) - Continued.



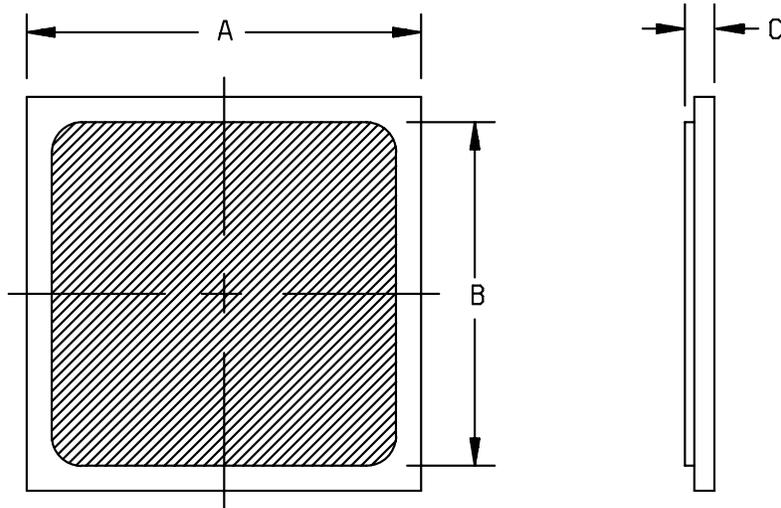
Ltr	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
A	.199 SQ	.201 SQ	5.054 SQ	5.105 SQ
B	.009	.011	0.229	0.279

A version

NOTES:

1. Dimensions are in inches.
2. Millimeter equivalents are given for information only.
3. Back metal: Ti - Pd - Ag.
4. Top metal: Ti - Pd - Ag.
5. Metallization: Ti = 700 Å; Pd = 700 Å; Ag = 31,400 Å.
6. In accordance with ASME Y14.5M, diameters are equivalent to ϕ x symbology.

* FIGURE 2. Physical dimensions JANHCA and JANKCA.



Ltr	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
A	.191 SQ	.201 SQ	4.851 SQ	5.105 SQ
B	.173 SQ	.183 SQ	4.394 SQ	4.648 SQ
C	.009	.010	0.229	0.254

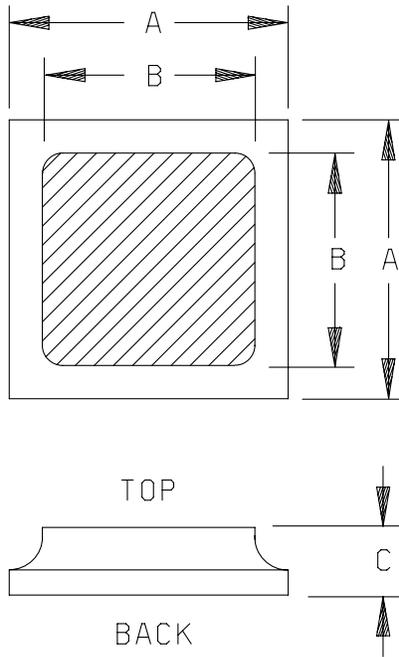
B version

NOTES:

1. Dimensions are in inches.
2. Millimeter equivalents are given for information only.
3. Back metal: Cr - Ni - Ag.
4. Top metal: Cr - Ni - Ag.
5. Metallization: Cr = 800 Å minimum, Ni = 1.5 Å minimum, Ag = 3,000 Å minimum.
6. In accordance with ASME Y14.5M, diameters are equivalent to ϕx symbology.

* FIGURE 3. Physical dimensions JANHCB and JANKCB.

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Ltr	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
A	.196 SQ	.202 SQ	4.98 SQ	5.13 SQ
B	.177 SQ	.183 SQ	4.50 SQ	4.65 SQ
C	.006	.012	0.15	0.30

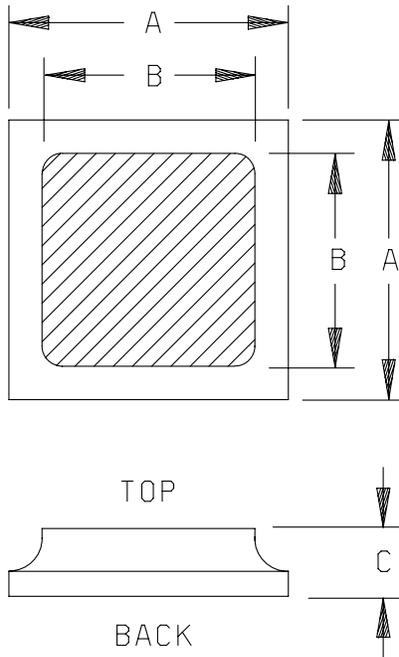
C version

NOTES:

1. Dimensions are in inches.
2. Millimeter equivalents are given for information only.
3. Back (cathode) metal: Silver.
4. Top (anode) metal: Silver.
5. In accordance with ASME Y14.5M, diameters are equivalent to ϕx symbology.

* FIGURE 4. Physical dimensions JANHCC and JANKCC.

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Ltr	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
A	.196 SQ	.202 SQ	4.98 SQ	5.13 SQ
B	.177 SQ	.183 SQ	4.50 SQ	4.65 SQ
C	.006	.012	0.15	0.30

D version

NOTES:

1. Dimensions are in inches.
2. Millimeter equivalents are given for information only.
3. Back (cathode) metal: Silver.
4. Top (anode) metal: Aluminum.
5. In accordance with ASME Y14.5M, diameters are equivalent to ϕx symbology.

* FIGURE 5. Physical dimensions JANHCD and JANKCD.

3.6 Polarity. The polarity shall be indicated by a graphic symbol with the arrow pointing toward the cathode terminal. The reversed units shall also be marked with an R following the last digit in the type number.

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

3.8 Electrical test requirements. The electrical test requirements shall be the subgroups specified in 4.4.2 and 4.4.3.

* 3.9 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 inspections. 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).

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

* 4.3 Screening (JANTXV and JANTX levels only). Screening shall be in accordance with appendix E, table E-IV of MIL-PRF-19500 and as specified herein. Specified electrical measurements shall be made in accordance with table I herein. Devices that exceed the limits of table I herein shall not be acceptable.

Screening (see appendix E, table E-IV of MIL-PRF-19500)	Measurement
	JANTX and JANTXV levels
(1) 3b	Surge (see 4.3.3)
(1) 3c	Thermal response (see 4.3.4)
4	Not applicable
9	Not applicable
10	Not applicable
11	V_{FM1} and I_{R1} (2)
12	Burn-in (see 4.3.2)
(3) 13	Subgroup 2 of table I herein, V_{FM1} and I_{R1} ; $\Delta V_{FM1} \leq \pm 0.1$ V (pk); $\Delta I_{R1} \leq \pm 5$ μ A dc or 100 percent from the initial value, whichever is greater

- (1) May be performed at any time after screen 3a. Surge shall precede thermal response.
- (2) I_{R1} measurement shall not be indicative of an open condition.
- (3) Thermal response need not be repeated if previously screened.

* 4.3.1 Screening (JANHC and JANKC). Screening of die shall be in accordance with appendix G of MIL-PRF-19500, as a minimum die shall be 100 percent probed in accordance with group A, subgroup 2, except test current shall not exceed 20 A.

4.3.2 Burn-in conditions. Burn-in conditions for all levels are as follows: Method 1038 of MIL-STD-750, test condition A; $T_C = +125^\circ\text{C}$, $V_R = 0.8$ to 0.85 rated dc (see 1.3), $t = 48$ hours.

4.3.2.1 Alternate burn-in conditions. $T_C = +150^\circ\text{C}$, $V_R = \text{rated } V_R$ (see 1.3), $I_O = 0$, $f = 50$ to 60 Hz, $t = 48$ hours.

4.3.3 Surge current. Surge current, see method 4066 of MIL-STD-750. $I_O = 0$; $V_{RWM} = 0$; $I_{FSM} = 800$ A; six surges; $T_A = +25^\circ\text{C}$; $t_p = 8.3$ ms.

4.3.4 Thermal response $Z_{\theta JX}$ measurements. The $Z_{\theta JX}$ measurements shall be performed in accordance with method 3101 of MIL-STD-750. The $Z_{\theta JX}$ conditions and maximum $Z_{\theta JX}$ limit shall be derived by each vendor and shall not exceed the $R_{\theta JC}$ (see 1.3). The chosen $Z_{\theta JX}$ measurement and conditions for each device in the qualification lot shall be submitted in the qualification report and a thermal response curve shall be plotted. The chosen ΔV_F value shall be considered final after the manufacturer has had the opportunity to test five consecutive lots. $t_H = 100$ to 250 ms; heating current $I_H = 30$ A. Measurement current: $50 \leq I_M \leq 250$ mA; $t_{MD} \leq 250$ μs .

4.4 Conformance inspection. Conformance inspection shall be in accordance with MIL-PRF-19500.

4.4.1 Group A inspection. Group A inspection shall be conducted in accordance with appendix E, table E-V of MIL-PRF-19500, and table I 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 E-VIb (JANTX and JANTXV) of MIL-PRF-19500 and as follows. Electrical measurements (end-points) shall be in accordance with the applicable steps of table I, group A, subgroup 2 (V_{FM1} and I_{R1} only) herein.

* 4.4.2.1 Group B inspection, appendix E, table E-VIb (JANTX and JANTXV) of MIL-PRF-19500.

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
B2	4066	$T_C = +55^\circ\text{C}$; $V_R = \text{rated } V_R$ (see 1.3); six 8.3 ms surges; 1 surge/minute; I_F (surge) = 800 A dc, $I_O = 0$.
B3	1037	25 percent rated $I_O \leq I_O$ applied \leq rated I_O , 2,000 cycles (see 4.5.2).

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 E-VII of MIL-PRF-19500, and as follows. Electrical measurements (end-points) shall be in accordance with the applicable steps of table I, group A, subgroup 2 (V_{FM1} and I_{R1} only) herein.

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

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
C2	2036	Tension, test condition A, weight = 10 pounds, t = 15s.
C2	2036	Bending stress, test condition F, method B; weight = 15 pounds, t = 15 s.
C2	2036	Seal torque, test condition D1, torque = 3 inch-pound, t = 15 s.
C2	2036	Stud torque, test condition D2, torque = 30 inch-pound, t = 15 s.
C6	1037	25 percent rated $I_O \leq I_O$ applied \leq rated I_O , 6,000 cycles (see 4.5.2).

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 DC intermittent operation life. A cycle shall consist of an "on" period, when power is applied suddenly, not gradually, to the device for the time necessary to achieve a delta case temperature of +85°C, +15°C, -5°C, followed by an "off" period, when the power is suddenly removed for cooling. Auxiliary (forced) cooling is permitted during the off period only. $30 \text{ s} \leq t_{\text{heating}} \leq 180 \text{ s}$.

4.5.3 Reverse recovery time. The reverse recovery time shall be measured as shown in circuit A on figure 6 or equivalent. Care should be exercised to minimize stray inductances in the test circuit and to ensure that the total resistance of the reverse current loop can be adjusted sufficiently low that more than two amperes will flow if not blocked by the diode being tested. Switch SW shall be activated and the regulated voltage source adjusted to achieve the following characteristics of the waveform:

- a. The d_i/d_t shall be the specified value between the forward 0.5 ampere point and the reverse 0.2 ampere point.
- b. The $i_r(\text{rec})$ shall be the maximum value obtainable, except that if it exceeds 2 amperes, the reverse-recovery time shall then be determined from the current waveform as shown in circuit B on figure 3.

4.5.4 Thermal resistance. Thermal resistance measurements shall be performed in accordance with method 4081 or method 3101 of MIL-STD-750. The case reference temperature shall be held to equilibrium within the range of 20°C to 80°C during the power application and shall be measured at the hex flat. The maximum limit of $R_{\theta JC}$ shall be 0.8°C/W. The following parameter measurements shall be used:

- a. $I_H = I_F \geq 10 \text{ A}$.
- b. $I_M \leq 250 \text{ mA}$.
- c. $t_{MD} \leq 250 \text{ } \mu\text{s}$.

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* TABLE I. Group A inspection.

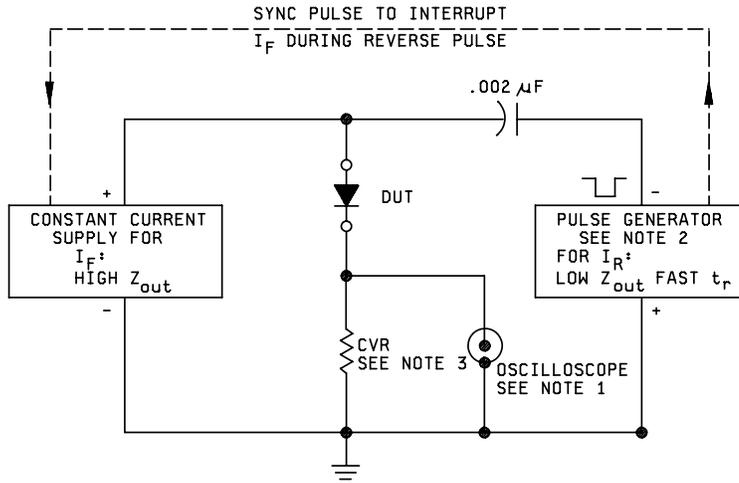
Inspection <u>1/</u>	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 1</u>						
Visual and mechanical inspection	2071					
<u>Subgroup 2</u>						
Forward voltage	4011	$I_{FM} = 70 \text{ A (pk)}$; duty cycle ≤ 2 percent (pulsed, see 4.5.1) $t_P = 300 \mu\text{s}$ maximum	V_{FM1}	.975		V dc(pk)
Forward voltage	4011	$I_{FM} = 150 \text{ A (pk)}$; duty cycle ≤ 2 percent (pulsed, see 4.5.1) $t_P = 300 \mu\text{s}$ maximum	V_{FM2}	1.18		V dc(pk)
Reverse current	4016	DC method; $V_R = \text{rated } V_R$ (see 1.3)	I_{R1}		25	$\mu\text{A dc}$
<u>Subgroup 3</u>						
High temperature operation:		$T_C = +150^\circ\text{C}$				
Reverse current	4016	DC method; $V_R = \text{rated } V_R$ (see 1.3)	I_{R2}		30	mA dc
Forward voltage	4011	$I_{FM} = 70 \text{ A (pk)}$; duty cycle ≤ 2 percent (pulsed, see 4.5.1) $t_P = 300 \mu\text{s}$ maximum	V_{FM3}	.84		V dc (pk)
Low temperature operation:		$T_C = -55^\circ\text{C}$				
Breakdown voltage	4021	$I_R = 1 \text{ mA}$	$V_{(BR)}$			
1N6304, R				50		V dc
1N6305, R				100		V dc
1N6306, R				150		V dc

See footnote at end of table.

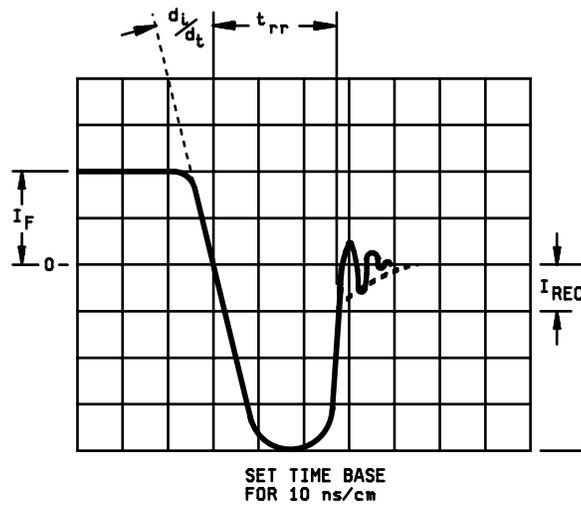
* TABLE I. Group A inspection.

Inspection <u>1/</u>	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 4</u>						
Reverse recovery time	4031	Condition B; $I_F = 0.5$ A dc, $I_R = 1$ A dc, $I_{REC} = 0.25$ A dc, $d_i/d_t = 85$ A/ μ s (minimum), (see 4.5.3 and figure 6)	t_{rr1}		50	ns
Reverse recovery time	4031	Condition C, $I_{FM} = 70$ A dc, $d_i/d_t = 130$ A/ μ s (see 4.5.3 and figure 6)	t_{rr2}		60	ns
Junction capacitance	4001	$V_R = 10$ V, $f = 1$ MHz $V_{sig} = 50$ mV (p-p) maximum	C_J		600	pF
<u>Subgroups 5 and 6</u>						
Not applicable						
<u>Subgroup 7</u>						
Forward recovery voltage	4026	$I_{FM} = 1$ A, $t_p \geq 20$ ns, $t_r = 8$ ns	$V_{F(Dyn)}$		2.2	V(pk)
Forward recovery time	4026	$I_{FM} = 1$ A	t_{fr}		15	ns

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



Circuit A



NOTES:

1. Oscilloscope: Rise time ≤ 1 ns; input impedance = 50 ohms maximum.
2. Pulse generator: Rise time ≤ 10 ns; source impedance 50 ohms maximum.
3. Current viewing resistor: Non-inductive coaxial type with resistance matched to pulse generator impedance. An appropriate current probe may be used in place of the C.V.R. A 50 ohm, 60 ns, charge line may be used for the Z_{out} .

FIGURE 6. Reverse recovery time circuit and waveform.

5. PACKAGING

* 5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When 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. The notes specified in MIL-PRF-19500 are applicable to this specification.)

* 6.1 Intended use. Semiconductors conforming to this specification are intended for original equipment design applications and logistic support of existing equipment.

* 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 material and finish (see 3.4.1).
- 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 die suppliers will be identified on the QPL (example JANHCA1N6304).

JANHC and JANKC ordering information				
Military PIN	Manufacturer			
	12969	12969	59377	59377
1N6304, R	JANHCA1N6304	JANKCA1N6304	JANHCB1N6304	JANKCB1N6304
1N6305, R	JANHCA1N6305	JANKCA1N6305	JANHCB1N6305	JANKCB1N6305
1N6306, R	JANHCA1N6306	JANKCA1N6306	JANHCB1N6306	JANKCB1N6306

JANHC and JANKC ordering information				
Military PIN	Manufacturer			
	12969	12969	12969	12969
1N6304, R	JANHCC1N6304	JANKCC1N6304	JANHCD1N6304	JANKCD1N6304
1N6305, R	JANHCC1N6305	JANKCC1N6305	JANHCD1N6305	JANKCD1N6305
1N6306, R	JANHCC1N6306	JANKCC1N6306	JANHCD1N6306	JANKCD1N6306

* 6.5 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

Preparing activity:

DLA - CC

(Project 5961-2007-050)

Review activities:

Army - AR, MI, SM
Navy - AS, MC
Air Force - 19, 99

* 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>.