

The documentation and process conversion measures necessary to comply with this revision shall be completed by 15 January 2013.

INCH-POUND

MIL-PRF-19500/308D  
 15 October 2013  
 SUPERSEDING  
 MIL-PRF-19500/308C  
 1 August 1999

PERFORMANCE SPECIFICATION SHEET

SEMICONDUCTOR DEVICE, DIODE, SILICON, POWER RECTIFIER, FAST-RECOVERY  
 TYPES 1N3909, 1N3910, 1N3911, 1N3912, 1N3913, R AND A VERSIONS  
 JAN, JANTX, AND JANTXV

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, semiconductor fast recovery, power rectifier diodes. Three levels of product assurance are provided for each device type as specified in MIL-PRF-19500.

1.2 Physical dimensions. See [figure 1](#) (DO-5).

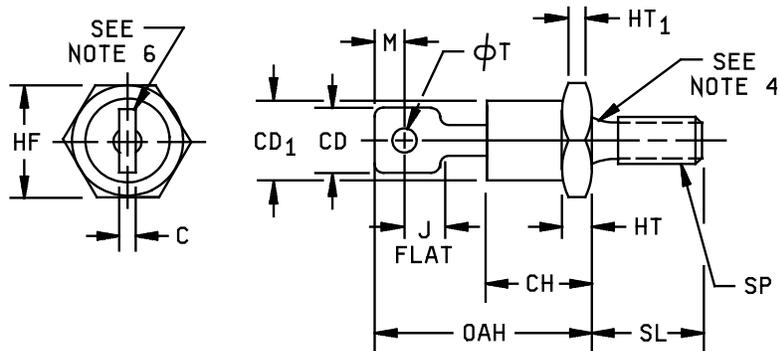
1.3 Maximum ratings.

Types	$V_R$	$V_{RWM}$	$I_O$ 1/ $T_C = 100^\circ C$	$I_f$ (surge) at 1/120 s $T_C = 100^\circ C$	$t_{rr}$	$T_{STG}$	$T_{OP}$
	<u>V dc</u>	<u>V (pk)</u>	<u>A dc</u>	<u>A dc</u>	<u>ns</u>	<u>°C</u>	<u>°C</u>
1N3909, R	50	50	30	300	200	-65	-65
1N3909A, AR	50	50	50	400	150	to +175	to +150
1N3910, R	100	100	30	300	200		
1N3910A, AR	100	100	50	400	150		
1N3911, R	200	200	30	300	200		
1N3911A, AR	200	200	50	400	150		
1N3912, R	300	300	30	300	200		
1N3912A, AR	300	300	50	400	150		
1N3913, R	400	400	30	300	200		
1N3913A, AR	400	400	50	400	150		

1/ Derate linearly, 2 percent of  $I_O$  per °C for  $T_C > 100^\circ C$ .  
 Barometric pressure reduced (altitude operation): 8 mmHg.

1.4 Primary electrical characteristics.  $R_{\theta JC} = 0.8^\circ C/W$  maximum.

\* Comments, suggestions, or questions on this document should be addressed to DLA Land and Maritime, ATTN: VAC, P.O. Box 3990, Columbus, OH 43218-3990, or emailed to [Semiconductor@dla.mil](mailto:Semiconductor@dla.mil). Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at <https://assist.dla.mil>.



Ltr	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
C	0.030	0.080	0.76	2.03
CD	0.250	0.375	6.35	9.52
CD <sub>1</sub>		0.667		16.94
CH		0.450		11.43
HF	0.669	0.688	16.99	17.48
HT	0.115	0.200	2.93	5.08
HT <sub>1</sub>	0.060		1.53	
J	0.156		3.97	
M	0.030		0.77	
OAH	0.750	1.000	19.05	25.40
$\phi T$	0.140	0.175	3.56	04.44
SL	0.422	0.453	10.72	11.50
SP	.250-28 UNF-2A THD NF optional		6.35-28 UNF-2A THD NF optional	

NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Units must not be damaged by torque of 30 inch-pounds applied to 0.250-28 UF-2B nut assembled on thread.
4. Diameter of unthreaded portion 0.249 inch (6.32 mm) max and 0.220 inch (5.59 mm) minimum.
5. Complete threads to extend to within 2.5 threads of seating plane.
6. Angular orientation for this terminal is underlined, however the major surfaces over dimension CD shall be flat and the minimum distance from the hole to any point on the periphery shall be 0.030 inch (0.76 mm) outside dimension J.
7. Max pitch diameter of plated threads shall be basic pitch diameter 0.2268 inch (5.76 mm) reference FED-STD-H28.
8. (Screw Thread Standards for Federal Services.)
9. A chamfer or undercut on one or both ends of the hex portion is optional: Minimum bas diameter at seating plane. 0.600 inch (15.24 mm).
10. Reversed (anode to stud) units shall be marked with an R following the last digit in the type number.

FIGURE 1. Physical dimensions (DO-5).

## 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 documents cited in section 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 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://quicksearch.dla.mil> or <https://assist.dla.mil> or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

\* 2.2 Order of precedence. Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this specification and the references cited herein, the text of this specification 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 manufacturers list 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 figure 1 (DO-5) herein.

3.4.1 Lead finish. Lead finish shall be solderable in accordance with MIL-PRF-19500. Where a choice of lead finish is desired, it shall be specified in the contract or purchase order (see 6.2).

\* 3.4.2 Diode construction. These devices shall be constructed in a manner and using materials which enable the diodes to meet the applicable requirements of MIL-PRF-19500 and this document.

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

3.6 Electrical test requirements. The electrical test requirements shall be as specified in table I herein.

\* 3.7 Marking. Marking shall be in accordance with MIL-PRF-19500. Manufacturer's identification and date code shall be marked on the devices. Initial container package marking shall be in accordance with MIL-PRF-19500.

3.7.1 Polarity. The polarity shall be indicated by a graphic symbol with the arrow pointing toward the negative end for forward bias. The reversed units shall also be marked with an R following the last digit in the type number.

\* 3.8 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).

4.1.1 Sampling and inspection. Sampling and inspection shall be in accordance with MIL-PRF-19500 and herein, except lot accumulation period shall be 3 months in lieu of 6 weeks.

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

\* 4.2.1 Group E qualification. Group E inspection shall be performed for qualification or re-qualification only. In case qualification was awarded to a prior revision of the specification sheet that did not require 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 of this revision to maintain qualification.

4.3 Screening. Screening shall be in accordance with table E-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 E-IV of MIL-PRF-19500)	JANTX and JANTXV levels
1/	Surge, see 4.3.1 Thermal response, see 4.3.2
4	Not applicable
9	$V_{F2}$ and $I_{R1}$ 2/
* 10	MIL-STD-750, method 1038, test condition A, $t = 48$ hours, $T_A = +150^\circ\text{C}$ (min)
11 3/	Subgroup 2 of <u>table I</u> herein $V_{F2}$ and $I_{R1}$ ; $\Delta V_{F2} = \pm 0.1$ v(pk); $\Delta I_{R1} = \pm 5$ $\mu\text{A}$ dc or 100 percent from the initial value, whichever is greater.
12	Not applicable
13	Not applicable

1/ Surge shall precede thermal response. These tests shall be performed anytime after screen 3 and before screen 9.

2/  $I_{R1}$  measurement shall not be indicative of an open condition.

3/ PDA of screen 13 shall apply to screen 11.

4.3.1 Surge current. Surge current, see MIL-STD-750, method 4066.  $I_O = 0$ ;  $V_{RM}(w) = 0$ ; Non-A version,  $I_{F(surge)} = 400$  A; A version,  $I_{F(surge)} = 500$  A; six surges;  $T_A = 25^\circ\text{C}$ ;  $t_p = 8.3$  ms

4.3.2 Thermal response. The thermal response measurements shall be performed in accordance with method 3101 of MIL-STD-750. The thermal response conditions and maximum thermal response limit shall be derived by each vendor. The chosen thermal response 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 thermal response values shall be considered final after the manufacturer has had the opportunity to test five consecutive lots. Heating current ( $I_H$ )  $\geq$  rated  $I_O$ ;  $t_H = 150$  to  $400$  ms;  $t_{MD} = 50$  to  $300$   $\mu$ s;  $50$  mA  $\leq I_M \leq 250$  mA.

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 MIL-PRF-19500, and [table I](#) herein. Electrical measurements (end-points) shall be in accordance with subgroup 2 of [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 table E-VIb (JAN, JANTX, and JANTXV) of MIL-PRF-19500 and [4.4.2.1](#) herein. Electrical measurements (end-points) shall be in accordance with subgroup 2 of [table I](#) herein. Delta measurements shall be in accordance with [table III](#) herein.

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

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
B2	4066	Non-A version devices: $T_C = 100^\circ\text{C}$ ; $V_R = \text{Rated } V_{RM}$ (see <a href="#">1.3</a> ), six surges. 1 surge per minute maximum. $t_p = 8.3$ ms. $i_f(\text{surge}) = 300$ A; $I_O = 30$ A dc
B2	4066	A version devices: $T_C = 100^\circ\text{C}$ ; $V_R = \text{Rated } V_{RM}$ (see <a href="#">1.3</a> ), six surges. 1 surge per minute maximum. $t_p = 8.3$ ms. $i_f(\text{surge}) = 400$ A; $I_O = 50$ A dc
* B3	1037	0.25 Rated $I_O \leq I_O$ applied $\leq$ Rated $I_O$ (see <a href="#">4.5.1</a> ) 2,000 cycles, $T_A \leq 35^\circ\text{C}$ . For irradiated devices, include $t_{rr}$ as an end-point measurement.
B3	1038 or 1049	Condition A; 340 hrs.

4.4.3 Group C inspection. Group C inspection shall be conducted in accordance with the conditions specified for subgroup testing in table E-VII of MIL-PRF-19500 and [4.4.3.1](#) herein. Electrical measurements (end-points) shall be in accordance with subgroup 2 of [table I](#) herein. Delta measurements shall be in accordance with [table III](#) herein.

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

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
C2	2036	Test condition F, method B, Weight = 15 pounds, $t = 15$ s.
C2	2036	Test condition D1, seal torque = 3 pound-inches, $t = 15$ s.
C2	2036	Test condition D2, stud torque = 30 pound-inches, $t = 15$ s.
* C6	1037	0.25 Rated $I_O \leq I_O$ applied $\leq$ Rated $I_O$ (see <a href="#">4.5.1</a> ) 6,000 cycles. $T_A \leq 35^\circ\text{C}$ . For irradiated devices, include $t_{rr}$ as an end-point measurement.

4.4.4 Group E inspection. Group E inspection shall be conducted in accordance with the conditions specified for subgroup testing in table E-IX of MIL-PRF-19500. Electrical measurements (end-points) shall be in accordance with subgroup 2 of [table I](#) herein. Delta measurements shall be in accordance with [table III](#) herein.

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

4.5.1 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. The heating time is such that  $30 \text{ s} \leq t_{\text{heating}} \leq 60 \text{ s}$ .  $P = V_F \times I_F$  or  $P = V_{F(\text{pk})} \times I_{\text{av}}$  if using sine wave current. DC full wave current (or equivalent half sine wave current) shall be used for the power required during the "on" period and equivalent half sine wave is permissible.

Within the time interval of 50 cycles before to 500 cycles after the termination of the test, the sample units shall be removed from the specified test conditions and allowed to reach room ambient conditions. Specified end-point measurements for qualification and quality conformance inspections shall be completed within 96 hours after removal of sample units from the specified test conditions. Additional readings may be taken at the discretion of the manufacturer.

4.5.2 Reverse recovery time. The reverse recovery time shall be measured in the circuit of [figure 2](#) or equivalent. Care should be exercised to minimize stray inductances in the test circuit and to ensure the total resistance of the reverse current loop can be adjusted sufficiently low so that more than 2 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 di/dt 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 when it exceeds 2 amperes.

The reverse-recovery time shall then be determined from the current waveform as shown on [figure 3](#).

\* 4.5.3 Pulse measurements. Conditions for pulse measurements shall be as specified in section 4 of MIL-STD-750.

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	3101	See 4.3.2	$Z_{\theta JX}$			°C/W
Forward voltage	4011	$t_p \leq 8.3$ ms, duty cycle $\leq 2$ percent pulse; $i_f = 50$ A(pk)	$V_{F2}$		1.40	V (pk)
Reverse current	4016	DC method, $V_R =$ rated $V_R$ (see 1.3)	$I_{R1}$	---	15	$\mu$ A dc
<u>Subgroup 3</u>						
High temperature operation:		$T_C = 150^\circ\text{C}$				
Reverse current	4016	DC method, $V_R =$ rated $V_R$ (see 1.3)	$I_{R2}$	---	6.0	mA dc
<u>Subgroup 4</u>						
Reverse recovery time	4031	$I_F = 1$ A dc; $V_R = 30$ V dc; $di/dt = -25$ A/ $\mu$ s $i_r(\text{rec}) \leq 2$ A(pk) See 4.5.2 See figures 2 and 3				
Non A-versions			$t_{rr}$	---	200	ns
A-versions			$t_{rr}$	---	150	ns
<u>Subgroup 5</u>						
Forward voltage	4011	$I_F = I_{F(\text{surge})}$ , $t_p = 800$ $\mu$ s	$V_{F1}$		2.75	V dc
Forward voltage	4011	$I_F = I_{F(\text{surge})}$ $t_p = 8.3$ ms	$V_{F1}$		2.55	V dc

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

2/  $V_{F1}$  shall be performed with either  $t_p = 800$   $\mu$ s or  $t_p = 8.3$  ms.

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

Inspection	MIL-STD-750		Sample plan
	Method	Conditions	
<u>Subgroup 1</u>			n = 45, c = 0
Thermal Shock	1056	0°C to 100°C, 100 cycles.	
Hermetic seal	1071		
Electrical tests		See <a href="#">table I</a> , subgroup 2	
<u>Subgroup 2</u>			n = 45, c = 0
HTRB	1038	Condition A; 1,000 hrs.	
Electrical end-points		See <a href="#">table I</a> , subgroup 2	
<u>Subgroup 4</u>			
Thermal impedance curves		See MIL-PRF-19500, table E-IX, group E, subgroup 4.	
<u>Subgroup 5</u>			n = 22, c = 0
Barometric Pressure	1001	t = 60 s, While the test is being performed, $I_R$ shall be monitored and shall not exceed group A limits. $T_C = 25^\circ\text{C}$ . 1N3912, 8 mmHg; V = 300 Vdc. 1N3913, 8 mmHg; V = 400 Vdc.	
<u>Subgroup 6</u>			
ESD	1020		

\* TABLE III. Groups A, B, C and E delta electrical end-point measurements. 2/ 3/ 4/

Step	Inspection <u>1/</u>	MIL-STD-750		Symbo l	Limits		Unit
		Method	Conditions		Min	Max	
1.	Reverse current leakage	4016	$V_R = \text{rated } V_R$ , (see 1.3), pulsed (see 4.5.3).	$\Delta IR$	$\leq \pm 100$ percent of initial value or $\pm 50$ nA, whichever is greater.		

1/ Devices which exceed the group A limits for this test shall be rejected.

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

a. Subgroup 3, see [table III](#) herein, step 1.

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

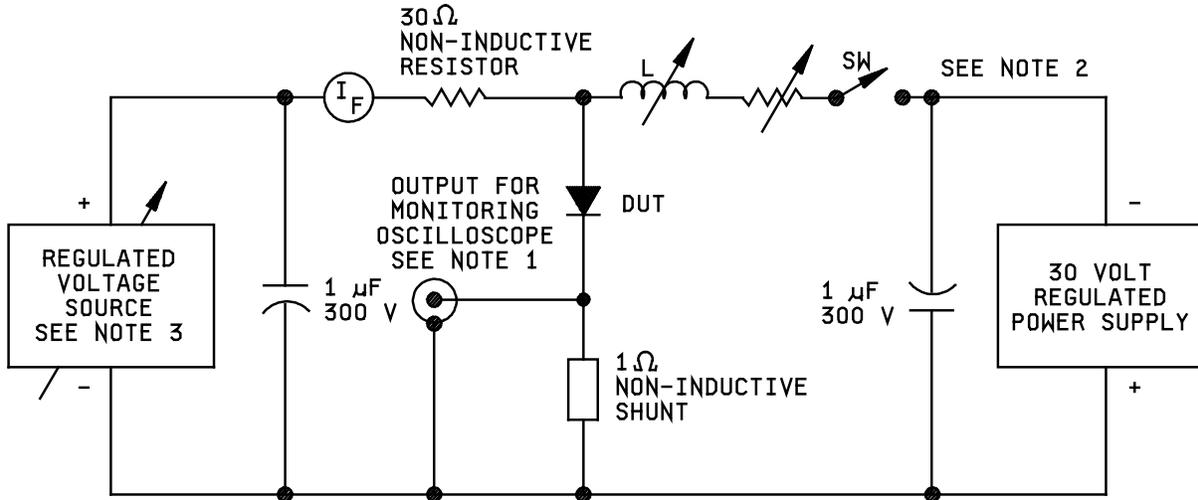
a. Subgroup 2, see [table III](#) herein, step 1.

b. Subgroup 6, see [table III](#) herein, step 1.

4/ The delta electrical measurements for table E-IX of MIL-PRF-19500 are as follows:

a. Subgroup 1, see [table III](#) herein, step 1.

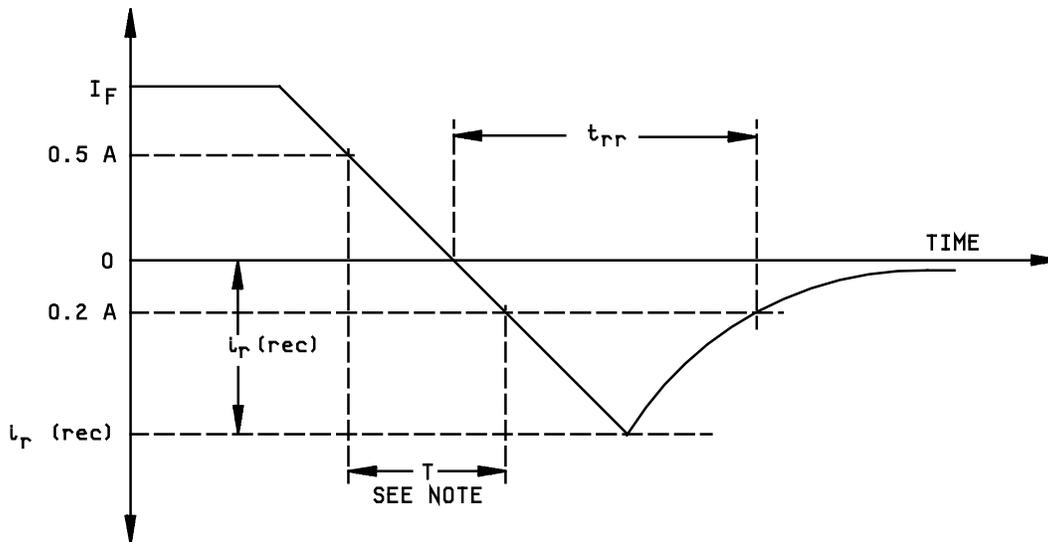
b. Subgroup 2, see [table III](#) herein, step 1.



NOTES:

1. Monitoring oscilloscope requirements:  $t_r \leq 14 \text{ ns}$ ,  $R_{in} \geq 9 \text{ M}\Omega$ ,  $C_{in} \leq 12 \text{ pF}$ ,  $L_{in} \text{ (series)} \leq 0.5 \text{ }\mu\text{H}$ .
2. SW characteristics: Mercury-wetted make-before-break relay switched at a 60 Hz rate. The relay should conduct for approximately 640  $\mu\text{s}$  and be open for approximately 7.7 ms. (C.P. Clare HGP 1004 or equivalent.)
3. Voltage source characteristics: Output impedance  $\leq 0.5 \text{ }\Omega$  from 0 to 2 kHz.

FIGURE 2. Reverse recovery test circuit.



NOTE:

Adjust L and R in accordance with 4.5.2 to achieve  $T = 0.028 \text{ }\mu\text{s}$  ( $L = 1.2 \text{ }\mu\text{H}$ ). Then  $\frac{di}{dt} = \frac{-0.7}{.028} = \frac{-25\text{A}}{\mu\text{s}}$ .

FIGURE 3. Reverse recovery current waveform through device under test.

## 5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements should 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.

## 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 Notes. 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 3.4.1).
- 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 Manufacturer's 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 DLA Land and Maritime, ATTN: VQE, P.O. Box 3990, Columbus, OH 43218-3990 or e-mail [vqe.chief@dla.mil](mailto:vqe.chief@dla.mil). An online listing of products qualified to this specification may be found in the Qualified Products Database (QPD) at <https://assist.dla.mil>.

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

Custodians:  
Army - CR  
Navy - EC  
Air Force - 85  
DLA - CC

Preparing activity:  
DLA - CC

(Project 5961-2013-085)

Review activities:  
Army - AR, MI, SM  
Navy - AS, CG, MC, OS  
Air Force - 19, 99